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Economics of Social Issues

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Thesis Abstract

This thesis deals with the analysis of various social issues from an economic perspective. Chapter one looks at the issue of gun crime from a game theoretical perspective, analysing the differing effects of concealed carry of handguns and open carry of handguns on the number of crimes committed. It is found that open carry only laws lead to fewer crimes than concealed carry only laws. In states where both types of carry are permitted, attitudes in favour of firearms are shown to increase carry rates and lower crime. Chapter two deals with the topic of suicide and mental health issues, examining empirically the effect of various economic indicators, such as Gross Domestic Product (GDP), unemployment and working hours on the suicide rate and the depression rate. Ordinary Least Squares (OLS) regressions show that a higher GDP is associated with lower rates of both suicide and depression. Chapter three is a theoretical paper which analyses the effect of corporate donations on the policy position of political parties. It is found that with a small minority supporting donors' positions, donations can have a large effect on policy positions. Under certain circumstances, parties can collude on policy position, at the expense of voters, to gain more donations.

Thesis Introduction

This thesis applies economic methods to the analysis of three different issues faced by society. The first chapter is on crime, specifically gun crime, and the laws surrounding it. The second focuses on mental health and suicide and their relation to economic indicators. Finally, the third section looks at politicians and elections, and the ability of a wealthy elite to affect policy positions.

In the US, gun control advocates and gun rights activists have been pitted against each other in an increasingly divisive struggle to affect firearms legislation. This section does not focus on the larger question of whether guns are overall negative or positive, instead limits efforts to looking specifically at whether open carry or concealed carry laws lead to better outcomes with regard to crime numbers and the cost to society. This question is analysed using a game theoretical framework in three different cases: concealed carry only states, open carry only states, and states which permit both form of carry. It is found that open carry only is superior to concealed carry only, as positive externalities associated with concealed carry lead to a lower carry rate and, hence, a lower rate of crime. When analysing a state which allows both forms of carry, it is found that a society which is more tolerant of guns has a lower crime rate due to greater rates of open carrying.

The second section of the thesis is an empirical analysis of the effects of GDP, unemployment, working hours, and other economic factors on the rate of suicide and depression in a nation. The purpose of this analysis is two-fold, firstly to determine the factors influencing suicide and shed some light on how to reduce suicide rates and secondly as a test of the effectiveness of the various economic indicators as proxies for welfare and utility. The first is relatively straight forward, as if it is found that, for

example, unemployment, is a determining factor in the suicide rate, it should be considered when formulating mental health policy. The second reason for the analysis is more from an economic theory point of view, with the idea being that if a specific indicator is found to have a strong association with the suicide rate, it is more likely to be a valid indicator of economic well-being. Conversely, if no link is found it calls into question how useful these indicators really are, and the limits of their usefulness in determining economic policy. It is found that higher GDP is associated with lower rates of suicide and depression and, somewhat surprisingly, trade freedom is also associated with a decrease in suicides.

The third section of the thesis deals with politics and donations. A model of elections is created involving three types of agents: voters, parties, and donors. Donors are interpreted as either being wealthy individuals or firms who have an interest in steering policy in a certain direction, against the wishes of voters. While the term "donors" is used, it may be more appropriate to refer to the activities of these agents as bribery rather than donating, as money given to parties is not used to finance an election campaign, instead it is modelled as providing a direct benefit to the recipient party. A democracy is usually put forth as being the best form of governance as it produces policy outcomes aligned with the views of the populace. If a democracy fails to produce policy outcomes consistent with the wishes of voters, it creates a democratic deficit. It is found that if donors can credibly commit to a cut-off point beyond which they donate nothing to a party, donations or bribes can have a large effect on policy positions, creating a democratic deficit. In addition, it is possible for donors to swing policies in their favour with only a small fraction of the electorate voting in their favour. Finally, parties co-operating on policy positions in order to gain extra donations at the expense of voters is examined. Such a scenario is possible if

parties are forward-looking enough and the effect of donations on party utility is high enough.

All of the issues discussed in this thesis are of significant importance to economists and the wider public. The first two sections deal with issues of literal life and death in the form of gun crime and suicide, while the last section deals with the very fundamentals of democracy and ensuring that government systems achieve their goals of a representative society. While these are of course important to economists and theorists, I firmly believe that there are wider implications for society and the findings in these chapters have real world applications. If policy makers are interested in reducing unnecessary deaths and crime rates, and desire a fair and representative democratic system of governance, one of the roles of academia is to provide answers to the causes of, and indeed solutions to, these problems. This thesis aims to contribute to this effort and enrich the debate on these social issues.

1 Gun Control

1.1 Literature Review

Gun control and firearm policy is one of the most divisive issues in the US in the current political climate, as, indeed, it has been for much of the past decades. School shootings and other mass killings in the US tend to capture the attention of the public across the world, with significant media attention devoted to these events, including the potential causes, and possible policy interventions. At the same time, individual gun attacks and murders are also a huge issue, and as of 2016, the US had the second highest number of firearm related deaths in the world with 37,200, behind only Brazil. It is well known that the USA has "more guns than people". Krouse (2012) estimates that roughly 310 million firearms were in the hands of civilians in the US as of 2009, making America the most armed nation on the planet.

The American public are split on issues of gun ownership and legal control. Parker et al. (2017) reports that 30% of those surveyed own at least one gun while 69% do not. Of that 69%, roughly half, 52%, said they would be open to owning a gun in the future. These numbers are not equal across demographic categories. Men, particularly white men, are more likely to be gun owners. Additionally, those living in rural areas are more than twice as likely to own a gun than those in urban centres. Perhaps most significantly there is a large political divide. Republicans, or those who lean Republican, are more than twice as likely to own a gun than Democrats or Democratic leaning independents. As for why gun owners choose to possess firearms, protection is consistently given as the main motivation, followed far behind by hunting and sport shooting.

Attitudes on gun control and legislation are also split. Schaeffer (2019), working for the Pew Research Center, found in a survey that the majority of Americans

support stricter gun control laws, but this is sharply divided along party lines, with 86% of Democrats supporting stricter measures compared to just 31% of Republicans. While there is broad consensus on barring those with mental illnesses from purchasing guns and enforcing background checks, other measures such as banning high-capacity magazines divide the population. Asked whether protecting gun rights or increasing gun control measures should be prioritised, there was an almost even split, with 53% wishing to protect gun rights and 47% wishing to prioritise increasing gun control measures. Indeed, this is a key factor in the debate, as the gun question has become inextricably linked with the US constitution, along with the question of whether owning guns is a right that no government should infringe upon. All of this makes gun control a very emotive issue, unsurprisingly, as for both sides it is literally a matter of life and death. It is then of paramount importance that researchers provide the correct theoretical and empirical framework to examine these issues and inform policy and public opinion. In contrast to the findings of Schaeffer (2019), Miller (2019) finds that increasing Republican partisanship does not decrease support for gun control measures and also finds that most Republicans support gun control. However, he also adds that even if gun control is not a partisan issue as such, it is more and more becoming one. He also finds that there is no significant rural/urban divide in attitudes on gun control, despite the widely held belief that those in rural areas are more likely to oppose it.

One of the most visible facets of the gun control debate is centred on mass shootings, however immediately a problem becomes apparent when examining these events, as there is no widely accepted definition of a mass shooting. Highlighting this issue, Booty et al. (2019) looks at four different databases to compare the number of mass shootings recorded in 2017. The most incidents recorded by a database was 346, while the lowest was 11, all dependent on the definition of mass shooting used. Mass

shootings are pivotal events when it comes to gun control measures, and inevitably after each incident the debate begins again. Newman and Hartman. (2019) show that those who live in close proximity to a mass shooting event are significantly more likely to support increased gun control measures.

Naghavi et al. (2018) estimate that there were 251,000 gun deaths worldwide in 2016. Two-thirds of these deaths were homicides, while the remainder were firearm suicides. Of that 251,000, just over half can be attributed to six countries; Brazil, United States, Mexico, Colombia, Venezuela, and Guatemala. The mortality rate per 100,000 for the US was 10.6 in 2016, a fall from 13.6 in 1990. However, despite this fall, when compared to similarly developed nations, the US death rate is significantly higher than others. For example, the same rate for the United Kingdom was 0.3, for Canada it was 2.1, for France 2.7 and for Switzerland 2.8. Per the CDC, (CDC 2020), there were 14,414 firearm homicides in the US in 2019. Homicide by handgun was more than double the number of homicides by larger weapons, such as rifles and shotguns. However, unfortunately, the vast majority of homicide deaths, 12,906, are coded as "Assault by other and unspecified firearm discharge", meaning we know nothing on the type of firearm used to carry out these homicides.

As well as homicide deaths, it is also important to consider the impact of firearms on suicide numbers. Worldwide in 2016, firearms were used in 67,500 suicides (Naghavi et al., 2018). This is quite a large number and accounts for just under a third of all suicide deaths. Miller and Hemenway (2008) state that over half of all completed suicide attempts in the US were carried out using a firearm in 2005. For the same time period, there were 40% more firearm suicides than firearm homicides. Bridges and Kunselman (2004) found that the availability of firearms in Canada was positively associated with both the rate of suicide and homicide. Sarai et al. (2017)

make the argument that suicidal impulses are usually short lived, and hence those who are suicidal and have access to a gun are more likely to commit suicide than those who do not have access to a firearm.

There is a rich empirical literature on the effect of guns on crime and homicide. However, findings differ greatly from study to study, with some finding a positive correlation between guns and crime and others finding the opposite. In the US, states vary greatly on firearm legislation. Two of the main issues are open carry and concealed carry laws. Those states which allow concealed carry permit citizens to carry hidden handguns on their person in public, while states which permit open carry allow the carrying of visible firearms in public. States broadly fall into three categories, those which only allow concealed carry, those which only allow open carry, and those which allow both forms of carry. Both these systems of gun carry have been the subject of much debate, and there are many publications claiming these laws either increase or decrease various types of crime. States in the US can be divided into four categories when it comes to right to carry laws, going from most permissive to least; unrestricted, shall-issue, may-issue, and no-issue. Unrestricted states require no permit for carrying. Shall-issue states grant permits based on the applicant meeting certain criteria. May-issue states are similar to shall-issue states with the addition of the fact that permit issue to those meeting requirements is at the discretion of local authorities. No-issue states do not permit carrying of firearms. Kovandzic et al. (2005) find no effect of an easing of concealed carry laws on crime. Gius (2014) finds that more restrictive carry laws may increase the number of murders in a state. Barati (2016) examines the effects of the introduction of shall-issue carry laws in states, finding that shall-issue laws show no improvement over may-issue, but do reduce crime rates when moving from no-issue to shall-issue. In other words, incremental

changes may not be enough to reduce crime, but larger changes may have an effect. Manski and Pepper (2018) caution against searching for overly simplistic findings on the effect of right to carry laws on crime rates, as results are highly sensitive to both data and assumptions of the underlying model. Still, they find that right to carry laws in Virginia reduced murder and larceny rates for almost every year, while increasing assault rates after 1997. Schell et al. (2020) find that more restrictive laws regarding firearms storage and use result in an 11% reduction in the number of gun related deaths.

One of the most important and controversial publications in the gun literature is Lott and Mustard (1997). Both of the authors, John R. Lott and David B. Mustard are prolific in this area and have published a large number of publications on this issue. The publication makes the bold claim that if states which did not permit concealed carry in 1992 had adopted right to carry laws it would have prevented 1,500 murders yearly, as well as reducing numbers of rapes, robbery, and assaults. Arguing that crime variation within states is much too large, in fact much larger than the crime variation between states, the authors opted to use county level data. They acknowledge that this causes some issues, such as a small number of crimes in a county causing a large shift in the variance between years. Another potential issue they mention is that reduced gun regulations may have an effect similar to that observed by Peltzman (1975), where increasing automobile safety regulations induces riskier behaviour. In the case of carry laws, allowing the carry of firearms may make individuals feel safer and hence more likely to enter more dangerous areas, which might cause an increase in crime. However, as the decision to engage in riskier behaviour is a voluntary one, the authors argue that if crimes increase due to this effect, society may still be better off.

The effect of guns on crime rates can largely be broken down into two competing sub-effects. Firstly, the greater availability of firearms may mean criminals find it easier to commit crimes. Secondly, the deterrence effect, where armed citizens prevent crimes from occurring, or, to put it in a well-used colloquial phrase "good guys with guns" reduce crime. Again, views are largely split on these issues. The deterrence effect of guns, and analysis of this effect, is inspired by Becker (1968) which was the first publication to examine economically the effect of punishment as a deterrence on criminal activity. Perhaps the most compelling evidence of the existence of this deterrence effect comes from a survey carried out by Wright and Rossi (1986), where over half, 56%, of criminals incarcerated in ten institutions would not attack a potential victim if it was known that he was armed. Moody and Marvell (2005) find that handguns have no effect on crime, concluding that either there is no relationship between guns and crime or the effects of criminals with guns and law-abiding citizens with guns cancel out. Lott (2013), in his seminal work "More Guns Less Crime", finds that in 95 percent of cases where guns were used to ward off an attack, simply brandishing the weapon was enough to end the attack. Bartley and Cohen (1998) estimate the "model uncertainty" of the model in Lott and Mustard (1997) and conclude that the deterrence effects found are too robust to be dismissed. Kleck and Delone. (1993) find that resisting a robbery with a gun both reduces the probability of the criminal escaping with the victim's possessions and the probability of the victim being injured. However, the same publication also finds that if a robber is equipped with a handgun, they are more likely to complete the robbery. Guerette and Santana (2010) find that if victims resist, this increases the effort needed by perpetrators to complete their crime, in turn causing a large decrease in the rates of robbery and rape. Plassmann and Tideman (2001) examine the effects of right to carry

laws on various categories of crime, finding that these laws have significant deterrent effects on reported rapes, murders, and robberies. Fortunato (2015) finds that the public have inaccurate perceptions of the number of concealed carriers in the US, an important contribution as the ability of gun carrying to create a deterrence effect relies on the public being aware of the number of carriers. Moorhouse and Wanner (2006) use a "gun control index" to measure the extent of gun control measures across states. They find that stricter gun control does not reduce the crime rate. Bilgel (2020) uses county level data in the US to determine whether the "more guns, less crime" hypothesis is correct. He finds that in no county did increasing gun ownership lead to higher homicide rates but in over 40% of the sample, a higher gun ownership rate led to lower crime rates. He concludes that gun ownership has a negative effect on the county homicide rate.

On the opposite side, there are many publications which find that guns cause greater levels of crime, due to a lack of deterrence effect and/or increased opportunities for potential criminals. McDowall et al. (1991) find no evidence of a deterrence effect due to firearms. Duggan (2001) uses sales data from a prominent gun magazine as an instrument to measure the level of gun ownership in an area and finds that gun ownership is associated with an increase in the rate of homicide. Ayres and Donohue (2002) claim that the results of Lott et al. (1997), while ground-breaking and important, do not stand the test of time, and find that shall-issue laws result in an increase in the crime rate. In a response to this publication, Plassman and Whitley (2003) state that Ayres and Donohue (2002) have simply "misread their own results" and claim that the data actually show that more permissive carry laws reduce crime rates. Branas et al. (2009) find that victims who possess a gun are almost four and a half times more likely to be shot during an assault than those without. Lindegaard et

al. (2015) find that a criminal's likelihood to engage in violence is related to the expected victim resistance. Ludwig (2000) reanalyses the data used by Lott et al. (1997) but finds that there is no evidence for a deterrence effect. Bachman et al. (2002) use National Crime Victimization Survey data and find that the probability of a woman being injured when being assaulted by an intimate partner was higher if she resisted. While this is not directly related to guns, it does imply that a deterrence effect may not exist. Cook and Ludwig (2002) state that as guns are expensive, ownership of a gun may actually make one more likely to be a target of burglary. They find no evidence for a deterrence effect of guns on burglary rates. Gius (2019) finds that arming students by relaxing carry laws on campuses, has no effect on the level of crime on campuses. Gius (2009) analyses the effect of gun ownership on the homicide rate. Using state-level data, he finds that the effect of gun ownership on the homicide rate is positive and significant at the 10% level.

Mass shootings are one of the most visible types of gun crime and receive a lot of media attention. Duwe et al. (2002) find that right to carry laws have neither a positive nor negative effect on the number of mass shootings in an area. Callcut et al. (2018) examine changes in open carry laws in California, a state which already has strict gun laws. They find that banning the open carry of even unloaded weapons is associated with a reduction in the number of firearms related deaths and the number of non-fatal firearm related hospitalisations. Lewis (2018) looks at the connection between the strictness of gun control measures in a state and the number of mass shootings. To measure the strength of gun control laws in a state a "state scorecard" was used, which is created by the Law Center to Prevent Gun Violence and finds that there is a negative relationship between the number of mass shootings in a state and

the value given by the state scorecard. In addition, it is found that mass shootings result in a lower number of victims in states where gun control is stronger.

Often discussed is the case of gun control in Australia, and the lessons it may have for the US. After a mass shooting in Port Arthur left thirty-five people dead, Australian authorities reacted quickly, and just a few weeks after this massacre many types of guns were banned. On top of this ban, the government introduced a gun buyback program. Chapman and Alpers (2013) state that since these events there have been no mass shootings in Australia and the gun buyback resulted in Australia destroying more than 1 million guns, representing approximately one third of all civilian weapons. Chapman et al. (2006) shows that the 1996 Australian measures reduced total firearm deaths and firearm suicides. However, strangely, it is also claimed that the number of homicides were also reduced by these laws, despite a p-value of 0.15, which is outside of statistical significance for almost every field of study, meaning most studies would interpret this as the gun laws having no effect on homicides. Bartos et al. (2020) analyse the effect of the gun buybacks with a quasi-experimental design, using motor vehicle fatality trends as a control group, and find that the program significantly reduced the homicide rate. Leigh and Neill. (2010) find that the gun buyback reduced firearm suicide rates by almost 80%. Klieve at al. (2009) find that Australian suicide rates had been declining as far back as 1988 and conclude that it may not have been the gun buyback program which led to the fall in suicides. Both Baker and McPhedran (2006) and Sheng Lee et al. (2010) come to similar conclusions, with the former finding that the only area the gun buyback may have impacted on is the suicide rate while the latter finds that there was no effect on the suicide or homicide rates.

Compared to the large empirical literature on the effect of firearms and gun controls, there are relatively few theoretical publications examining the subject. Taylor (1995) develops two separate models of gun control, one where criminals attack with guns or do not attack, and a second where criminals could attack with or without a firearm. In addition, the second model allowed for the fact that guns might cost more to a criminal than a non-criminal. The results of the first model were that more stringent gun control measures might actually reduce social welfare as it disarms potential victims. With the second model, some gun control laws were capable of improving welfare, mostly measures narrowly targeted towards preventing criminals from possessing firearms. All of this depends on the existence of a gun deterrence effect on crime, and, if such an effect does not exist the results are invalid. The paper also makes the point that while the global optimal state may be full disarmament of the entire population, policies geared towards this end may not be possible. It's important to recall the huge number of guns in the US and the strong opposition to even some moderate measures. Attempts at universal disarmament could potentially lead to a situation similar to civil war. With regards to the connection between this paper and the empirical literature, the findings in Taylor (1995) are in line with the predictions made by Lott and Mustard (1997), Plassmann and Tideman (2001) and others.

Neto and Olivera (2012) shows that with imperfect information gun control cannot reduce crimes. The model uses a sequential move game where criminals are the first movers. The rationale behind this is that criminals usually surprise their potential victims and so, criminals will have a potential advantage over an equally skilled victim. Mullin (2001) examines the issue of gun buyback programs through a theoretical lens. The purpose of a gun buyback is to reduce the number of guns in

circulation, hence increasing the price of guns and making it more difficult for criminals to acquire them. It is found that a once off and unanticipated buyback will only result in a temporary fall in the holding of guns. However, a repeated buyback program actually results in the opposite effect than intended, causing gun holdings to increase, as it acts to lower the costs of gun ownership.

Mialon and Wiseman (2005) examine the effects of guns and gun control on crime numbers and also the utility of potential victims. Victims can "lie low", in order to avoid criminals, which means staying home at night or avoiding dangerous places. It is assumed that there is some loss of utility from lying low. In the final model, with strict gun control measures driving the price of firearms up, there is no crime, but all potential victims lie low. In this paper, the right to bear arms is viewed as a fundamental freedom, as it allows citizens to freely roam the street without an imminent threat of being victimized. As an alternative to gun control, the authors suggest that harsh punishments for gun crime may be a better method of reducing crime. In the model, harsh punishments and no gun control lead to a better outcome than the situation with gun control.

It is clear that the issue of gun control legislation, crime rates, and the right to bear arms is an incredibly important topic for the times that we live in. With such an emotionally charged debate taking place in the public eye, and with many high-profile cases of mass and school shootings, it is of utmost importance that academics and researchers weigh in with accurate information both in the form of theoretical models and empirical research. Unfortunately, there is no broad consensus among researchers on any clear, simple answer to the question of guns and crimes. However, it is still necessary for the debate to be informed by the best insights possible from the literature, where authors are upfront about the assumptions of their models and the limitations of

datasets and empirical methods. Only in this way is it possible for lawmakers to be fully informed on the effects of their decisions and the best ways to move forward.

1.2 Open Versus Concealed Carry: A Game Theoretical Analysis

Abstract

This paper uses a game theoretical approach to analyse the effects of open and concealed carry of handgun laws in the USA. Assuming the existence of a deterrence effect, the results of the model show that with homogenous agents, open carry leads to better results than concealed carry, with less crimes committed. This is as a result of positive externalities associated with concealed carry driving down gun ownership, and hence, increasing the incentive to commit crime. When accounting for heterogeneity of agents in preferences for open carry weapons, the result depends on society's attitude towards the carrying of firearms in public, with a more gun friendly populace leading to higher carry rates and lower crime. Counterintuitively, it is also found that increasing the price of guns leads to more citizens open carrying.

1.3 Introduction

Gun laws and gun crime have always been in the mind of the public and policymakers in the US, particularly in the current climate, where mass shootings, murders and most recently, civil unrest and looting, have put discussion of gun issues on the front burner. While much attention has been paid to issues such as assault weapon bans, gun free zones and gun taxes, relatively little attention has been applied to comparing open carry and concealed carry. When commentators have come out in favour or against a certain type of carry policy, they rarely compare the merits or drawbacks of one system of handgun carry to another. The public debate has been mirrored in the academic sphere, with a lot of attention understandably directed

towards the absolute effect of policies such as carry laws and gun free zones on their own, but little on comparing policies or forms of carry.

Gun policy is certainly a massively controversial topic, being a literal life and death matter, and on both sides emotional arguments and cognitive biases may impede the implementation of optimal solutions aiming to minimise deaths and costs to society. Academics and lawmakers can analyse the issue at length and come up with perfect solutions to these problems, but if they are unable to implement their findings, due to political concerns, they are not of much use. To that end, this chapter, with focus limited solely to analysing the difference between open carry and concealed carry of handguns, may provide solutions that are acceptable to both gun control advocates and ardent defenders of the second amendment. Neither increased gun control or easier access to firearms will be advanced by this analysis, only the method of carrying will be examined and a partial solution implemented is more effective than a perfect solution which is not.

The first part of this chapter is an extension of Taylor (1995), a publication in which a game theoretical model is used to show that under certain circumstances increasing gun control can cause crime to increase. In Taylor (1995) the criminal does not have a chance to observe if the victim has a gun before making the decision to attack. As such, Taylor's model is consistent with a concealed carry world. The open carry world is modelled as a sequential game, since it ensures that any potential criminal is aware of whether a potential victim is carrying a weapon or not, whereas this knowledge is hidden under a concealed carry regime. Oliveira et al. (2015) also examines gun control using a game theoretical model and finds that gun control measures with complete information leads to a decrease in gun crime. Southwick

(2000), models choice of weapons of both potential criminals and victims, finding that victims who use guns have lower injury rates from violent crimes.

Central to the model is the existence of a deterrence effect, and this assumption runs throughout the chapter. The absence of a deterrence effect implies that the criminal's decision is not dependent on the choice of the Law-Abiding Citizen (LAC) to carry, and hence the results of this analysis will not hold. Indeed, if such an effect does not exist then a full ban on firearms (assuming this would be effective at reducing the number of criminals who can obtain guns) would always be optimal. In such a case, the question of open vs concealed carry is moot, as carrying a gun will have no effect on the criminal. In the larger gun control debate, the deterrence effect is also of pivotal importance. Deterrence effect in this chapter refers to a criminal being reluctant to attack a person if they are carrying a weapon.

There is a rich literature looking at this deterrence effect, but the evidence for its existence is mixed. Lott et al. (1997) find that there is some evidence that concealed weapons deter crime. Ayres and Donohue (2002) contradict Lott et al. (1997) and claim that their findings are not robust with the addition of a larger dataset. Plassmann and Tideman (2001) find that right to carry laws deter certain crimes, including murder and rape. Kovandzic et al. (2008) find that guns in non-criminal hands reduce homicide rates, an important finding as it separates the deterrence effect from the fact that greater access to firearms may allow criminals to become better armed. Although the above have found evidence of a deterrent effect, a meta-analysis by Kleck (2015) concludes that the evidence that more guns cause less crime is weak, while Kovandzic and Marvell (200) find that concealed carry laws have no effect on crime rates.

While some publications fail to find any effect that guns decrease crime, this is separate to saying that guns are not a deterrent, as the effects of easier access to firearms may act in both directions when it comes to crime numbers. A publication by Ludwig (1998) exploits the fact that a person must have reached a certain age before being allowed to carry a handgun and finds that concealed carry increases crime rates. Ludwig (2000) reanalyses the data from Lott et al. (1997) and finds that there is no deterrence effect. Duggan (2001) finds that "reductions in the fraction of households owning a gun can explain one-third of the differential decline in gun homicides relative to non-gun homicides since 1993". Gius (2013) suggests that states with restrictive concealed carry laws have more gun related murders, and assault weapon bans have no effect on the murder rate. The latter finding may be to do with the fact that most murders are committed using handguns.

For the purposes of this chapter, we can divide US state carry laws into three categories (although there is variation within these groups in the real world, this simplification does not impact results):

- open carry only
- concealed carry only, or
- both systems permitted.

While it is also possible that neither open carry of a weapon (OCW) or concealed carry of a weapon (CCW) is permitted, this is not the case in any state (although some states such as Hawaii and Maryland have restrictive laws making them close to this case) and is not examined in this chapter. Concealed carry of handguns is prohibited or severely restricted in at least parts of New York, Massachusetts, California, Rhode Island, Hawaii, Maryland and New Jersey. Open carry of handguns is explicitly

forbidden in District of Columbia, Florida, Illinois, New York and South Carolina while it is forbidden in practice in Hawaii, Maryland and New Jersey.

Within these broad categories, and even within states themselves, laws and their implementation vary greatly. States are often described as “shall-issue” or “may-issue”. In “shall-issue” states, permits are given out unless there is a reason not to, whereas in “may-issue” states, permits are only given out when an important reason is provided. Some states described as “may-issue” have in practice banned carrying of handguns.

The format of the chapter is as follows, firstly open carry only states are modelled as a sequential move game involving two players, an LAC and a criminal. The LAC moves first and decides to carry a gun or not. Observing this, the criminal decides to attack or not. Secondly, concealed carry only states are modelled as a simultaneous move game involving the same players, payoffs and strategies as previously. Thirdly, states permitting both open and concealed carry of handguns are modelled. This involves the same two players, firstly the LAC decides to open carry or not, if he decides to open carry, the criminal then must look for another victim or drop out. Drop out probability is exogenous and is given by (1-m). If the LAC chooses not to open carry, he enters what is referred to as the “concealed carry sub-game”. In this sub-game, nature decides whether or not the LAC meets a criminal. The LAC must then decide to carry a concealed weapon or not, while if he meets a criminal the criminal decides simultaneously to attack or not.

The results of this chapter show that the different carry regimes may lead to very different crime rates. In open carry only states, crime does not occur at all, if a deterrent effect exists. In concealed carry only states there are some criminal attacks,

as is the case if both systems are permitted (with heterogeneous agents). Open carry only has preferable outcomes to concealed carry only, as the positive externalities associated with concealed carrying lead to gun ownership among LACs being lower than optimal. A criminal cannot know if a law-abiding citizen is carrying but knows the probability that he is. If a citizen decides to carry, this increases the probability that any given citizen is carrying. This makes a criminal less likely to attack any citizen. Because the benefit of carrying cannot be fully realised by a citizen carrying themselves, this causes a lower probability that any one citizen carries.

Finally, the main contribution of this chapter is to examine a regime which allows the carry of both open and concealed firearms with the addition of a "social" cost to the model. The social cost captures the fact that there may be some degree of hostility towards those who open carry. It is found that a lower social cost leads to a higher rate of open carry and a lower rate of crime.

It is important to acknowledge the limitations of this model; specifically, deaths other than homicides are ignored. These deaths, for example accidental deaths and suicides, must be considered when making any policy recommendations with regard to carry laws. Sommers (1984) finds that stricter gun laws would lower the suicide rate. Leenaars et al. (2003) finds that the passing of gun control legislation decreased the suicide rate in Canada. A meta-analysis by Anglemeyer et al. (2014) finds that access to firearms leads to a greater risk of a fatal suicide attempt and a greater risk of dying from homicide. Clearly this is an important issue in the firearm access debate, and while it is beyond the scope of this analysis, it nonetheless must be taken into account when considering the results. In addition, it may be the case that the presence of guns causes an increase in spontaneous crimes, such as shooting

someone in a fit of anger. It very well may be the case that such murders or attacks would not take place if guns were not present. Such an issue is not included in the model but needs to be considered when looking at policy.

1.4 The Model

In order to model open and concealed carrying, the process shall be split into three different steps, modelling open carry only, modelling concealed carry only and finally combining both of these games together to show a state which allows for both types of firearm carry.

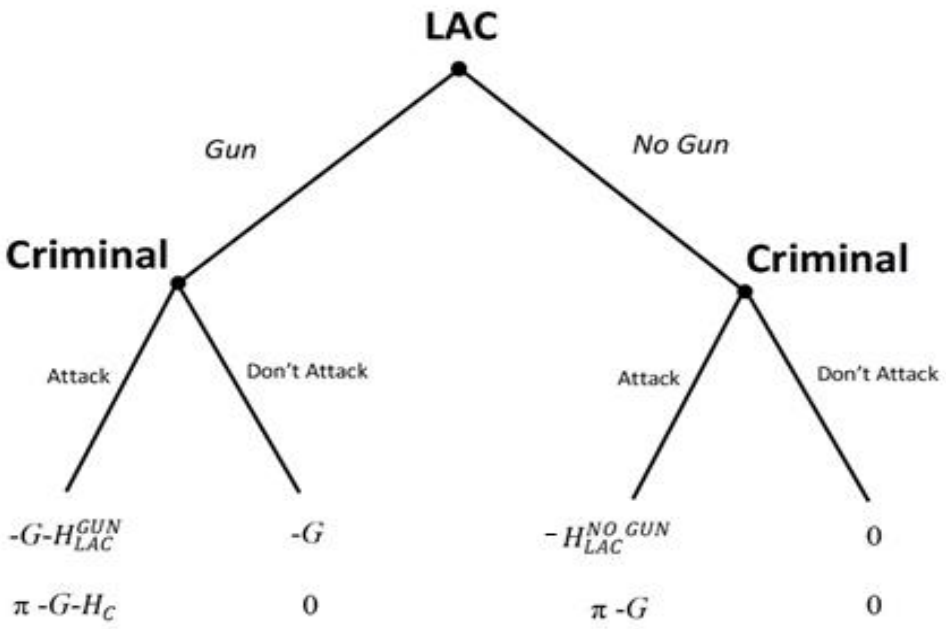

Figure 1.1. First payoff to LAC, second to Criminal

1.5 Open Carry Only

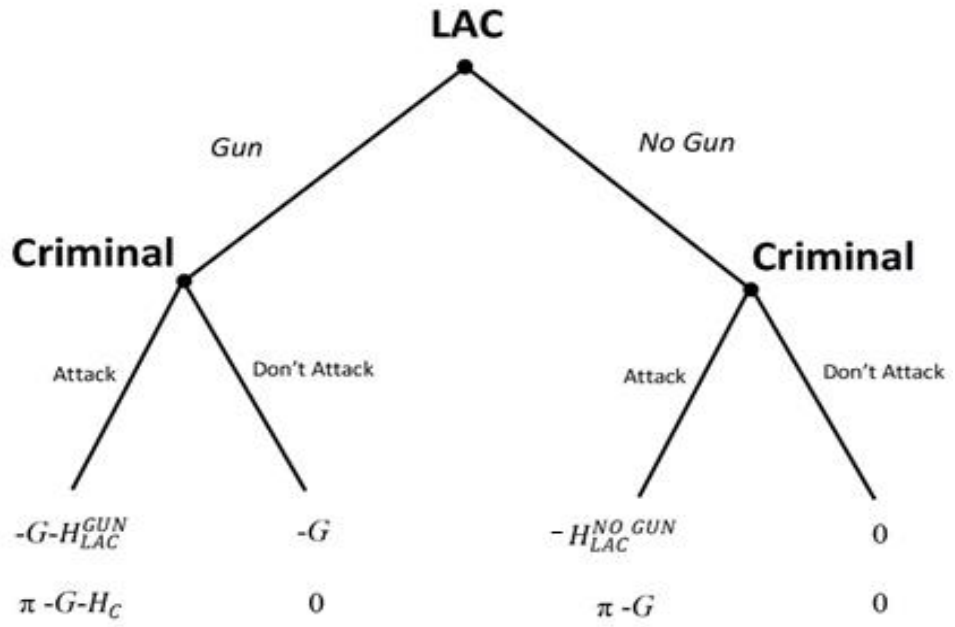

Figure **1.1** shows the sequential move open carry game. There are two players, the LAC and the criminal. The first payoff is to the LAC and the second is to the criminal. The LAC moves first and decides to either carry a gun or not. At the second stage of the game the criminal decides to either attack (and so, buy a gun) or not attack. The reason for allowing the criminal to either purchase a gun or not is to account for the effects of gun control, effectively an increase in the cost of a gun, *G*, on making crime less beneficial and hence deterring it, and also to stay consistent with Taylor (1995). Open carry is modelled as a sequential move game to capture the fact that a criminal observes if an LAC has a gun or not:

- G: cost of owning a gun
- π: benefit of attacking to criminal
- H_C: damage/harm to criminal if LAC is armed
- H_{LAC}^{GUN}: damage/harm done to LAC when carrying a gun
- $H_{LAC}^{NO\ GUN}$: damage/harm done to LAC when not carrying a gun

If the LAC carries a gun and the criminal attacks, the LAC receives a payoff of ($-G-H_{LAC}^{GUN}$), where $-H_{LAC}^{GUN}$ is the harm that the criminal inflicts on the LAC and G is the cost of purchasing a gun. The criminal receives a payoff of ($\pi-G-H_C$) where π is the benefit to attacking (this could be a monetary gain or even simply sadistic pleasure) and H_C is the physical harm the LAC inflicts upon the criminal. If the LAC carries a gun and the criminal does not attack, the payoff to the criminal is 0 while the payoff to the LAC is $-G$. If the LAC does not carry a gun and the criminal attacks, the payoff to the LAC is $-H_{LAC}^{NO\ GUN}$, which is the physical damage that the criminal inflicts upon the LAC. Note that $H_{LAC}^{NO\ GUN}$ and H_{LAC}^{GUN} are different, this is to allow for the fact that the criminal may be able to inflict less (or more) damage if the LAC is carrying a weapon. The criminal's payoff is $\pi-G$, assuming that the LAC cannot cause physical damage if he does not have a gun. If the LAC does not carry a gun and the criminal does not attack, the payoff to both players is zero.

Depending on the relative payoffs of the LAC and criminal, there are a number of possible Nash equilibria (NE). Assume that an LAC prefers not to be attacked regardless of whether the LAC is carrying a weapon; $-G > -G-H_{LAC}^{GUN}$, and $0 > -H_{LAC}^{NO\ GUN}$

- Case 1 - It is a pure strategy Nash equilibrium for the criminal to attack and for the LAC not to carry a gun if $\pi-G - H_C > 0$, $\pi-G > 0$ and $-H_{LAC}^{NO\ GUN} > -G-H_{LAC}^{GUN}$.
- Case 2 - It is a pure strategy Nash equilibrium for the criminal to attack and for the LAC to carry a gun if $\pi-G - H_C > 0$, $\pi-G > 0$ and $-H_{LAC}^{NO\ GUN} < -G-H_{LAC}^{GUN}$. As in Case 1, attacking is strictly dominant for the criminal but carrying a gun is now a strictly dominant strategy for the LAC.

- Case 3 - It is a pure strategy Nash equilibrium for the criminal not to attack and for the LAC not to carry a gun if π-G < 0 and π-G - H_C< 0. In this case it is a strictly dominant strategy for the criminal not to attack. As the criminal will not attack, the best response of the LAC is then to not carry a gun. This case is particularly relevant in countries such as those of western Europe, Australia and Canada that have strict gun regulations such that G is high enough to discourage criminals.
- Case 4 - It is a pure strategy Nash equilibrium for the criminal not to attack and for the LAC to carry a gun if π-G - H_C < 0 but π-G > 0 and -G > -$H_{LAC}^{NO\ GUN}$.

In Case 4 there is no crime, and this is the case which is focused on in this chapter. A handgun deterrence effect exists in that it is better for the criminal to not attack if the LAC is carrying a gun but better to attack if the LAC is not carrying. It is also assumed that it is beneficial for the LAC to carry a gun. The LAC chooses to carry a weapon which deters the criminal from attacking. As shown in the next section this outcome is superior to a state which only permits concealed carry under the same parameter restrictions.

While most of this chapter is devoted to analysing case 4, this does not mean that case 4 is the only possible case in the real world or even necessarily the most likely. Case 4, however, is the most interesting from a theoretical point of view and is arguably the most relevant case for those nations dealing with significant gun crimes, particularly the US. Cases 1 and 2 are particularly unfortunate for the nation in question, as criminals always attack. With the parameter restrictions in place in these cases, the outcome will always be a simple pure strategy NE regardless of the timing of the game. Case 3 is interesting in that it may be considered an ideal state for

advocates of gun control, with the cost of guns being so high as to prevent all gun crime. It is important to note, however, that while increasing the cost of guns to a level which puts a nation into case 3 results in no crime, increasing a low cost of guns by a small amount may actually make the crime rate go up. In other words, while the ideal state may be a very high gun cost, small increases may not make crime rates fall.

The parameter, H_C, is where the deterrence effect arises. If H_C is large enough to wipe out the gains from the crime (if $H_C > \pi$-G) then a deterrence effect exists, otherwise there is no deterrence effect.

When looking at this model it is necessary to consider which type of crimes fall within this framework, and how this game can be interpreted. The exact nature of the harm and gain received from this game is deliberately defined loosely, so as to create a model which can be applicable to several different categories of gun crime. Consider, firstly, a homicide or assault with a firearm. In this case π would be the benefit to the criminal of eliminating the victim. This may be, for example, a witness to a crime that criminal elements wish to prevent from testifying. Or it could be that the criminal has a vendetta against this particular person and kills/injures them for this reason. In these cases, the harm dealt to the LAC is physical damage or pain. But this model is not only applicable to attacks on the victim's person, but it could also be a mugging or home invasion. In this case, then, π would be a monetary gain and the harm inflicted on the victim could be financial, through the loss of property, or also physical pain/in jury.

1.6 Concealed Carry Only

Figure 1.2 shows the payoff matrix for the concealed carry only game. In each cell the first payoff is to the LAC and the second is to the criminal. The LAC can either choose to carry a concealed handgun or not, while the criminal can choose to buy a gun and attack or to not purchase a gun at all and, hence, not attack. This game is similar to the game in Taylor (1995) but in this case it is solely being used to represent a concealed carry game. The sequential move framework above is used as a means of ensuring that when a citizen is open carrying that the criminal is aware of this. In contrast, the simultaneous move game in this section is used to capture the fact that the criminal will not be aware of the LAC's decision to carry or not.

It is important to look at which parameter values lead to a pure strategy Nash equilibrium:

- Case 1 - It is a pure strategy Nash equilibrium for the criminal to attack and for the LAC not to carry a gun if π-G - H_C> 0, π-G > 0 and -$H_{LAC}^{NO\ GUN}$ > -G-H_{LAC}^{GUN}.
- Case 2 - It is a pure strategy Nash equilibrium for the criminal to attack and for the LAC to carry a gun if π-G - H_C > 0, π-G > 0 and -$H_{LAC}^{NO\ GUN}$ < G-H_{LAC}^{GUN}. As in Case 1, attacking is strictly dominant for the criminal but carrying a gun is now a strictly dominant strategy for the LAC.
- Case 3 - It is a pure strategy Nash equilibrium for the criminal not to attack and for the LAC not to carry a gun if π-G < 0 and π-G - H_C< 0. In this case it is a strictly dominant strategy for the criminal not to attack. As the criminal will not attack, the best response of the LAC is then to not carry a gun.

All of the three above cases lead to the same outcome in both a concealed carry and open carry regime. Case 4, outlined below, is the main case of interest where a deterrence effect exists, and I focus on this case for the rest of the model.

- Case 4 - There is no pure strategy Nash equilibrium if π-G - H_C< 0, π-G > 0 and if -$H_{LAC}^{NO\ GUN}$ < -H_{LAC}^{GUN}-G and -$H_{LAC}^{NO\ GUN}$ > -G.

	Attack	**Do Not Attack**
Gun	$-G\ -H_{LAC}^{GUN}\ , \pi - G - H_C$	$-G, 0$
No Gun	$-H_{LAC}^{NO\ GUN}, \pi - G$	0, 0

Figure 1.2. Criminal is column player and LAC is row player.

This scenario has already been examined under an open carry regime in Case 4 of Section 1.5 and led to no crime. With these parameter restrictions, the LAC's best response to a criminal attacking is to have a gun, while their best response to a criminal not attacking is to not have a gun. The opposite is true for the criminal; the best response for the criminal to the law-abiding citizen not having a gun is to attack, while the best response of the criminal to the law-abiding citizen having a gun is to not attack. This means that there is no pure strategy Nash equilibrium given these parameter values. Denote P_{GUN}^{LAC} as the probability that the LAC carries a concealed gun and denote $P\ _{Attack}^{Criminal}$ as the probability of the criminal choosing to attack an LAC.

The LAC is indifferent between concealed carrying and not concealed carrying when:

$$EV_{GUN} = EV_{NO\ GUN}$$

And the criminal is indifferent between attacking and not attacking when:

$$EV_{ATTACK} = EV_{DO\ NOT\ ATTACK}$$

In both cases EV stands for Expected Value. The probability of the criminal attacking is given by:

$$P_{Attack}^{Criminal}$$

The Expected Value for the LAC is:

$$(-G-H_{LAC}^{GUN})P_{Attack}^{Criminal} - G(1-P_{Attack}^{Criminal}) = (-H_{LAC}^{NO\ GUN})P_{Attack}^{Criminal}$$

The probability of the LAC carrying a gun is given by:

$$P_{GUN}^{LAC}$$

The Expected Value for the criminal is:

$$(\pi\text{-}G - H_C)P_{GUN}^{LAC} + (\pi - G)(1-P_{GUN}^{LAC}) = 0$$

From the above expected values, we can solve out the following probabilities:

1.1

$$P_{GUN}^{LAC} = \frac{\pi - G}{H_C}$$

1.2

$$P_{Attack}^{Criminal} = \frac{G}{H_{LAC}^{NO\ GUN} - H_{LAC}^{GUN}}$$

Note that $H_{LAC}^{NO\ GUN} - H_{LAC}^{GUN}$ is the harm prevented by carrying a gun, the harm differential. These probabilities can be interpreted as the percentage of law-abiding citizens who carry a gun and the percentage of criminals who attack, provided he meets an LAC. With this interpretation, it is clear that the second probability represents an important value for policymakers as it is a representation of the crime rate. Taylor

(1995) notes that as the price of a gun rises, crime increases. The reason behind this is that less LACs will carry a gun when the price goes up. This in turn leads to criminals being more likely to attack. While the price of a gun also makes it less rewarding for a criminal to attack (*G* has increased) this effect is not as strong as the effect previously mentioned. It is important to remember that this only holds given the specific parameter values imposed. While it may be effective to make guns so costly that they are almost impossible to obtain, for example, through banning them and imposing heavy punishments, it may be the case that a small increase in the cost of a gun, when guns are currently not overly costly, can actually cause more crime. This is relevant to US states considering marginal increases in gun control measures such as tax increases on firearms or additional red tape.

On the issue of gun costs for criminals, it is important to note that the same cost, *G*, is imposed on both the criminal and the LAC, in keeping in line with Taylor (1995). In reality, there are a few ways in which this may not hold true. Firstly, consider that it may be the case that it is more costly for criminals to acquire a gun than LACs. Such a situation could arise if convicted felons are barred from gun ownership, if those attempting to commit a crime must pay more for a gun in order to make it untraceable to the authorities, or if we simply consider the possibility of criminal punishment as being included in *G*. In this case, the *G* present in the equation which determines the probability of and LAC carrying will be higher, and so less LACs carry. It will have no effect on the number of criminal attacks, provided π-*G* remains greater than zero.

On the other hand, it may be possible, if firearms can be reused in several crimes, that the *G* given for criminals is too high. If a criminal intends to use a gun

during multiple crimes, the cost of a gun for any individual crime falls to zero. This would cause a rise in the proportion of LACs carrying but would not affect the crime rate unless it caused π-G - H_C to be greater than zero. In the next section the G for criminals is dropped, but this has no major implications for the model.

Under the exact same conditions as the open carry case, the concealed carry only state leads to a much higher level of crime, given by Equation 1.2. In a straight choice between open or concealed carry, and given the assumptions above, it is much better for a state to opt for open carry over concealed carry.

1.7 Open and Concealed Carry

This section is an extension to the previous models of open and concealed carry of firearms in this chapter. There are two major differences to the previous models. Firstly, in this model an LAC is permitted three choices with regard to firearm carry, namely, to open carry a gun, to concealed carry a gun, or he can opt to not carry a gun at all. In 45 states in the US some form of both open and concealed carry is allowed, at the time of writing. The second difference is that there is now an additional benefit or cost to open carrying a weapon, s_i, where s_i $\forall i$ denotes the individual i's taste for open carrying a weapon. An LAC only receives s_i if he opts to open carry a firearm. Each individual s_i comes from a general distribution, $L(s)$, depending on an individual's characteristics and tastes regarding the open carry of firearms. The variable, s, is interpreted in this case as the "social" cost, or benefit, of carrying a firearm. Examples of costs and benefits that fall under s could be the reluctance of certain minority groups to carry a firearm openly for fear of being accosted by the police or others, or simply a general dislike of attracting extra attention by openly carrying a gun. A positive s could come about from those who wish to make a political

statement by carrying openly, perhaps in support of the second amendment in the US or because he just likes that it appears to make him look tough.

As most US states allow both forms of carry in some form or another, any analysis of open and concealed carry laws necessarily must look at such a case if it is to have any claim to real world validity. As previously explored, given assumptions laid out earlier, LACs are always better off open carrying than concealed carrying. This means that if we were to simply allow LACs to choose between open and concealed carrying without the addition of s_i, open carrying would be a strictly dominant strategy. Effectively, this means that there is no difference between a state that only allows open carry and one which allows both open and concealed carry in terms of outcome for the players. However, in real life we do not see such stark results in states which allow both type of carry laws. In reality we see some open carry, others concealed carry while others still do not carry at all. This must mean that there is something which provides an incentive for some citizens to not want to open carry, modelled as s_i, mentioned above.

To simplify the game, it is assumed that criminals have already purchased a gun and so do not incur a cost of G.

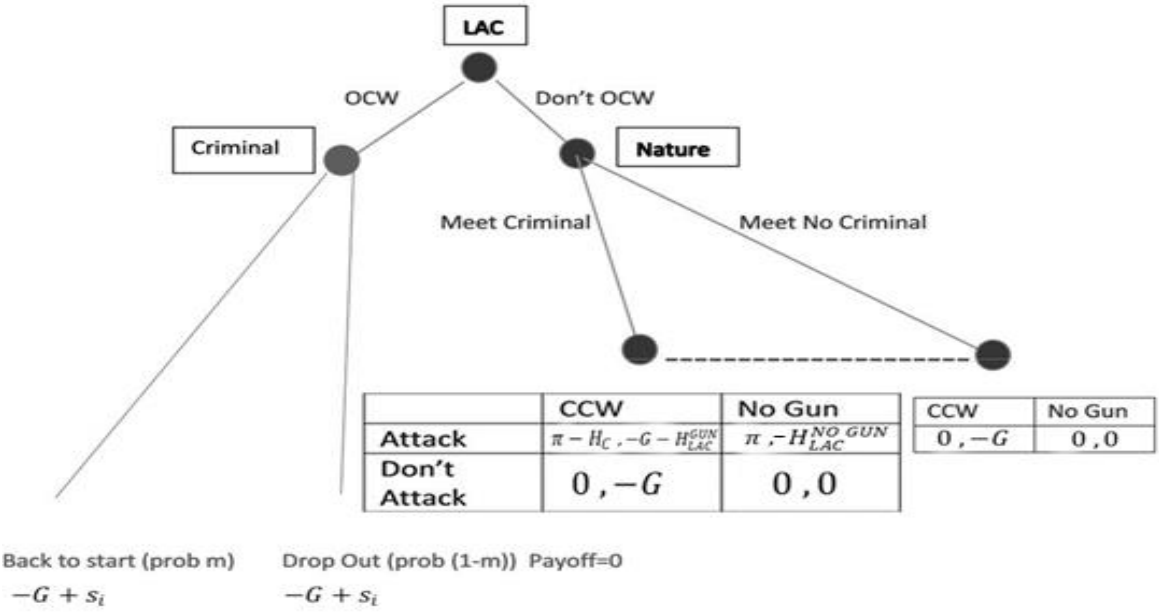

Figure 1.3. Concealed/Open Game with heterogeneous agents, first payoff to criminal.

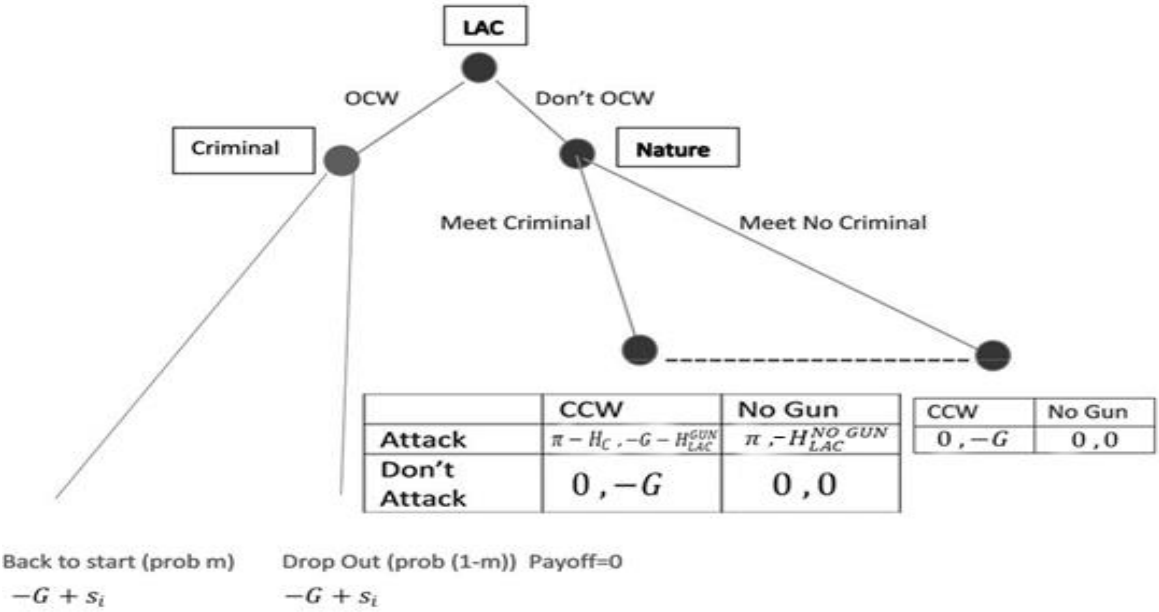

Figure ***1.3*** shows the game faced by citizens and criminals in a state which allows both

the open and concealed carry of weapons. In the previous section, cases where pure strategy NEs existed were analysed. In this section, we will look only at the cases where there are no pure strategy NE. The following assumptions must be made:

1. The payoff to an LAC who is attacked is greater if he has a weapon than if he doesn't: $-G-H_{LAC}^{GUN}>-H_{LAC}^{NO\ GUN}$
2. The payoff to a criminal who attacks an LAC with a concealed weapon is less than zero: π-$H_C<0$
3. A criminal who attacks a LAC without a gun receives a positive payoff: $\pi > 0$

There is a unit mass of 1 LACs and a mass of $0<k<1$ criminals. This means that not all LACs meet a criminal. First, the LAC chooses whether to open carry or not. From the previous open carry game, if there exists a deterrence effect this means that the criminal never attacks an open carrying LAC. If the same assumption is made in this case, the criminal also never attacks an open carrying LAC, so if the criminal ends up in such a situation, the criminal will either go back to the very start of the game, with the hopes of then meeting an LAC who does not carry a weapon, or he can drop out. Probability of continuing is determined exogenously and is given by *m*. Hence, the probability of dropout is (1-*m*).

If the LAC does not open carry, then he may decide to carry a concealed weapon or not carry a firearm. An important aspect of reality that this game attempts to capture is that it is possible that an LAC will equip themselves with a concealed weapon and yet never meet a criminal. An LAC is not aware of whether or not he is in the state of the world where he meets a criminal or where he does not, this is shown

through the dashed notation, and must assign a probability to both possibilities. These probabilities will be endogenously determined in equilibrium.

In the previous model, agents are homogenous, however in this extension we allow LAC agents to be heterogeneous in *s*. The value of an LAC's s_i is critical as it determines whether the LAC will open carry or not. Let $\hat{s}$ be the critical value of s_i, such that an individual with $s_i = \hat{s}$ is just indifferent between open carrying and not open carrying. Individuals with $s_i > \hat{s}$ open carry while those with $s_i < \hat{s}$ do not open carry. Denote $L(\hat{s})$ as the proportion of LAC who do not open carry and (1- $L(\hat{s})$) is the proportion of LACs who open carry

Define α as the probability that a criminal meets an LAC that does not open carry:

1.3

$$\alpha = L(\hat{s}) + (1- L(\hat{s}))\mathrm{m}\alpha$$

The above states that the probability of a criminal meeting an LAC who does not open carry is equal to the sum of initial probability of meeting an LAC not open carrying a weapon and the probability of initially meeting a citizen who is open carrying multiplied by the probability of continuation. Rearrange to get:

1.4

$$\alpha = \frac{L(\hat{\mathrm{s}})}{1 - m(1 - L(\hat{\mathrm{s}}))}$$

If the LAC does not open carry, there is an $\frac{\alpha k}{L(\hat{\mathrm{s}})}$ probability that he meets a criminal, this is the probability of a criminal meeting a non-open carrying LAC multiplied by the number of criminals, all divided by the amount of LAC which decide not to open carry. Similarly, $1 - \frac{\alpha k}{L(\hat{\mathrm{s}})}$ is the probability that the LAC does not meet a criminal.

Given this, we can solve for the expected payoff to the criminal and LAC if they are in the two-by-two concealed carry/no gun game where the criminal has a choice of attacking or not, represented on the right-hand side in

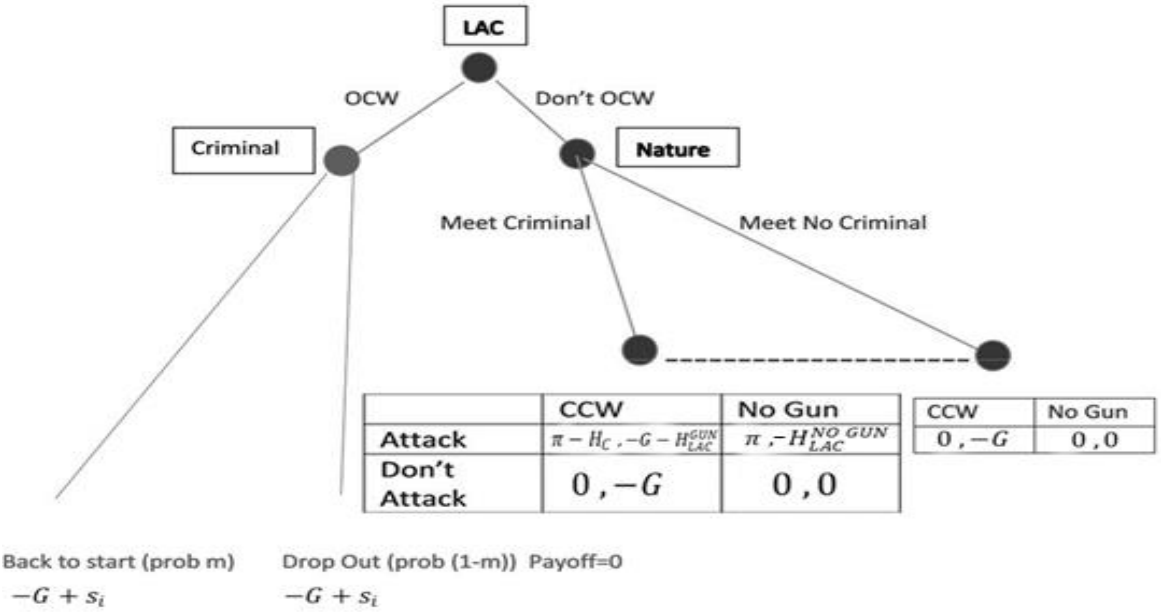

Figure ***1.3***, if the LAC chooses not to open carry, henceforth referred to as the concealed carry sub-game.

Define *p* as the probability of criminal attack in the concealed carry sub-game. Expected payoff to LAC concealed carrying is:

1.5

$$(1-\frac{\alpha k}{L(\hat{s})})(-G)+\frac{\alpha k}{L(\hat{s})}[(1-p)(-G)+(p)(-H_{LAC}^{GUN}-G)]$$

Set this equal to the expected payoff of carrying no weapon, $-H_{LAC}^{NO\ GUN} p \frac{\alpha k}{L(\hat{s})}$ so that the LAC is indifferent and solve:

1.6

$$p\alpha k = \frac{GL(\hat{s})}{H_{LAC}^{NO\ GUN} - H_{LAC}^{GUN}}$$

Subbing in for α from Equation 1.4:

1.7

$$p = \frac{G - Gm(1 - L(\hat{s}))}{k(H_{LAC}^{NO\ GUN} - H_{LAC}^{GUN})}$$

Equation 1.6 is an expression for the number of attacks that occur and is similar to Equation 1.2 in the concealed carry only game. The most important difference is the effect of $L(\hat{s})$, the proportion of the population which decides not to open carry, which increases the number of crimes committed. As the number of those not open carrying depends positively on s_i, the social cost of open carrying, a less gun friendly populace will lead to an increased rate of crime.

An LAC is indifferent between open carrying and not open carrying if:

1.8

$$-G + s_i = -H_{LAC}^{NO\ GUN} p \frac{\alpha k}{L(\hat{s})}$$

Using Equation 1.6 we can rewrite this as:

1.9

$$-G + s_i = \frac{GH_{LAC}^{NO\ GUN}}{H_{LAC}^{GUN} - H_{LAC}^{NO\ GUN}}$$

From this we can derive the value of $\hat{s}$ which leaves individual agents exactly indifferent between entering the simultaneous move game and open carrying:

1.10

$$\hat{s} = \frac{GH_{LAC}^{GUN}}{(H_{LAC}^{GUN} - H_{LAC}^{NO\ GUN})}$$

If an agent i has $s_i > \hat{s}$ he open carries and receives a payoff of $-G + s_i$. If an agent has $s_i < \hat{s}$ he does not open carry, and then makes a decision between concealed carrying or not carrying at all and receiving an expected payoff of $\frac{GH_{LAC}^{GUN}}{(H_{LAC}^{GUN} - H_{LAC}^{NO\ GUN})}$.

Note that if s_i is zero for all i, all LAC will open carry. This means that $\alpha = 0$, and all criminals will meet an LAC who open carries. This means that $p\alpha k$, the number of crimes carried out, will also be zero.

Let q be the probability that an LAC, given that he has already chosen not to open carry, concealed carries. In order for there to be a mixed strategy Nash equilibrium, the expected payoff to the criminal of attacking must be equal to the expected payoff of not attacking:

1.11

$$(\pi - H_C)q = \pi(1 - q)$$

1.12

$$q = \frac{\pi}{H_C}$$

From this we can ascertain the number of LACs who carry a concealed weapon to be $qL(\hat{s})$ and the number that do not carry any gun to be $(1-q)L(\hat{s})$.

1.8 Comparative Statics

1.6

$$p\alpha k = \frac{GL(\hat{s})}{H_{LAC}^{NO\ GUN} - H_{LAC}^{GUN}}$$

The number of attacks in equilibrium is given above. It is reasonable to assume that there is no way for a policymaker to affect $H_{LAC}^{NO\ GUN}$ or H_{LAC}^{GUN} directly, so the only way to affect the probability or number of criminal attacks is by changing *G*, possibly through taxation/subsidisation or regulation of firearms, or through changing s_i. An increase in s_i will cause less open carrying and higher rates of crime. It may then be in the government's interest to promote the open carry of weapons. One way to think about this is that any given LAC would rather open carry a weapon if he was not worried about the reaction from other citizens. Reducing s_i will increase the payoff of those who then decide to open carry.

Changing *G* will have two competing effects on the number of attacks. Firstly, as *G* is present as a positive in the numerator, an increase causes attacks to go up. However, if we look at equation **1.10**, we see that *G* is also a component of $\hat{s}$, and as *G* rises it causes $\hat{s}$ to rise. A rising $\hat{s}$ means that $L(\hat{s})$, the proportion of the LAC population which does not open carry increases. $L(\hat{s})$, like *G*, is present in the

numerator. Increasing *G* directly causes number of crimes to rise, but indirectly causes them to fall. The overall effect of *G* depends on the distribution of $L(\hat{s})$.

$(H_{LAC}^{NO\ GUN} - H_{LAC}^{GUN})$ is the difference between the damage done to an LAC if he doesn't carry a concealed weapon and if he doesn't carry a weapon at all. The greater is $(H_{LAC}^{NO\ GUN} - H_{LAC}^{GUN})$, the greater the benefit from carrying a concealed weapon. As this benefit increases, the number of citizens carrying a concealed weapon will increase, in turn reducing the potential benefit to the criminal of attacking. For this reason, an increase in $(H_{LAC}^{NO\ GUN} - H_{LAC}^{GUN})$ will cause the probability of a criminal attacking to fall. In terms of the real world this can be thought of a measure of the level of firearm skill that an LAC has.

1.10

$$\hat{S} = \frac{G H_{LAC}^{GUN}}{(H_{LAC}^{GUN} - H_{LAC}^{NO\ GUN})}$$

$\hat{s}$ is the critical value of s_i. It is negative as $H_{LAC}^{GUN} < H_{LAC}^{NO\ GUN}$. At levels of s_i greater than this critical value, an individual LAC open carries and at levels below the critical value he does not. It follows, then, that $\hat{s}$ is the determinant of $L(\hat{s})$, the probability that an LAC does not open carry. Again, it is reasonable to assume that H_{LAC}^{GUN} and $H_{LAC}^{NO\ GUN}$ are fixed, or at the very least difficult to change. *G*, on the other hand, can change much more easily and can be affected by policymakers. As *G* rises, the critical value will become lower (more negative) meaning a higher number of LACs will find that their *s* is above the critical value, causing a higher number of citizens to open carry. This arises from the fact that an increase in *G* leads to an increase in *p*, the probability of attack. Higher *G* means a higher likelihood of being attacked if an LAC

decides not to open carry, hence open carrying becomes more attractive. H_{LAC}^{GUN} is present in both the numerator and denominator. Differentiating with respect to H_{LAC}^{GUN} the rate of change is -$GH_{LAC}^{NO\,GUN}$, meaning as H_{LAC}^{GUN} increases, the critical value falls and hence more citizens will open carry.

It is interesting to note that the number of criminals, denoted by *k* has no effect on either the number of crimes or $\hat{s}$. This implies that locking criminals away has no actual effect on the number of crimes which occur in equilibrium and initiatives to reduce the number of criminals on the streets will not be effective.

The expected payoff to a LAC of not open carrying is $-H_{LAC}^{NO\,GUN} p \frac{\alpha k}{L(\hat{s})}$. While at first it may appear that a greater number of LAC not open carrying will increase the payoff (make it less negative), $L(\hat{s})$ also appears in α and p. From Equation 1.9 we can rewrite the expected payoff as $\frac{GH_{LAC}^{NO\,GUN}}{(H_{LAC}^{NO\,GUN} - H_{LAC}^{GUN})}$. Here, it is clear that the number of LACs who decide to open carry has no effect on the payoff of non-carrying citizens.

The expected payoff to a LAC of open carrying is $-G + s_i$. The payoff may be positive, negative or zero. It increases in s_i and falls in *G*. Only those with s_i greater than the critical value will open carry, hence the payoff to those who open carry will be greater than or equal to $\frac{GH_{LAC}^{NO\,GUN}}{(H_{LAC}^{NO\,GUN} - H_{LAC}^{GUN})}$. If the option to open carry was taken away, those who prefer to open carry would receive a lower payoff and be worse off.

The expected payoff to criminals is zero, those that drop out will receive zero while those that enter the concealed carry game will have probabilities of attack set such that the expected payoff from attacking is equal to the expected payoff of not attacking. The payoff to not attacking is zero, hence expected payoff is zero.

1.9 Conclusion

It is not possible to capture the nuance of every states' law within the scope of the model and so it has to be divided into three broad categories; only open carry, only concealed carry or both are legal. When comparing only open carry to only concealed carry, and given specific assumptions regarding deterrence and defence being worthwhile, it is clear that an open carry policy leads to less crime and a higher level of gun ownership. With concealed carry, there is a positive externality present, in that a citizen carrying a gun protects themselves but also reduces the probability of other citizens getting attacked. This externality is not present under an open carry regime, as criminals can tell who is carrying a weapon and who is not. The presence of this externality in concealed carry systems leads to a lower level of gun ownership than the social optimal and means that open carry systems are more efficient in lowering the number of crimes.

When analysing states that permit both the open and concealed carry of handguns, it is necessary to examine what would cause someone to prefer to carry a concealed weapon over the alternative of openly carrying a weapon. In the first model, it is always more beneficial to carry openly but this is clearly not the case in reality, where there is a mix of open carrying, concealed carrying and citizens who do not carry guns at all. In order to achieve such a mix, the model allows for heterogeneity of agents, specifically with regard to attitudes toward open carrying weapons. A cost (benefit), s, is added to each LAC agent if he chooses to open carry, each agent receives a different cost and this leads to the result that some LACs prefer to concealed carry or not carry a weapon at all. The variable s can be interpreted in many different ways, it can represent any cost (or benefit) that an agent receives if he open carries over and above that which he receives from concealed carrying or not carrying at all.

The key finding of this chapter is that a populace more friendly to the open carry of weapons will have a lower rate of crime. If a deterrence effect exists, open carry is strictly superior to concealed carry for an individual, provided the societal cost is not too high. One of the ways we can interpret s is as the benefit/cost of being seen with a weapon in public. To some this might be beneficial as it makes a political statement in favour of the right to bear arms, or it could be considered a cost in that openly carrying a weapon may attract some unwanted attention, or even in some cases outright hostility from other members of the public or the police.

There are several other ways in which s can be interpreted, for example, it may vary with firearm skill, but the main effect of s, is that it creates a more realistic picture where different citizens make different choices with regard to carrying a handgun. This does not change with the interpretation of s.

Of crucial interest to policymakers is the rate of violent crime perpetuated in a nation, which is represented in this chapter by Equation 1.6. With the assumptions regarding the existence of a deterrence effect and that carrying a weapon is beneficial, the only way for policy makers to lower the number of attacks is by decreasing G, the price of guns or to promote the open carrying of weapons by making it more acceptable to carry in public. This may mean that initiatives such as those in Seattle, where a tax was placed on firearms, may in fact cause the crime rate to increase, due to the lower number of guns in circulation. It is very important to emphasise the assumptions under which this is true. If these assumptions do not hold, a fall in the price of guns may be counterproductive. The situation in Europe, where the price of guns is vastly higher than in the US due to strict laws, most likely breaks the assumptions that are critical to the results of the model, specifically the assumption on carrying a gun being

beneficial, and so it would not be wise to recommend loosening the laws with regards to gun control in European nations. Overall, it appears that a situation where guns can freely be held by all and on the other end, where guns are so costly as to be rare, are both efficient outcomes. Problems may arise when examining situations between these two extremes.

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2 Economic Indicators and Mental Health

2.1 Overview of Literature

Macroeconomic markers such as GDP, unemployment and others are often referenced when evaluating the well-being of society. The idea behind this being that as there is greater production in society (GDP), the average resident of a country tends to enjoy a higher standard of living, or that with lower numbers unemployed that less people are likely to suffer from poverty or deprivation. But how great a connection is there in reality between indicators such as these and an individual's happiness? If GDP goes up, does this cause a corresponding rise in utility? And which economic factors need to be taken into account when evaluating the well-being of society? One way to measure this is to look at the most unhappy in society, those diagnosed with depression or those that commit suicide. It is possible that the effects of increases in various indicators may not have a uniform effect across society, benefitting one section more than another. It may be possible that GDP rises do increase the utility of many individuals but still correlate with a rise in suicide, implying that the positive benefits are not enjoyed by some of the most vulnerable in society. It is important, then, that economists evaluate the usefulness of these measures of well-being.

Suicide is a significant problem throughout the world, and according to the World Health organisation, WHO (2019), around 800,000 people die of suicide each year, greater than deaths from breast cancer, malaria and homicide. Even more worrying is the fact that suicide is the second leading cause of death in those aged between 15 and 29. Many factors are put forward as influencing the suicide rate in the literature, ranging from country-specific effects, macroeconomic indicators and, somewhat strangely, country music is shown to be positively associated with suicide rates by Stack and Gundlach (1992).

Happiness and income do appear to be linked, but the effect may not be linear. Ball and Chernova (2008) use self-reported values in the World Values Survey to examine the link between happiness and income. They find that both absolute and relative income are associated with happiness levels, but changes in relative income have a much larger effect. They also find that non-income factors are more important than income factors. Easterlin et al. (2010) look at the "happiness-income paradox". This paradox refers to the fact that empirical studies have found that while happiness and income appear to be directly connected at a specific point, over time this relationship breaks down in the long term and happiness is not linked to income. They show that this paradox holds not only for developed nations, but also for many developing countries. Tsui (2014) analyses survey data from Taiwan and shows that absolute changes in income exhibit a stronger relationship with happiness than relative or expected income, however relative and expected income are also positively associated with happiness. Fanning et al. (2019) show that countries experiencing a decline in per capita consumption, measured using both GDP and carbon footprint, experience significant reductions in happiness. However, countries which are experiencing an increase in per capita consumption do not see a corresponding increase in happiness.

Unemployment is one possible determinant of mental health issues. An unemployed person may face an increased risk of poverty (Saunders, 2002), anxiety and depression (Sandifer et al., 1985) and the possible onset of stress (Baum et al., 1986). When considering policy positions or possible mental health interventions, the effect of unemployment must be considered by governments. As for the empirical literature regarding the effects of unemployment on suicide and mental health issues, the findings differ greatly between publications and there appears to be no clear

consensus. Some trends that do emerge are the varying effects of unemployment on men and women, with unemployment tending to be linked more with male suicide rates. Additionally, it is reported that government labour market policies may play a significant role in reducing the impact of unemployment on suicide. Many studies also examine suicide by age rate as the effect can also vary drastically. Broadly, two types of studies exist, those using aggregate data and comparing different countries, or those comparing individuals based on their unemployment status. The former is advantageous in that it gives a better picture of the individual impact of unemployment, however it faces the drawback of being less able to compare policies across countries and may not be able to distinguish the direction of this effect. It may be that mental health issues are viewed as undesirable to employers and so those who are likely to commit suicide are more prone to job loss.

Noh (2009) examines the effect of unemployment on suicide rates while accounting for GDP per capita, finding that unemployment is positively associated with suicide rates in high income countries but negatively associated with the rate in lower income countries. Stuckler et al. (2009) investigate the effect of unemployment on the suicide rate using data from 26 EU countries. They find that while an increase in unemployment is associated with a rise in the suicide rate, this effect can be mitigated by softening the blow of unemployment through the use of active labour market programmes. Norström and Grönqvist (2015) come to a similar conclusion in their analysis of unemployment during The Great Recession. Splitting European countries into categories based on the strength of their unemployment protection, they find significant effects of unemployment on male suicide rates in all categories except for the Scandinavian welfare system, and conclude that stronger unemployment protection mitigates the effects of unemployment on suicide rates. For female suicide

rates, only in Eastern Europe were there significant effects. Stack and Haas (1984) look at this question from a different point of view, instead analysing the effects of unemployment duration on suicide. They find that longer spells of unemployment may lead to a greater risk of suicide, an effect which holds for both men and women. Gunnell et al. (2018) look at the effect of suicide on those aged between 15 and 44, finding that the unemployment rate significantly affected the suicide rate for both men and women, with the effect being stronger on those who are younger.

Andres (2005) makes use of data on 15 European countries and finds no effect of the unemployment rate or the female participation rate on either male or female suicide rates, but also notes that the suicide rates of different demographic groups are affected differently by economic factors, something which should be accounted for when formulating mental health policy. Using Danish data, Browning et al. (2006) find no link between job loss and health outcomes. In particular, they mention that there is no link between job loss and diseases related to stress or hospitalisation. Crombie (1990) finds an "inconsistent" effect of unemployment on suicide, with the effect differing across countries and between men and women. Nordt et al. (2015) examine the suicide rate over 63 different countries and find that unemployment was a significant predictor of suicide rates both before and during The Great Recession. Kuroki (2010) uses Japanese data at the municipal level, to examine the effects of unemployment, arguing that data at this level is more appropriate than aggregate data at the state or country level. Municipal level data can capture community level effects that would be lost in an analysis of individuals or with aggregate data at a larger level. Kuroki finds, like many other studies, that unemployment has a strong impact on male suicide rates, mostly between the ages of 35-64, but the effect on women is far less straightforward. While many studies find a stronger link between unemployment and

suicide for men than women, the reverse finding is less common. In one study, Kposowa (2001) finds a stronger effect of unemployment rate on the female suicide rate than the male suicide rate.

GDP per capita may be another economic predictor of suicide and mental health issues. Lower GDP implies a lower average individual and household income, and, possibly, higher rates of poverty. In general, it makes sense to think that individual well-being will be connected to GDP through additional consumption of goods and services in high GDP countries. While it may be the case that increases in GDP do not affect all citizens of a country equally, perhaps the benefits accrue more to the rich than other strata of society, on average a higher GDP should mean citizens are better off. GDP is one of the most important economic indicators used to measure well-being, and economic growth is often viewed as the ultimate marker of successful economic policy. Whether the prominence of GDP is justified or not is an important topic of debate. It is particularly important to examine the impact of GDP on well-being, as GDP is so often used to inform economic policy. If this relationship is not as strong as previously thought, there may be substantial implications for policymakers. Blanchflower and Oswald (2004) find that reported levels of well-being had decreased in the 25 years preceding the publication, despite the fact that GDP had risen substantially during this time. Van den Bergh (2007) argues that extensive use of GDP is a poor proxy for social welfare and its use as such is a form of information failure. England (1998) states that GDP should be rejected as a measure of social well-being due to several drawbacks. Currently, the literature acknowledges that GDP is not an objective measure of social welfare and many attempts have been made to provide alternative measures to replace or augment GDP. Some publications that fall into this category include Van den Bergh and Antal (2014), Fluerbaey (2009), Constanze et al.

(2009), and Döpke and Maschke. (2016). Kubiszewski et al. (2013) compare GDP to GPI (Genuine Progress Indicator), a measure of social welfare which includes many more measures than GDP. They argue that GPI is a much more suitable measure of welfare than GDP and find that GPI per capita does not rise after GDP per capita hits $7000.

If GDP is an adequate measure of well-being, there should be evidence indicating a negative association with mental health issues and suicide rates. Higher well-being should imply lower suicide rates and lower rates of mental health problems. While the effect of unemployment on mental health issues has been thoroughly investigated, the effects of GDP are less documented. Many studies focus instead on the effect of important economic events, such as The Great Recession, on suicide. Similar to the findings in the literature examining the link between unemployment and mental health problems, it appears that the general consensus is that factors such as GDP per capita, recessions and economic growth largely affect men to a much larger degree than women. Many studies find that these macroeconomic factors may have a large effect on the male suicide rate but little to no effect on the female suicide rate.

Fountoulakis et al. (2014) find that unemployment, inflation and economic growth are all correlated with male suicide rates, however GDP per capita is not. For women, they find that only unemployment is correlated with suicide rates. Zhang et al. (2010) find that suicide rates in China decreased during the past few decades of strong economic growth. Dos Santos et al. (2016) examine Portuguese suicide rates over a century, from 1910 to 2013, to analyse the effect of various socioeconomic events. They find that suicide rates increase significantly during recessionary periods, and that the male suicide rate is linked more strongly with GDP fluctuations than the female rate. Yoon et al. (2012) use Korean monthly GDP data to examine the effect

of declining GDP during a recession on suicide rates among workers in the agriculture, fisheries and forestry sectors. They find a lagged effect of a fall in GDP, where suicide rates increase between one to four months after GDP declined. Okada et al. (2020) find that GDP per capita has no effect on suicide rates when they analysed Japanese government statistics. However, they also find that government financial support significantly reduces the rate of suicide. Carleton (2017) examines the effects of temperature on suicide rates in India, finding that increased heat has a significant effect on the rate of suicide, but only during the growing season. The reason given for this is that high temperatures can reduce crop yields, lowering income for families and possibly inducing financial hardship. Chang et al. (2013) examine the effect of the 2008 economic crisis by comparing actual suicide rates in 2009 with the expected trend based on data from 2000-2007. They find that the suicide rate of men increased in European and American countries. However, this may be primarily driven by unemployment, and not income or GDP. The authors note that increasing unemployment appears to be associated with increases in the suicide rate. Brainerd (2001) finds that a substantial increase in the male suicide rate in countries which were part of the former Soviet Union may have been partially caused by large falls in GDP.

While GDP captures the level of income in a country, it says nothing about the distribution of income. It may be the case that suicide is associated with individuals who are experiencing deprivation or poverty, and as such, a country with high GDP but high inequality may have a higher suicide rate than a country with moderate GDP and lower levels of inequality. Inequality may also affect an individual's self-esteem if they compare their own situation to that of others and consider themselves a failure if they are relatively worse off. Fernquist (2003) finds that perceived levels of income inequality are more strongly related to male suicide rates than to female suicide rates.

Inagaki (2010), measuring inequality using the Gini coefficient, finds that increasing income inequality is positively associated with an increase in the Japanese suicide rate. Piatkowska (2020) finds that relative poverty rates, as opposed to absolute poverty rates, are positively related to suicide rates. Tran and Morrison (2020) analyse data on 1684 US counties to examine the effect of localised income inequality on suicide rates. They find no overall effect of income inequality on suicide rates but point out that inequality may have varying effects in different geographical areas. Jaen-Varas et al. (2019) find that inequality, as measured by the Gini index, has a positive association with the suicide rate of adolescents. Kiadaliri et al. (2014) analyses the effect of various socioeconomic factors on suicide in Iranian provinces. They find that lower socioeconomic status is associated with an increase in the male suicide rate. Hsu et al. (2015) find that suicide rates are more than twice as high in deprived areas of Hong Kong and suicide rates are positively correlated with deprivation. Bando et al. (2012) find that wealthier areas of Brazil actually experience a higher level of suicide, however this varies across regions and the state of São Paulo had higher rates of suicide in poorer areas. Machado et al. (2015) use the Gini coefficient as a measure of income inequality and find that it is positively related to the rate of suicide in Brazil, meaning income inequality increases suicide rates.

Whitley et al. (1999) use the Townsend deprivation index to measure poverty. This index includes four variables: unemployment, home ownership, car ownership and household overcrowding. They find that as the Townsend deprivation score increased, suicide rates also increased. Choi et al. (2019) find that poverty increases the risk of suicide in older adults. This effect is much stronger for males than females. A review by Iemmi et al. (2016) examines 37 studies which look at suicide rates in low- and middle-income countries, pointing out that over 75% of suicides worldwide

occur in these nations. They divide the studies into two categories, those dealing with completed suicides and those looking at suicidal intentions and behaviours. In both categories there were a majority of publications which reported a positive association between poverty and suicide/suicidal behaviours. Hoffmann et al. (2020) analyse the effect of US county level poverty rates on suicides of those between the ages of 5 and 19. They found that the suicide rate for this age group increased as county level poverty rates increased. Kerr et al. (2017) find that poverty rates are positively linked to the risk of suicide among all ages and genders. They also find that loss of a home through foreclosure was, perhaps counterintuitively, negatively associated with the suicide rate for women, and those aged over 65, but positively associated for those between the ages of 45 and 64.

Leisure time and working hours are another factor which may have a large effect on an individual's utility. If working hours in a country are particularly high, to the extent that many individuals are overworked, it may create mental health issues and possibly result in suicides. Lee et al. (2020) find that longer working hours in South Korea are associated with higher suicide rates. Those working over 45 hours per week were found to have higher rates of suicide than those working between 35 and 44 hours per week. Takeuchi et al. (2014) examine the effects of working hours, income and leisure time on suicide in Japan. They find a significant positive effect of working hours on the male suicide rate and a negative effect of income. Leisure time is also found to be correlated with the suicide rate, but less strongly than working hours or income. Frijters et al. (2009) analyse the effect of long working hours on mental health. They make use of a General Health Questionnaire (GHQ) to quantify mental health and find that working more than 60 hours per week may result in mental health issues. Virtanen et al. (2011) examine the association between longer working hours

and the symptoms of anxiety and depression, finding that working over 55 hours is associated with a significant increase in the risk of symptoms arising compared with those working 40 hours or below. Choi et al. (2021) analysed the effect of long working hours on workers in South Korea. They find that those working over 69 hours per week are significantly more likely to experience symptoms of depression than those who work 40 hours per week. The effect was found to be stronger in women and low-income workers. Niedhammer et al. (2015) find that longer working hours are associated with a rise in anxiety in men.

The effects of economic factors on mental health appears to be vast, and numerous publications have found a link between these factors and suicide, and mental health issues. Income/GDP, unemployment, inequality and working hours were all found to influence mental health of individuals to some degree. There appears to be a strong trend in the literature showing that the effect of economic factors is far stronger on men than on women, although more research is needed to determine exactly why this is the case. The effects of various factors appear to differ depending on age category, and, worryingly, there is a large number of teenagers and children committing suicide. The suicide rate of those under 18 is shown to be affected by income and poverty. There is no doubting that mental health issues must be considered when formulating policy, and legislators have a responsibility to ensure that those vulnerable to mental health problems are not left behind. The academic literature on this issue is crucial and must be used to inform the debate on mental health issues and inform policy.

2.2 Abstract

This chapter examines the link between mental health issues and economic indicators such as GDP, unemployment, Economic Freedom Index in a subset of Organisation for Economic Cooperation and Development (OECD) countries. It is found that GDP per capita is negatively associated with both suicide rates and depression rates. This finding is robust to the addition of country and time fixed effects as well as random country effects. No effect is found for unemployment, income inequality, working hours, government spending or part-time work rate on suicide or depression. For the Economic Freedom Index, no effect is found for the index overall but when it is split into its constituent parts, it appears that trade freedom and government integrity are negatively associated with suicide and depression rates.

2.3 Introduction

Utility of individuals and social welfare have been some of the main preoccupations of the field of economics since the time of John Stuart Mill (Mill, 1963). While utility itself cannot be directly measured, proxies for welfare can be employed, including GDP, unemployment, real wages, and working hours. However, the extent to which these measures align with utility and which are most significant is not clear. To investigate the impact of each of these measures, this chapter examines correlations between these representations of wellbeing and indicators of mental health status. This chapter empirically tests the effect of various economic indicators (GDP, unemployment, income inequality and others) on both depression and suicide rates in the population. While depression and suicide are not perfect instruments for utility, they are arguably more objective and reliable than self-reported life satisfaction or happiness (Diener et al., 2009).

People who are unemployed will have a lower income, and thus presumably, a lower level of utility. In addition, the job search process and the social stigma attached to unemployment may cause significant distress. These factors are known to contribute to increased levels of depression and/or suicide (Blakely et al., 2003). Dooley et al. (1994) analyse a panel dataset of individuals and find that there is a significant increase in symptoms of depression in those who become unemployed, but no significant effect of unemployment on clinical depression. Following on from this, Dooley et al. (2000) analyse unemployment as a continuum (adequate and inadequate employment to unemployment) and find that negative changes along this continuum increase depression rates independent of other factors such as income. Stankunas et al. (2006) find that depression symptoms, as measured using the Beck Depression Inventory, are higher in those who are long term unemployed versus those who are unemployed over a shorter period in Lithuania. Chang et al. (2009) find that unemployment caused by the 1997-1998 Southeast Asian economic crisis was associated with an increase in the number of male suicides. Andres (2005) finds that suicide is not influenced by unemployment rates, but economic growth and other factors do influence suicide rates. Similarly, when examining gender, Yang (1992) finds that the unemployment rate affects the suicide rate for white males only.

GDP per capita is often used as a measure of a nation's well-being. As GDP increases, it is believed that a country is better off. With regard to mental health and suicide, higher levels of income could lead to a happier populace and, hence, a lower rate of suicide. However, the evidence to support this theory is mixed. Noh (2009), using OECD data, finds that higher GDP is associated with an increased rate of suicide. Ceccherini-Nelli and Priebe (2011) find that while unemployment is associated with an increase in suicide rates, GDP and CPI also are linked with suicide,

but the direction and significance of these factors are inconsistent. Blasco-Fontecilla et al. (2012) find that the effect of real GDP varies depending on the country. This current analysis uses real GDP per capita (at 2011 prices) to analyse the effect on depression and suicide rates. It is seen that GDP is negatively correlated with both suicide rates and depression rates. This holds true even when accounting for factors such as country and time fixed effects; discussed later.

In addition to examining unemployment and GDP, other factors of employment are analysed, specifically working hours and part-time work. Martens et al. (1999) find that those who work irregular hours report a greater number of mental health issues than workers with fixed hours. Additionally, Roxburgh (2004) finds that "time pressure" is a significant predictor of distress, regardless of gender. A meta-analysis conducted by Fujino et al. (2006) reports that seven of the seventeen studies examined show a statistically significant effect of working hours on mental health problems, while the other ten studies show no significant effect. In the following analysis, it is found that there are significant effects of both the percentage of employees who engage in part-time work and the number of work hours on suicide and depression. However, the direction and significance of these effects are inconsistent and depend largely on the inclusion of country and time effects.

Finally, the relationship between the Economic Freedom Index and suicide and depression is examined. To the best of my knowledge, this is the only study to examine a link between the index and mental health. The Economic Freedom Index takes on a value between 0 and 100, where 100 implies the maximum level of freedom and zero implies no freedom. The index depends on several factors including government spending, tax burden, property rights, and trade freedom, among others. Economic

freedom could have a positive impact on mental health due to the fact that it may allow individuals the freedom to make more choices and as such, live better, more fulfilling lives. Furthermore, economic freedom may allow for the hope of greater social mobility. On the other hand, if economic freedom denotes lower government spending on social and health projects or more precarious working conditions, it could have a negative causal effect on mental health outcomes. With respect to government spending, Minoiu and Andres (2008) find that both health and welfare spending in US states is negatively correlated with suicide rates. Antonakakis and Collins (2014) find that in Greece, "austerity" (government spending cuts and tax rises), has varying effects on the suicide rate depending on the age and gender category.

This analysis examines the effects of economic freedom in two ways; firstly, by using the overall index score, and secondly, by splitting the index into its constituent parts. As a whole, the effects are found to be inconsistent. However, some of the constituent parts have effects that are robust to the inclusion of fixed effects, particularly trade freedom.

The chapter uses data on 29 different countries, spanning from 1995 to 2016 and incorporates both suicide rates and depression rates. While suicide rates have been examined in detail with regard to economic factors, depression rates have not. The main contribution of the chapter was made possible by the Global Health Data Exchange database on mental health issues. An additional impact of this chapter is the inclusion of a large range of economic variables, many of which, particularly the Economic Freedom Index, have not been examined in this context previously or have not been examined together.

2.4 Methodology and Data

To analyse the effect of economic variables firstly on suicide, followed by depression, a simple Ordinary Least Squares model is used. This takes the form of:

$$S = \alpha + \beta x + e$$

Where:

- S is the suicide rate or depression rate, measured as number affected per 100,000 people
- α is the intercept
- β denotes the OLS regression coefficients for the right-hand side variables
- x denotes the explanatory variables, detailed below
- e is the error term

The variables included in x are:

- Average number of hours worked per year
- Percentage of workforce working part-time jobs
- Percentage of national wealth held by the top 10% of the population
- GDP per capita in US Dollars in 2011 Prices
- Unemployment Rate
- Percentage of GDP spent on healthcare
- Government Spending as a percentage of GDP
- Economic Freedom Index Score, which includes taxation

The regression is carried out as above and with the Economic Freedom Index score split into its constituent parts. This is explained in greater detail below.

Data on depression rates is obtained from the Global Health Data Exchange database via the ourworldindata.com website. This database was created by the Institute for Health Metrics and Evaluation (IHME), an independent research centre at the University of Washington. Real GDP per capita is also found on this same website, provided by the World Bank. 2011 is the base year for this indicator. Data on unemployment numbers is taken from the World Bank's online database at https://data.worldbank.org. The OECD database is used for data on government spending, suicide rates, the part-time employment rate and number of hours worked per year. Statistics on wealth held by top 10% are obtained from the world inequality database and the Economic Freedom Index data is taken from heritage.org.

The regression is run with each observation being a year in a country. There are 519 observations in the database, consisting of 29 countries, and years ranging from 1995 to 2016. The countries included in the dataset are as follows: Australia, Austria, Belgium, Switzerland, Chile, Czech Republic, Germany, Denmark, Spain, Estonia, Finland, France, United Kingdom, Greece, Hungary, Ireland, Italy, Japan, South Korea, Lithuania, Luxembourg, Latvia, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia and Sweden. The number of years/observations is not the same for each country, with the dataset containing data on many years for some countries and as little as three for some others, such as Chile. As much of the data comes from the OECD, it is not possible to include non-OECD nations in the dataset. Not all OECD members are included in the data. This is due to limitations in the sources other than the OECD, which are lacking data on some countries or years for certain countries. Of note is the absence of the USA, which was initially included, but had to be removed due to data on certain variables not being available.

Due to the possibility of potentially relevant variables not included in the regression affecting suicide and depression rates, the coefficients given may be biased. This may occur if these variables, picked up in the error term, are correlated with the x variables included in the regression. This could lead to the problem of omitted variable bias. One solution to this would be to add in every possible variable that could affect suicide and depression. However, this is not feasible due to the vast amount of possibly relevant variables. In addition, many of these variables are difficult to quantify. As an example, the culture of a nation may affect a person's mental health, but it is very difficult, if not impossible, to quantify every relevant aspect of culture. To circumvent this problem, the regression is carried out with country fixed effects added in. To account for these effects, dummy variables are created for every country except one. These dummy variables should theoretically capture country-specific effects that have an influence on depression/suicide rates, but that are not included in the regression on the right-hand side. These dummy variables' coefficients can be interpreted as being the additional rate of depression/suicide a country has above and beyond the rate of the omitted country.

In addition to country-specific factors, there may also be time-specific factors influencing suicide and depression rates. If there is a trend over time where the rates are rising or falling independently of the economic variables included, the β coefficients estimated by the regression will be biased. As above, similar to country fixed effects, time fixed effects can be included to control for this possibility.

Country	Avg Suicide Rate
Australia	11.307
Austria	16.423
Belgium	18.335
Switzerland	15.825
Chile	10.467
Czechia	14.568
Germany	11.938
Denmark	11.985
Spain	7.410
Estonia	19.819
Finland	19.405
France	16.915
UK	7.005
Greece	3.486
Hungary	25.777
Ireland	11.565
Italy	6.414
Japan	21.833
South Korea	29.988
Lithuania	36.837
Luxembourg	13.060
Latvia	23.000
Netherlands	9.538
Norway	11.530
Portugal	8.129
Slovenia	22.100
Poland	15.165
Slovakia	12.517
Sweden	12.559

Table 2.1 Average suicide rates across time period of dataset (deaths per 100,000) by country.

Note that there are data on more years available for some countries than others

As we can see from Figure 2.2, Lithuania has the highest average suicide rate at 36.8 per 100,000 whereas Greece has by far the lowest at 3.48 (Figure 2.1). Not only does Greece have the lowest average suicide rate, but it is also seen to be consistently lower than the other 6 lowest countries every year, with the highest rates reported in Greece still far below the lowest rates of Italy (Figure 2.1). This may be partially explained by the particularly dim view that the Orthodox church, which a majority of Greeks follow, has on suicide. The Orthodox church usually does not allow those who have died of suicide to be given a funeral (https://www.goarch.org/-

/regarding-suicides-and-cremation). This could mean that either people in Greece are more reluctant to commit suicide, or it may be the case that a death is not reported as a suicide to avoid the social stigma attached to it, or, indeed, a combination of these factors.

Lithuania's suicide rate is the highest on average. While it is quite high from the 1990s, peaking at over 48 per 100,000 in 2000, it has fallen consistently since then (Figure 2.2). South Korea's rate is similar to that of Lithuania in the later period of the 2000s but has also fallen recently. At the other end of the spectrum, the UK and Italy have consistently low rates, below 8 per 100,000, with little variation between years.

Some other countries have notable patterns, such as Luxembourg which has large variation year to year, but overall, it has a rate close to the average. Switzerland's rate of suicide drops sharply beginning in 2008-2009 and it has stayed consistently low ever since (Figure 2.3). This trend is interesting as the rate falls exactly at the beginning of The Great Recession, the opposite of what we might expect. This may be partially explained by tougher gun laws in Switzerland brought in during 2008 to bring the nation in line with EU regulations (loc.gov/law/help/firearms-control/switzerland.php).

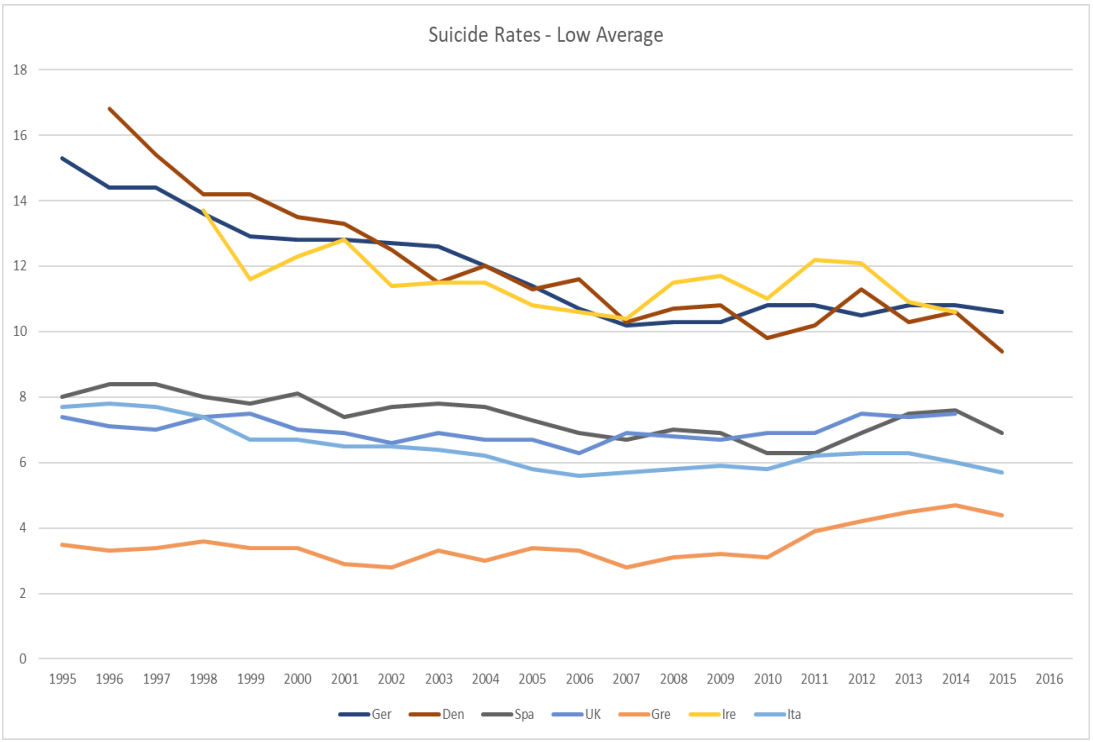

Figure 2.1 Low Suicide Countries, note Greece is far below the rest even after the Great Recession

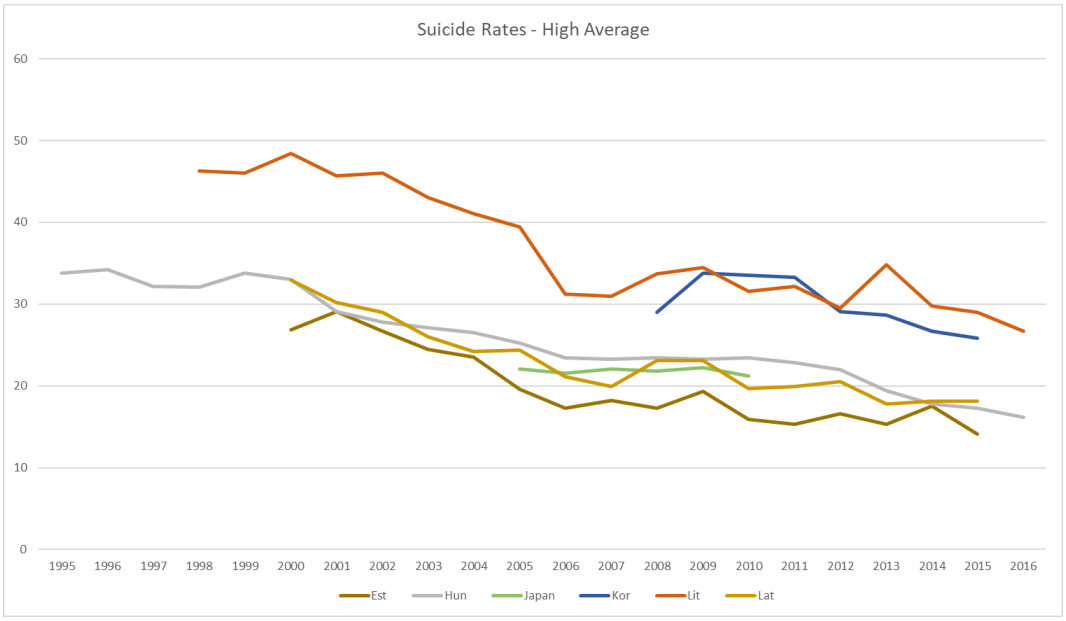

Figure 2.2 High Average Rate Countries

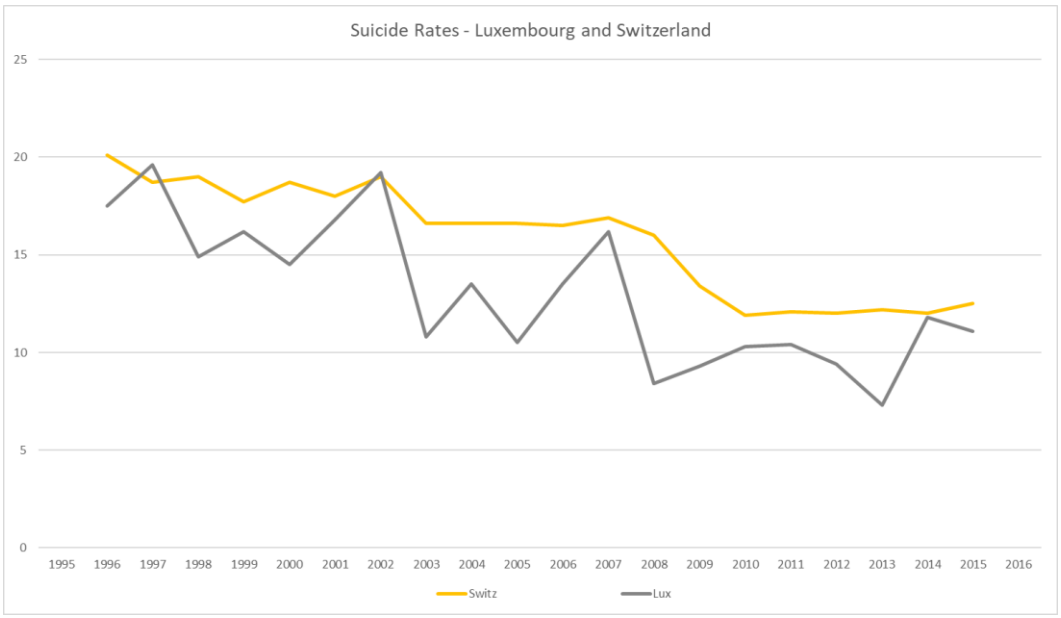

Figure 2.3 Luxembourg and Switzerland. Note the large variance in Luxembourg's rate and the sharp decline in the Swiss rate at the 2008-2009 mark.

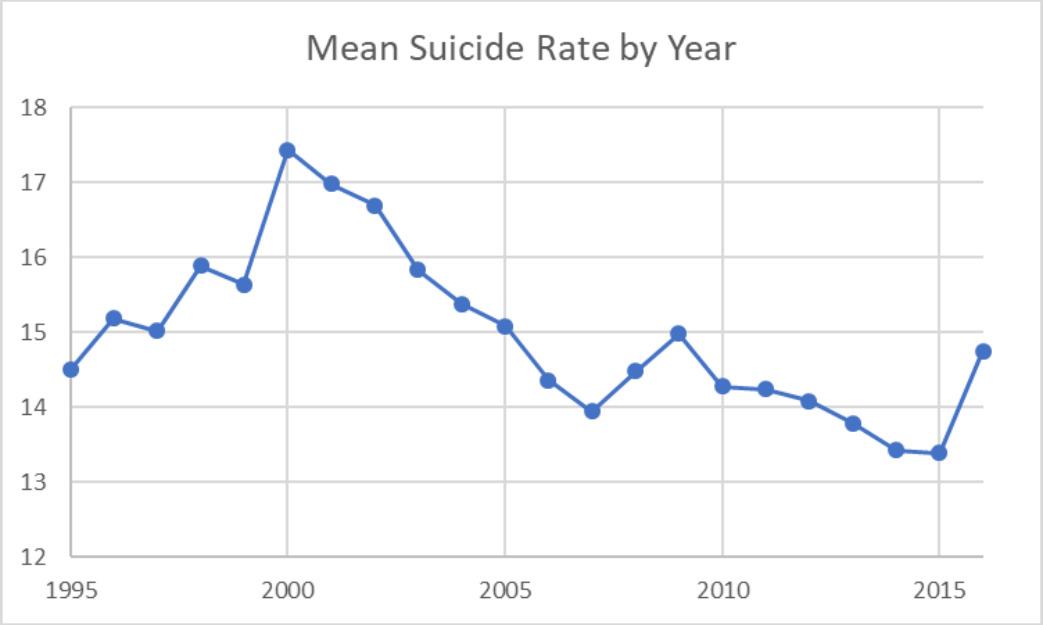

Figure 2.4 Mean suicide rate per 100,000 by year. The increase in 2000 is due to this being the first year Lithuania appears in the data.

Note the slight increase just as the Great Recession begins.

Country	Avg. Depression Rate
Australia	5.092
Austria	3.612
Belgium	4.277
Switzerland	4.102
Chile	4.211
Czechia	3.079
Germany	4.140
Denmark	3.575
Spain	3.730
Estonia	4.556
Finland	5.473
France	4.604
UK	4.386
Greece	4.575
Hungary	3.191
Ireland	4.557
Italy	3.880
Japan	3.371
South Korea	4.000
Lithuania	4.682
Luxembourg	3.953
Latvia	3.965
Netherlands	4.353
Norway	4.010
Portugal	5.149
Slovenia	2.523
Poland	2.738
Slovakia	3.418
Sweden	5.089

Table 2.2 Average depression rate (percentage of population) across time period in dataset

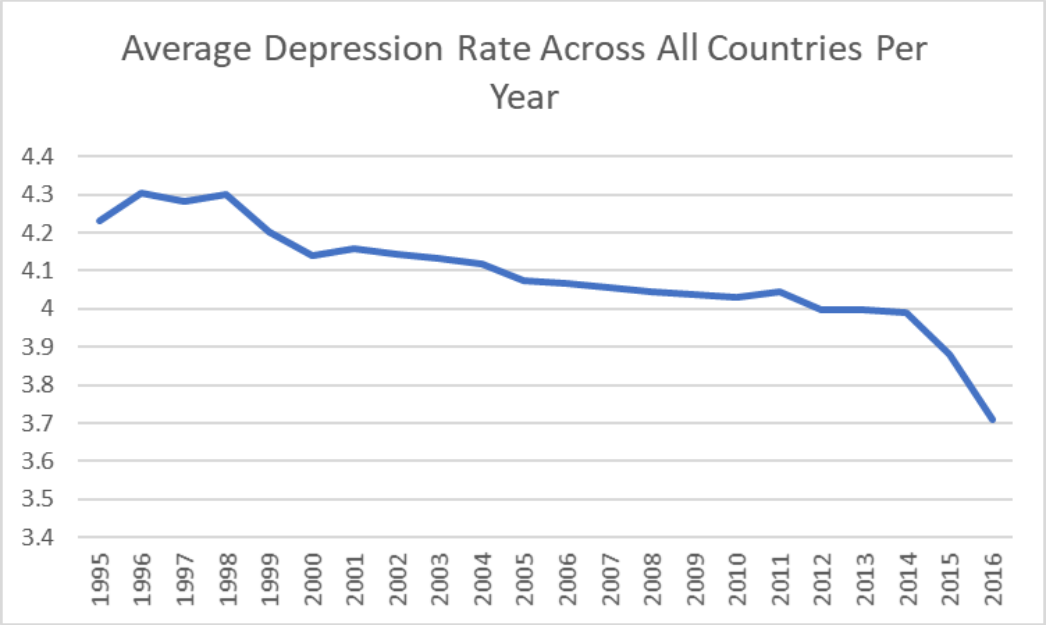

Figure 2.5 Average depression rates per year across all countries.

Unlike the suicide rate, the rate of depression falls consistently over time. The variance in the rate of depression is very small when compared to the variance in the suicide rate, and this may pose a problem when estimating regression coefficients.

2.4.1 A Note on Economic Freedom Index

The Economic Freedom Index is a measure of economic freedom published annually by The Heritage Foundation. All data used for this study relating to the Economic Freedom Index was taken from https://www.heritage.org/index/. In this site, economic freedom is defined as:

"*Economic freedom is the fundamental right of every human to control his or her own labor and property. In an economically free society, individuals are free to work, produce, consume, and invest in any way they please. In economically free societies, governments allow labor, capital, and goods to move freely, and refrain from coercion*

or constraint of liberty beyond the extent necessary to protect and maintain liberty itself."

The index takes a value between 0 and 100, with 0 indicating the lowest level of freedom and 100 indicating the highest level. The value of the index is calculated based on twelve different categories (property rights, government integrity, judicial effectiveness, government spending, tax burden, fiscal health, business freedom, labour freedom, monetary freedom, trade freedom, investment freedom and financial freedom). The overall index is then calculated as a simple average of the twelve values above. As economic freedom is quite vague and depends on several different characteristics of an economy, the regressions below are carried out with both the overall value as a variable and the index split into some of its constituent parts. Of the twelve factors above, eight are included in the regression. Judicial effectiveness, fiscal health and labour freedom are excluded as data is not available before 2004. Tax burden is also excluded, as this would correlate largely with government spending and would draw power away from the t-test. The eight factors included are defined below.

2.4.2 Property Rights

Average score of the following five: physical property rights; intellectual property rights; strength of investor protection; risk of expropriation, and quality of land administration.

2.4.3 Government Integrity

Takes account of public trust in politicians, irregular payments and bribes, transparency of government policymaking, absence of corruption, perceptions of corruption, and governmental and civil service transparency.

2.4.4 Government Spending

Simply the larger the spending, the lower the index score. In the regression, actual government spending levels are used instead.

2.4.5 Business Freedom

Various factors to do with ease of starting a business, obtaining licences, closing a business and the availability of electricity.

2.4.6 Monetary Freedom

Inflation over the last three years and price controls.

2.4.7 Trade Freedom

Tariffs and non-tariff barriers.

2.4.8 Investment Freedom

Many factors determine this, including expropriation of property, foreign investment, and capital controls. The more controls there are, the lower the index score.

2.4.9 Financial Freedom

This entails the following: the extent of government regulation of financial services; the degree of state intervention in banks and other financial firms through direct and indirect ownership; government influence on the allocation of credit; the extent of financial and capital market development, and openness to foreign competition.

More information on these measures is available on The Heritage Foundation website.

2.5 Regression Results

Suicide Regressions, Obs = 519				
Hours worked	-0.021 (0.003)***	-0.022 (0.003)***	0.011 (0.004)***	0.005 (0.004)
Part-time Workers (%)	-0.466 (0.053)***	-0.47 (0.054)***	0.0455 (0.074)	0.073 (0.073)
Wealth of top 10% (%)	3.553 (7.626)	2.559 (7.997)	-5.816 (7.439)	1.386 (7.401)
Real GDP per capita	-0.0002 (0.00003)***	-0.0002 (2.71E-05)***	-0.0004 (0.00004)***	-0.0003 (5.06E-05)***
Unemployment (%)	-0.364 (0.077)***	-0.41 (0.083)***	0.046 (0.042)	0.111 (0.043)**
Govt. Spending as % of GDP	-0.071 (0.065)	-0.075 (0.069)	-0.17 (0.039)***	-0.135 (0.042)***
Economic Freedom	0.099 (0.065)	0.071 (0.07)	-0.214 (0.041)***	-0.195 (0.044)***
Health Spending	-1.675 (0.26)***	-1.789 (0.281)***	0.942 (0.221)***	1.257625 (0.233)***
Country Fixed Effects (FE)	no	no	yes	yes
Time FE	no	yes	no	yes

Table 2.3 Suicide Regressions

Suicide Regressions with Economic Freedom Split into Constituent Parts, Obs=519				
Hours worked	-0.027 (0.003)***	-0.029 (0.003)***	0.008 (0.004)**	0.004 (0.004)
Part-time Workers (%)	-0.416 (0.053)***	-0.444 (0.054)***	0.035 (0.077)	0.039 (0.078)
Wealth of top 10% (%)	4.851 (8.218)	-3.653 (8.672)	0.308 (7.855)	2.434 (7.85)
Real GDP per capita	-0.0002 (2.74E-05)***	-0.0002 (2.82E-05)***	-0.0004 (3.96E-05)***	-0.0003 (5.38E-05)***
Unemployment (%)	-0.392 (0.081)***	-0.396 (0.084)***	0.056 (0.042)	0.113 (0.044)**
Govt. Spending as % of GDP	-0.086 (0.06)	-0.108 (0.062)*	-0.115 (0.04)***	-0.102 (0.041)**
Health Spending	-1.916 (0.279)***	-2.204 (0.289)***	0.821 (0.22)***	1.073 (0.24)***
Property Rights	0.023 (0.043)	0.052 (0.044)	-0.023 (0.02)	-0.034 (0.02)
Government Integrity	-0.118 (0.037)***	-0.118 (0.039)***	-0.064 (0.018)***	-0.059 (0.019)***
Business Freedom	0.159 (0.037)***	0.142 (0.039)***	-0.016 (0.016)	-0.003 (0.016)
Monetary Freedom	0.024 (0.064)	0.087 (0.071)	-0.038 (0.027)	-0.04 (0.029)
Trade Freedom	-0.233 (0.063)***	-0.438 (0.087)***	-0.117 (0.029)***	-0.065 (0.036)*
Investment Freedom	0.027 (0.033)	0.017 (0.034)	-0.028 (0.016)*	-0.02 (0.016)
Financial Freedom	-0.008 (0.025)	-0.024 (0.026)	-0.014 (0.013)	-0.01 (0.013)
Country FE Time FE	no no	no yes	yes no	yes yes

Table 2.4 Suicide Regressions with Economic Freedom Split into Constituent Parts

Depression Regressions, Obs = 519				
Hours worked	-0.0005 (0.0003)*	-0.0004 (0.0003)	0.0009 (0.0002)***	0.005 (0.004)
Part-time Workers (%)	0.016 (0.006)***	0.015 (0.006)***	0.0006 (0.003)	0.073 (0.074)
Wealth of top 10% (%)	2.285 (0.8)***	3.421 (0.821)***	0.361 (0.323)	1.386 (7.401)
Real GDP per capita	-3.45E-06 (2.76E-06)	-1.05E-06 (2.78E-06)	-0.00001 (1.59E-06)***	-0.0003 (5.1E-05)***
Unemployment (%)	0.013 (0.008)	0.025 (0.009)***	-0.0009 (0.002)	0.111 (0.043)**
Govt. Spending as % of GDP	0.017 (0.007)**	0.019 (0.007)***	-0.001 (0.002)	-0.135 (0.042)***
Economic Freedom	0.026 (0.007)***	0.039 (0.007)***	-0.005 (0.002)***	-0.195 (0.044)***
Health Spending	-0.009 (0.027)	0.042 (0.029)	0.026 (0.01)***	1.258 (0.233)***
Country FE Time FE	no no	no yes	yes no	yes yes

Table 2.5 Depression Regression

Depression Regressions with Economic Freedom Split into Constituent Parts, Obs=519				
Hours worked	0.0004 (0.0003)	0.0006 (0.0003)**	0.0006 (0.0002)***	0.0004 (0.0002)***
Part-time Workers (%)	0.006 (0.005)	0.008 (0.005)	-0.002 (0.003)	-0.001 (0.003)
Wealth of top 10% (%)	0.542 (0.804)	1.638 (0.85)*	0.322 (0.328)	0.414 (0.333)
Real GDP per capita	-8.89E-06 (2.68E-06)***	-6.58E-06 (2.76E-06)**	-0.00001 (1.65E-06)***	-5.67E-06 (2.28E-06)**
Unemployment (%)	0.031 (0.008)***	0.029 (0.008)***	0.0003 (0.002)	0.003 (0.002)
Govt. Spending as % of GDP	-0.007 (0.006)	-0.003 (0.006)	-0.0002 (0.002)	0.00006 (0.002)
Health Spending	0.014 (0.027)	0.039 (0.028)	0.023 (0.009)***	0.039 (0.01)
Property Rights	-0.003 (0.004)	-0.008 (0.004)*	-0.005 (0.0008)***	-0.006 (0.0009)***
Government Integrity	0.022 (0.004)***	0.022 (0.004)***	-0.0005 (0.0008)	-0.0004 (0.0008)
Business Freedom	0.013 (0.00361)***	0.0170137 (0.00384)***	0.0015766 (0.00063)**	0.0022348 (0.0007)***
Monetary Freedom	0.024 (0.006)***	0.018 (0.007)**	0.0006 (0.001)	0.002 (0.001)
Trade Freedom	-0.008 (0.006)	0.015 (0.009)*	-0.006 (0.001)***	-0.005 (0.002)***
Investment Freedom	0.009 (0.003)***	0.0117605 (0.00331)***	0.0001536 (0.00065)	0.0003741 (0.00068)
Financial Freedom	-0.01 (0.002)***	-0.009 (0.003)***	-0.0001 (0.0005)	0.0004 (0.0006)
Country FE Time FE	no no	no yes	yes no	yes yes

Table 2.6 Depression Regressions with Economic Freedom Split into Constituent Parts

"" = $p < 0.1$*

*"**" = $p < 0.05$*

*"***" $p < 0.01$*

Red asterisks indicate that the sign of significance has changed with the addition of fixed effects.

To summarise the above, sixteen regressions are carried out: eight each for suicide and depression. Firstly, four regressions are carried out with economic freedom as a single variable, one with no fixed effects, one with country fixed effects, one with time fixed effects and one with both fixed effects. Secondly, the same set of regressions are carried out again, this time with economic freedom split into its constituent parts. Finally, the same procedure is repeated for depression rates. It is possible that the inclusion of fixed effects, particularly the country fixed effects, may lead to underestimating the effect of some variables, possibly to the point of making variables with a significant effect appear to be insignificant. However, without the inclusion of these fixed effects, the regression results may be affected by omitted variable bias. This occurs if variables relevant to suicide and depression are not included but are correlated with any of the right-hand side variables above. In a later section, an alternative approach to the fixed effects model is outlined and the results of this method are discussed.

The most significant result from the above is with regard to GDP per capita. As we can see, real GDP per capita has a significant negative association with both suicide rates and on depression rates. Out of the sixteen regressions, GDP is a significant predictor of suicide/depression in fourteen. For suicide, GDP is shown to

have a significant negative association with suicide rates, including when any fixed effects are added. The impact of GDP found in this analysis contradicts the findings of other publications such as Noh (2009), who finds that GDP and suicide rates are positively correlated, and Ceccherini-Nelli and Priebe (2011) who find inconsistent effects from GDP. This may imply that higher GDP positively improves the lives of those who may be depressed or at risk of committing suicide. On a more theoretical level, this may imply that GDP per capita is a good proxy for utility/welfare. With regard to depression, without fixed effects/with time fixed effects only and with the Economic Freedom Index not split into its constituent parts, there is no significantly negative association found between GDP and depression rates.

Hours worked does not appear to affect a nation's suicide rate. Neither the raw number of hours worked, or the proportion of part-time workers have consistent effects in these regressions. Any significance from part-time work disappears with the addition of country fixed effects, while for hours worked the coefficient varies widely depending on which fixed effects are included. In this case it is hard to be certain whether or not these factors affect suicide and depression. It is not unreasonable to assume that significance of working hours may be found by further analysis containing individual level data. Such significant coefficients would not be found by examining country level data, as in this case.

For unemployment, the relationship with suicide is negative with no fixed effects but this becomes insignificant, or even positive, with the addition of country fixed effects. With respect to depression, interestingly, unemployment appears to be associated with increased rates, but is also sometimes insignificant. It is not possible to say if unemployment truly has any effect on depression and suicide rates or not due

to the inconsistency of the effect. Wealth inequality, as measured by the percentage of overall wealth held by the top decile, has no relationship with suicide rates and mostly seems to have no association with depression rates. With no country fixed effects, and with economic freedom not split into its constituent parts, wealth inequality appears to be associated with increasing depression rates. However, due to the disappearance of this association with the inclusion of country fixed effects there is not enough evidence to say that wealth inequality has any link with suicide rates or depression rates.

Government spending may reduce suicide rates but not depression rates. Out of the eight suicide regressions. a significantly negative correlations is found in five. Some of these non-significant results may come from the fact that government spending is included as a constituent part of economic freedom, so without the index being split out it is being included twice, which makes the value of the coefficient fall. When the index is split into parts, the government spending score is left out, specifically because government spending as a percentage of GDP is already included. The above regressions were re-run with government spending in dollars, as opposed to as a percentage of GDP, but this had no effect on the results. The effect of health spending is inconsistent, which may be partially due to reverse causality, where health spending is driven by suicide/depression rates, and not vice versa.

As a single variable, economic freedom appears to be associated with falling suicide rates when country fixed effects are included, but otherwise has no effect. For depression, there are both positive and negative significant associations found, depending on the inclusion of fixed effects. When economic freedom is split into its constituent parts, the only variables to have consistently significant associations with

suicide rates are government integrity and, surprisingly, trade freedom. Both of these variables are associated with a fall in the suicide rate. Trade freedom solely accounts for tariff and non-tariff barriers to trade, and it may be the case that trade freedom is correlated with another variable that is not included in the regression. For depression, business freedom is the only variable to have a consistent effect, where it appears to be associated with an increase the level of depression in a country.

As Lithuania has such a large suicide rate when compared to the rest of the countries in the sample, it could be responsible for incorrect results. It is possible that Lithuania's data points are being given undue weight in the regression analysis. To overcome this potential issue, the suicide regressions were re-run without Lithuania included, but this was found to not cause any changes in the significance of the variables.

2.6 Robustness Checks: Random Effects Model and Heteroskedasticty

There are many drawbacks to the Fixed Effects (FE) model used above to account for the effect of country and time on suicide and depression. The main problem with these models is that they tend to underestimate the significance of a variable, making t-stats fall below their true value. This may be the case if explanatory variables, such as GDP and unemployment in this case, are correlated with the country and/or year. Essentially, this means that explanatory variables are being included twice.

Bell and Jones (2015) state that "FE models effectively cut out much of what is going on - goings-on that are usually of interest to the researcher". The alternative method they offer is called Random Effects, or RE, modelling, which they argue is

"nearly always preferable" to fixed effects modelling. With fixed effect modelling, it is assumed that some characteristic of each observation, in the case of this paper the year and country, might impact other variables or outcomes. In this case, not including fixed effects could lead to omitted variable bias. Including fixed effects removes the effects of these characteristics. Random effects modelling, on the other hand, assumes that variation in the random effects associated with characteristics such as the year or country is not related to the other explanatory variables. A Hausman Specification test can be used to determine whether a RE or FE model works best for a specific dataset.

A Random Effects model was run for both depression and suicide, with economic freedom as itself and split into its constituent parts. The results of the Random Effects model did not differ significantly from the results of the fixed effects model. See Table 2.8.

A Breusch-Pagan Lagrangian Multiplier Test was used to find whether or not heteroskedasticty is present in this data. It was found that there was heteroskedasticity present, meaning that the OLS model is not the best linear unbiased estimator, as it does not meet all the assumptions of the Gauss-Markov theorem. In this case, a weighted least squares estimator can be used, or standard errors can be adjusted to be "robust", meaning the estimator and estimated standard errors are consistent. The above models were run with robust standard errors but there was no change in the significance of the right-hand side variables. For robust standard errors see Table 2.7 below.

Suicide Regressions with Robust Standard Errors, Obs = 519		
Hours worked	-0.021 (0.004)***	0.01 (0.004)***
Part-time Workers (%)	-0.466 (0.044)***	0.045 (0.082)
Wealth of top 10% (%)	3.55 (8.698)	-5.816 (8.432)
Real GDP per capita	-0.0002 (0.00002)***	-0.0004 (0.00006)***
Unemployment (%)	-0.364 (0.085)***	0.046 (0.044)
Govt. Spending as % of GDP	-0.071 (0.077)	-0.17 (0.05)***
Economic Freedom	0.099 (0.06)	-0.214 (0.05)***
Health Spending	-1.675 (0.184)***	0.942 (0.253)***
Country FE	no	yes

Table 2.7 Suicide Regressions with Robust Standard Errors.

Red asterisks indicate a change in the sign of significance

Random Effects Model, Obs = 519		
	Suicide	Depression
Hours worked	0.009 (0.004)**	0.0008 (0.0002)***
Part-time Workers (%)	0.061 (0.07)	0.001 (0.003)
Wealth of top 10% (%)	-9.665 (7.177)	0.295 (0.322)
Real GDP per capita	-0.0004 (0.00004)***	-0.00001 (1.59e-06)***
Unemployment (%)	0.029 (0.042)	-0.001 (0.002)
Govt. Spending as % of GDP	-0.148 (0.04)***	-0.0009 (0.002)
Economic Freedom	-0.217 (0.042)***	-0.005 (0.002)***
Health Spending	0.685 (0.216)***	0.023 (0.01)***

Table 2.8 Random Effects

Another potential issue which may arise is that of multicollinearity. This refers to a situation in which some, or all, of the explanatory variables are strongly related, meaning that the independent variables in the regression are not actually independent at all. This can cause many different issues, such as increasing variance and covariance, affecting the standard error or increasing the R-square.

In order to test for the presence of multicollinearity, we calculate the Variance Inflation Factor (VIF) of each independent variable. To calculate this a regression is run for each independent variable, with it now being positioned as a

dependent variable, and the rest as explanatory variables. For example, if there is a regression specified as $Y = a + bx_1 + cx_2 + dx_3 + \varepsilon$, x_1, the independent variables are x_1, x_2 and x_3. Too calculate the VIF score for x_1, first run the following regression:

$$x_1 = \alpha + \beta x_2 + \gamma x_3 + \varepsilon$$

Then, calculate the VIF as equal to $\frac{1}{1-R^2}$. The R^2 shows the proportion of the dependent variable that is explained by the independent variables. A low R^2, and hence, a low VIF, implies that multicollinearity is not present.

Variable	**VIF**
Government Spending	2.74
Hours Worked	2.53
Economic Freedom	2.31
Part Time Percentage	2.17
GDP	1.97
Health Spending	1.84
Unemployment	1.51
Wealth % held by top 10%	1.35
Mean VIF	2.05

VIF, Economic Freedom as one variable

Variable	VIF
Government Integrity	6.74
Property Rights	5.51
Hours Worked	3.04
Government Spending	2.47
Part Time Percentage	2.34
GDP	2.26
Health Spending	2.23
Investment Freedom	1.95
Financial Freedom	1.86
Unemployment	1.77
Business Freedom	1.73
Monetary Freedom	1.70
Wealth % held by top 10%	1.65
Trade Freedom	1.58
Mean VIF	2.63

VIF, Economic Freedom split into constituent parts

2.7 Conclusion

Suicide and depression are significant issues facing society. According to the CDC (CDC, 2019) in 2017 suicide was the 10th highest cause of death in the US with over 47,000 people ending their own life. Often, it is young people who commit suicide, making it the second highest cause of death among those aged 10-34. As a comparison, in the same year, 2017, homicide accounted for just over 19,000 deaths, less than half the amount due to suicide in the US. Often, but not always, it is those who have some form of mental illness, such as depression, who end their own lives. While depression itself does not guarantee a suicide will occur, it is in and of itself a notable problem in addition to the potentially lethal outcome. Simon et al. (2000) show that people with depression whose symptoms improve greatly are more likely to hold down a job and miss less days working than those who do not improve as much. This potentially means that depression leads to less productive workers. It is evident, then, that suicide and mental health issues are a substantial social problem and may well be of interest to policymakers.

Determining the source of suicide and depression is of utmost importance to policymakers formulating strategies to tackle this problem. Not only this, but we also must consider the relative importance of economic indicators in terms of social well-being when setting economic policies and goals. If we can take depression and suicide as a proxy for "happiness" levels or economic well-being, we may be able to use suicide and depression statistics to determine which economic indicators matter most to improving welfare.

The key finding of this study is that as GDP per capita increases, depression rates and suicide rates both fall. This finding is robust to the inclusion of fixed effects,

random effects, and a range of other robustness checks. This may imply that GDP per capita is a good indicator of overall welfare in a society and that a government which is welfare maximising is justified in targeting GDP growth. Not only is this good economic policy, it can also be considered to be a good mental health policy.

Other variables considered in this study (unemployment, hours worked, economic freedom etc.) have fewer clear links with the rates of depression and suicide in a country and vary greatly dependent on the inclusion of fixed effects. With that said, it would not be prudent to state with any great degree of certainty that any of these variables do or do not influence suicide or depression. It may be of use to look at individual level data to find the effect of poverty and unemployment/working hours on suicide and depression levels.

Indeed, further research on this topic needs to be undertaken. It may be possible to expand this question beyond the scope of this study by including data from more countries and possibly with additional explanatory variables, such as alcohol intake levels, climate, wage levels, labour laws, and others.

2.8 Appendix

The tables below show the mean values of each variable for each country included in the data.

	Years	Hours Worked Mean	Part Time % Mean	Top 10% Share Wealth Mean	GDP Mean
Australia	2001-2015	1711.431425	24.37848419	30.14857143	40497.637
Austria	1995-2016	1587.545455	15.95035054	27.44909091	40925.093
Belgium	1996-2015	1568.394	17.93658681	28.011	38948.877
Switzerland	1996-2015	1656.75	26.17999347	30.755	53013.294
Chile	2013-2015	1997.666667	16.78169916	54.0201011	22236.73
Czech Republic	1995-2016	1814.363636	3.721273573	28.22454545	25306.464
Germany	1995-2015	1428.042857	19.78897404	33.25333333	38663.041
Denmark	1996-2015	1438.35	17.53855352	27.6085	43304.174
Spain	1995-2015	1730.042857	10.16241813	29.24238095	30817.402
Estonia	2000-2015	1889.3125	7.641183875	33.680625	23008.486
Finland	1996-2015	1594.7	11.39340844	27.9485	37341.43
France	1995-2014	1537.7825	13.80216187	32.8865	35490.226
United Kingdom	1995-2015*	1518.15	23.46517174	33.952265	35210.551
Greece	1995-2015	1943.904762	7.923273424	30.67952381	26386.514
Hungary	1995-2016	1795.740909	3.704845881	25.92409091	20885.113
Ireland	1998-2014	1765.647059	20.84732492	30.92647059	43513.47
Italy	1995-2015	1806.564286	14.30657232	28.85619048	35934.901
Japan	2005-2010	1760.333333	19.18839923	42.21866667	35807.129
South Korea	2008-2015	2122.625	10.66038287	42.82722383	31342.598
Lithuania	1998-2016	1611.210526	8.194405876	30.78631579	19745.325
Luxembourg	1996-2015	1556.65	13.68571274	30.3665	85874.922
Latvia	2000-2015	1743.25	7.383034837	31.56875	18193.195
Netherlands	1996-2016	1441	34.83422495	26.20571429	43409.233
Norway	1996-2015	1432.455	20.384426	27.203	60715.005
Poland	1999-2015	1844.411765	10.02895741	36.85941176	19331.236
Portugal	1995-2014	1724.529412	10.12668184	33.64058824	25622.857
Slovakia	1995-2014	1789.411765	2.633954636	24.03235294	19575.274
Slovenia	2000-2015	1686.15625	7.457979416	25.324375	27301.544
Sweden	1995-2016	1464.954545	14.18827561	26.67954545	39888.533

**, indicates 2000 is missing from the data*

	Unemployment Mean	Health Spending Mean %	Economic Freedom Mean	Property Rights Mean	Govt Integrity Mean	Business Freedom Mean
Australia	5.477142811	6.329736676	80.71428571	90	86.26428571	88.73571429
Austria	5.056818203	7.452763232	69.43636364	90	79.02272727	73.50909091
Belgium	7.928499913	6.912140095	68.21	85.5	69.66	81.01
Switzerland	3.940999997	1.810910297	79.32	89	88.205	75.225
Chile	6.460000038	3.635132669	78.73333333	90	71.76666667	69.7
Czech Republic	6.389545462	7.194361767	68.97272727	70	46.74090909	74.63181818
Germany	8.024285589	6.569563592	69.8	90	80.14761905	79.43333333
Denmark	5.511000037	7.601694984	73.57	90.5	94.735	93.74
Spain	16.70904764	5.679098332	66.92857143	70	61.88571429	73.84761905
Estonia	9.801249921	4.687151674	75.7625	79.0625	61.7	81.875
Finland	9.788499975	6.892258862	70.945	90.25	94.22	84.595
France	9.663999915	7.499939971	61.5	72.5	71.245	80.755
United Kingdom	6.325499964	6.289562603	77.16	89.5	83.72	89.485
Greece	13.38285719	5.723235396	59.38095238	55.71428571	43.86666667	72.29047619
Hungary	8.066818194	5.240459077	63.57272727	67.04545455	50.02727273	73.38181818
Ireland	7.880000044	6.451347261	79.2	90	76.63529412	88.01176471
Italy	9.757142771	6.503562032	61.73809524	60.95238095	48.69047619	73.95238095
Japan	4.421666702	6.499381938	72	71.66666667	72.66666667	84.46666667
South Korea	3.428750038	3.740361609	69.9125	70.625	53.75	90.9625
Lithuania	11.60052636	5.574742992	69.43684211	53.68421053	45.25789474	77.22105263
Luxembourg	4.138499987	4.53454436	75.445	90	85.955	80.17
Latvia	12.33249995	3.869857549	66.64375	50.9375	41.1	73.75
Netherlands	4.587142854	6.305002841	73.53809524	90	88.04761905	79.22857143
Norway	3.669500017	7.383724573	68.295	90	87.555	80.04
Poland	12.82117653	4.504844567	62.21176471	59.11764706	44.92941176	64.47647059
Portugal	8.37941188	6.510148189	64.33529412	70	63.94705882	75.38235294
Slovakia	14.75882351	5.986199818	62.28823529	51.47058824	43.69411765	71.14705882
Slovenia	6.96875006	6.520985105	60.99375	56.875	60.0625	81.075
Sweden	7.234090881	6.522561234	68.87727273	84.77272727	91.83181818	81.76363636

	Monetary Freedom Mean	Trade Freedom Mean	Investment Freedom Mean	Financial Freedom Mean	Govt Spending Mean
Australia	84.03571429	82.50714286	76.07142857	90	34.69370866
Austria	83.94545455	81.96818182	74.54545455	72.72727273	51.89268039
Belgium	83.01	82.68	81.5	71.5	51.66297497
Switzerland	87.125	85.09	74.5	83	33.62628652
Chile	84.76666667	82	88.33333333	70	23.96581241
Czech Republic	79.90454545	80.88181818	71.36363636	85.45454545	43.04852938
Germany	84.43809524	82.47619048	82.38095238	58.0952381	46.36054982
Denmark	86.58	82.68	78.25	83.5	54.17213183
Spain	80.1952381	82.44761905	73.57142857	70.95238095	41.87443614
Estonia	80.36875	85.8625	90	82.5	37.35160879
Finland	84.925	82.23	74.75	68.5	52.34591969
France	82.02	80.17	55.25	57.5	54.30505284
United Kingdom	81.14	82.68	81	87	40.89144418
Greece	75.64285714	80.3047619	59.76190476	45.23809524	49.0004767
Hungary	73.16363636	77.87272727	72.27272727	68.63636364	49.52467511
Ireland	83.05882353	82.95294118	86.76470588	81.17647059	38.49889962
Italy	82.28571429	81.73333333	72.61904762	62.85714286	48.88511512
Japan	91.78333333	80.9	60	46.66666667	37.11106652
South Korea	79.2625	71.075	70	70	32.37509957
Lithuania	79.22105263	84.56842105	73.42105263	73.15789474	37.25754823
Luxembourg	83.5	82.98	86.5	80.5	41.59587276
Latvia	78.93125	84.0625	74.375	61.875	37.45348002
Netherlands	83.45238095	82.93333333	85.23809524	86.19047619	44.24889327
Norway	80.39	84.045	61.75	53.5	44.79151013
Poland	76.51764706	81.74117647	61.47058824	62.35294118	43.87224078
Portugal	81.58823529	82.41176471	68.82352941	53.52941176	45.96386764
Slovakia	74.19411765	78.8	66.47058824	64.70588235	44.08302396
Slovenia	78.1375	80	61.25	50	47.39774697
Sweden	85.27272727	82.73636364	81.59090909	75.90909091	53.33517231

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3 Political Donations

3.1 Overview of Literature

In a democratic system, it is assumed, or perhaps hoped, that the electorate drive changes in policy positions of governments. Electoral competition should lead to the majority view prevailing on all issues, provided voters vote for the party which best represents their interests. However, special interests such as corporate donors or a wealthy elite, may also influence policy positions through donations, lobbying or simple bribery. There has been much work on the purpose of political donations, with some arguing it is used as a means of affecting policy, while others argue that the purpose is to support those who donors already agree with ideologically. Others still put forward the idea that donations are used as a means of gaining access to a politician and can actually be beneficial as lobbyists or insiders use this access to share information with politicians. The implications of donations and their effects is of huge importance for policymakers. If donations or bribes can shift the policy position of a candidate or party, this may lead to a democratic deficit with citizens left unhappy with the governance of the nation. Conversely, if donations are mainly used simply as a means of supporting a preferred candidate or to gain access, the implications for policies will differ greatly. Legislation relating to political donations and campaign financing must be based on the best available evidence of the effect these donations have on policy positions and the behaviour of politicians. While it may not be the place for economists and other academics to dictate what an optimal democracy should look like, individual opinions and goals can be guided by the evidence put forward, and if a certain path is decided on, academics can provide evidence to show the effects of such a path.

While private donations have always been a feature of democratic governance, the role they play is still hotly debated and there is a vast empirical literature on the subject. Many articles have been published claiming that donations can influence policy decisions. Johnson and Livingstone (2020) examine campaign contributions from the Australian gambling industry. They find evidence for a link between donations and policy positions, showing that the timing of donations indicated that they were being used to influence legislation. Fang et al. (2016) experimentally examine the effects of different donation transparency regimes and find that different systems lead to different policy outcomes. A system where neither the public nor the candidate are aware of the identity of donors leads to a situation where donors cannot affect policy positions. Stratmann (2002) analyses legislators votes on financial services regulation, finding that changes in donations can cause a change in voting behaviour of legislators. Junior legislators are found to be more responsive to these changes. Stratmann (1998) finds that the timing of political action committees' (PACs) contributions indicate vote buying, and that contributions are larger when important legislation is being considered. Davis (1993) finds that under certain favourable circumstances, namely when there is low visibility of the issue in question and little competitive pressure between lobby groups, it is possible for PACs to exert a degree of influence over roll call votes. As well as roll call votes, lobbyists and donors may attempt to influence the writing of legislation at the committee stage. This is the topic of study of Powell and Grimmer (2016). The study uses "exile" of representatives from committees, where representatives lose their seat on a committee after their party suffers electorally, to analyse the effect of donations. They find that exiled legislators receive less donations that those who retain their place on the committee, implying that donors target those with the power to influence policies. Fellowes and Wolf

(2004) find that the ability of PACs and individual donors to influence policy depends on the type of policy in question. They find that businesses can influence policy when it comes to taxation and regulation but lack the ability to do so on the issue of government expenditures which benefit businesses. Grossmann (2012) uses quite a different method from others to tackle this issue, analysing the views of policy historians to determine the effect of donations on policy. He finds that donations may have a large influence but that many methods utilised in the literature would be unlikely to find it. Giger and Klüver (2016) compare voter preferences on certain issues with their representatives voting patterns on the same issues. They do this by examining votes in Swiss referenda and find that voter preferences and representatives votes differ, partially caused by the influence of interest groups. Persson and Tabellini (2002) find that campaign contributions can have an effect on policy positions, specifically they show that higher contributions made it more likely for representatives to support the Emergency Economic Stabilization Act. Gordon et al. (2007) identify two possible motivations for donating; investment, and consumption. They reason that if donors are motivated by personal gain, donations will be larger from companies where executives' pay is dependent on their company's earnings, and they find that this is indeed the case. This implies that the investment motivation for donations is dominant.

On the opposite side, there have been many empirical works which contradict the hypothesis that donor money can influence policies. These publications often argue that the main purpose of donations is not to influence policies, but, instead, to support a preferred candidate or gain lobbying access to a politician. Milyo et al. (2000) suggest that the extent to which PACs can influence candidates' policy positions has been grossly overstated, as they point out only a small fraction of donations come from

PACs and very few PACs donate the legal maximum. The issue of causality makes it difficult to determine why donors donate, as it is hard to ascertain whether policy position causes donations or donations cause policy positions. Bronars and Lott (1997) provides an innovative solution to this problem, arguing that if politicians are in their final term of office, they have less incentive to vote in the interests of their donors, as they no longer must worry about capturing future donations. If final term voting patterns differ from previous terms, then politicians are being paid to change their policy positions. If voting patterns do not differ then it is likely that donors are donating to help those they already agree with ideologically. They find that campaign contributions are not used to buy votes. Wawro (2001) uses a probit model with the inclusion of random effects to solve the problem of possible reverse causality and finds no evidence to suggest that donors are purchasing votes. Grenzke (1989) analyses the contribution of 120 PACs and finds no evidence to indicate that contributions affect votes. Dow and Endersby (1994) examines the contributions of interest groups in California, a state which, as of 1994, had no maximum level of donations. The idea behind this is that if donations have an effect anywhere it should be in a state where donors can spend freely. They find no effect of donor money on roll call votes. Nichter (2014) looks at the "vote buying" literature and finds that different publications have different definitions of what this phrase means. He finds that different definitions can lead to different empirical results.

One alternative motivation suggested for donations is gaining access to politicians. Kalla and Broockman (2016) set up an experiment where 191 congressional offices were contacted to arrange a meeting. One group was set as the control, and in this case the offices were not informed that the group requesting the meeting was a donor. The second group of offices were informed that the group was

a donor. Policy makers were over three times as likely to agree to a meeting when they were informed that the group in question was a donor. Brunell (2005) states that as many groups donate to more than one party, for example donating to both Republicans and Democrats in the US, that access must be an important motivation behind donating. However, at the same time, he argues that donors do have a preference for one party over others, which is shown by certain groups donating token amounts to parties they dislike, and amounts intended to achieve electoral success to preferred parties.

To complement the extensive empirical work in this area, there is an equally large body of theoretical work. Fundamental to the question of donations and bribery is why voters vote for a certain candidate, and this can largely be broken down into two separate schools of thought, spatial models and valence models. Spatial models operate under the assumption that voters vote for the candidate or party which has policy positions most similar to their own. For example, if policy position on a given issue could be represented as a number between 0 and 1, candidate A has policy position 0.5 and candidate B has policy position 0.75, a voter with optimal policy 0.25 would always vote for candidate A. These models build on the work of Hotelling (1929) and Downs (1957). In valence models, it is assumed that, for voters, issues of ideology are secondary to the performance or competence of candidates. Valence issues are those in which a large majority of voters agree on, such as the belief that economic growth or reduction of crime is a positive. In these models, voters care more about how well politicians can achieve positive outcomes in valence issues rather than their position on divisive issues such as gun control, abortion, environmental protection, or tax policy. Valence issues were first studied in this context by Stokes (1963). Whether or not valence models or spatial models are correct matter greatly for

this issue, as it may affect the extent to which donors can influence policy matters. In reality, it is likely that both valence issues and ideological positions play a role.

Austen-Smith (1987) mentions two motivations for donations: aiding a candidate with similar views in their bid for election and influencing candidates' policy positions. These may not be mutually exclusive. In the model, competing interest groups donate solely to aid the election of their preferred candidate, however, candidates themselves account for this when setting their policy positions. To secure donations, candidates may set policy positions close to donors' preferences. While donors are not explicitly trying to influence policy, their contributions may have that effect regardless. The main difference from this model type and what the author calls "explicit exchange models" is that candidate policy positions do not tend to vary wildly. Grossmann and Helpman (1996) creates a model which allows interest groups to donate unconditionally or on the condition that a candidate sets policy positions in a certain way. Donating unconditionally is motivated by affecting the result of the election in favour of a preferred candidate while donating with conditions is motivated by a desire to influence the policy position of a specific candidate. Donations are used by parties to sway uninformed voters. Informed voters, on the other hand, vote for the candidate which best represents the general interests of the population. Candidates can gain votes by aligning with the general interest and winning informed voters or move away from the general interest in order to gain donations to sway uninformed voters. With a single interest group, donations flow to the most popular party which in turn chooses policy positions in line with the wishes of the interest group. The party does at least as well, electorally, as it uses the contributions to win the votes of the uninformed group. Baron (1994) was the first to introduce the informed vs uninformed voters model, and divides potential equilibria into two policy categories, particularistic

equilibria and collective equilibria. Particularistic equilibria lead to candidates separating if the proportion of uninformed voters is high enough. Collective equilibria see all candidates locating themselves at the median of voters' preferences. Snyder (1991) creates a model where lobbyists buy votes on bills and finds that the largest bribes are paid to representatives which are only slightly opposed to the vote rather than those who are strongly opposed.

Rasmusen and Ramseyer (1994) look at the fact that the value of bribes received by officials in exchange for favours seem almost trivially low. So low, in fact, are these bribes that in many cases they do not even cover the expected cost to the official of taking the bribe. They give many examples to show this, such as the case of Georgia legislators in the 1790s selling 35 million acres of public land far below the market price at $500,000. For this, legislators only received $1000 each. To account for this paradox, they create a model in which legislators are punished by the electorate for bad legislation even if they personally voted against it. This creates a scenario where actions are driven by the expectation of what others are going to do, similar to the bank run model in Diamond and Dybvig (1983). If an individual legislator expects other legislators to vote in favour of an unpopular piece of legislation, she knows she will be punished regardless of her own vote, hence she will vote yes on the legislation in exchange for even an infinitesimally small bribe. In this sense, low bribes arise from a coordination failure among legislators and under an autocratic government bribes would have to be higher to succeed.

If contributions to politicians have an effect on candidates' policies, there may be an argument for strengthening campaign finance laws to prevent wealthy donors from exerting undue influence over the democratic process. Coate (2004) develops a model to determine the effect of campaign finance laws on social welfare. He finds

that even under the optimistic assumption that candidates use campaign contributions to convey accurate information to the electorate, that it is still Pareto optimal to put a limit on campaign contributions. This of course implies that under less optimistic assumptions, it is also Pareto optimal to limit donations. Stratmann and Fransisco (2006) analyse the effects of campaign contribution restrictions on the outcomes of Assembly elections between 1980 and 2001. They find that these restrictions lead to closer races and a greater number of candidates.

Groseclose (1996) looks at the purchase of political influence from a different point of view, where favours are given by party leaders to members of their party to induce them to vote a certain way. This is sometimes referred to as "horse-trading" or "back-scratching". In many parts of Europe and other regions, there is a party whip system in place, which prevents party members from voting against the party line. As such, it is likely that this type of favour trading is more prevalent in the US. The author develops a model of this favour trading and tests it empirically, finding that this trading was present.

An important factor in preventing corrupt behaviour among politicians is the existence of a mechanism to punish this behaviour. While many activities seen as corrupt are explicitly illegal, it may be possible for politicians to evade these rules and still accept money in exchange for favours. In such a case, the only possibility of punishment is during elections, where corrupt politicians, if found out, may lose their seat. Winters and Weitz-Shapiro (2013) look at when and why voters are willing to support corrupt politicians. They survey citizens in Brazil and find that the vast majority of voters have a strong desire to punish corruption, implying that if corrupt officials are voted back into office, it must be due to a lack of information. Ferraz and Finan (2008) examine the effects of anti-corruption audits in Brazilian municipalities.

They find that the outcomes of the audits had a significant effect on the electoral performance of the incumbent candidate, providing more evidence that greater information leads to corrupt behaviour in politicians being punished by the electorate. Easier access to credible information should then lead to voters voting against corrupt politicians. However, another effect of corruption may be to cause potential voters to withdraw from the political process altogether, due to loss of faith in the system as a result of the revealed corruption. Chong et al. (2015) use a field experiment in Mexico to show that while information of corruption will reduce support for the incumbent candidate, it also decreases voter turnout. In this sense, corruption has a double effect on the degradation of representative democracy. Firstly, the direct effect of subverting the will of the people, and secondly an indirect effect of reducing voter turnout and so making the government even less representative of the wishes of the electorate. Zechmeister and Zizumbo-Colunga. (2013) use an OLS regression and find that citizens are more concerned about perceived corruption during times of poor economic conditions. Krause and Méndez (2009) find that the type of democratic system in place affects how voters punish corruption. Less democratic nations react negatively to corruption while no punishment effect is found for more mature democracies.

The literature on political donations, lobbyists influencing politicians, potential corruption, and bribery is quite large and diverse and contains innovative treatments empirically and theoretically. Many studies contradict each other and there are no hard and fast answers. It is clear that more work in this area could be fruitful and provide additional insights. Many empirical studies show that special interest groups do buy votes with donations and bribes, however on the other side many studies show the opposite, that vote buying is not occurring. It may be that vote buying happens under some circumstances, but not under others, and if this is the case,

ascertaining which circumstances lead to vote buying could be an area worth exploring. There are also a variety of potential motivations suggested for donations, vote buying being one but also it is possible that donors are simply aiding their favoured candidate. One who they ideologically agree with already and so do not need to influence their positions. It is even possible that there is a less cynical reason for donations, that donations are simply a consumption good given with no strategic intentions in mind, neither to influence candidates policies nor to change who wins. The theoretical literature is similarly rich, with varying reasons given for donations and many different answers to the effect of these donations. Many put forward the idea that it is competence on valence issues that drives electoral success, and not ideological choices. Other studies consider the importance of policy positions on voters both informed and uninformed, and the extent to which a well-financed campaign can sway both types of voters. Finally, the idea of electoral punishment of corrupt politicians is examined. Such punishment is crucial to a democratic system, as if it is not present it could incentivise office holders to engage in corrupt behaviour and subvert the democratic process. This punishment effect appears to exist, implying voters dislike corruption, but similarly a release of information on corruption can make voters lose faith in the democratic system and refrain from voting in future elections.

3.2 Can Private Donations Influence Policy Positions Against the Public Good?

Abstract

This chapter examines the influence of campaign contributions to political parties on policy positions. Assuming donors and voters are in total opposition to each other, and there is no dissension of opinion among these groups, is it possible for donors to shift policy positions against the will of citizens? This question is examined

in the case of dictatorship and a two-party democracy. Dictatorship regimes enjoy significant scope to implement policies in line with the will of financial backers, whereas electoral competition in a democracy mitigates this possibility. If donors can commit to a policy cut-off position, beyond which donations are zero, or a minority of voters agree with donors, this reverses the previous finding and donations can exhibit a strong influence on policy. In fact, a small minority voting with donors' interests can cause large policy shifts. It is also shown that in a repeated game, it is possible to sustain party collusion in equilibrium given the right circumstances, leading to voter views on policy being ignored completely.

3.3 Introduction

Campaign finance and political donations have been a hot topic ever since the Citizens United ruling in the US found restrictions on donations to be unconstitutional. The upshot of this was that wealthy individuals and corporations faced no limit on the level of money they could donate to political candidates. Those opposing the legality of large donations argue that allowing such money to change hands gives undue power to the wealthy to influence policy decisions in their favour, as, presumably, they are getting something in return for their donation. On the opposite end, supporters of Citizens United argue that regulating political donations amounts to an attack on the right to freedom of speech, and hence an attack on the US constitution itself. This topic is not just of interest to the United States, as campaign finance laws and political donations are a feature of democratic systems across the globe. Lobbying of government officials and donations to candidates to swing the political agenda in their favour is widespread and is a concern for many throughout the world. It may even be argued that such activities have the potential to severely harm the democratic process if wealthy donors have a disproportionate effect on government policy. This can all

lead to a “Democratic Deficit”. Such a deficit is present when policy positions do not reflect the views of voters, or a majority of voters. The existence, or lack thereof, of such a democratic deficit is crucial to determining the role and effect of donations. Lax and Phillips (2011), find that such a deficit exists in the US, as policy reflects the will of the majority only about half the time. Rudenkova (2014) suggests that self-regulation of the lobbying industry has not reduced the democratic deficit in the EU, but that legal limits on lobbying activity may reduce it. Meirowitz (2008) states that a problem with campaign finance limitations is that they generally increase the likelihood of an incumbent winning. Pastine and Pastine (2012) also state that campaign finance reform increases the probability of an incumbent victory, but only insofar as the challenger is not making a more efficient use of campaign spending. Leong et al. (2012) contends that, from a utilitarian perspective, a ban or cap on donations is an optimal policy if it satisfies the rational concerns of society with regard to the influence of donors. To this end they find that lobbyists should be completely banned from donating small gifts. It is also worth considering how efficiently voting can translate the views of society into policy. In Arrow (1950), the concept of the impossibility theorem was first discussed. This stated that with three or more choices in a system that gives a ranked outcome, no voting system can satisfy all of the following conditions:

- if every voter prefers A to B, then the group prefer A to B
- no single voter can determine the group’s preferences, and
- if every voter's preference between A and B remains the same, the group’s preference also remains the same

This implies that even without donors influencing policy, it may not be possible to have a democratic system which truly represents its citizens

Finally, there are articles which consider campaign financing as a signal to voters on the quality of the candidate or party. Prat (2002) models an interest group with inside information on the quality of a candidate which donates only if the information is positive. Potters et al. (1997) find that campaign expenditure may convey important information on candidates to voters.

Contained in this chapter is a theoretical treatment of political donations and the effect they can have on government policy. In the model there are three groups: voters, donors and political parties. The parties run for election and must choose their position on a variety of issues. Meanwhile, the voters and donors are considered each as being of a single block, all donors have the same optimal policy position, as do all voters. Voters and donors are diametrically opposed on these issues, with voters voting for the party closest to their beliefs and donors donating money to parties to shift the party further towards their preferred position. The purpose of this is to ascertain if it is possible for donors to influence policies in their favour against the public good. In later sections, the effect of a split in voter aims is examined, significantly affecting results. This approach contrasts with that taken by previous publications such as Ball (1999) and Austen-Smith (1987), where voters, donors or both are split on their optimal policy position.

For donors, it is not just enough for parties to support their preferred policies, rather they require parties to support their policies and to also win enough votes to have an influence on policy. Taking the example of a parliamentary democracy, for a party to be attractive to donors they should not only support donors' preferred policies but also win enough seats in parliament to have a reasonable chance to implement these policies. This assumption is central to the model as it allows competitive pressures to drive parties closer to the goals and aims of voters.

Donations do not influence votes in this model, instead donations are viewed as a separate desirable outcome to parties of policy positions. This differs from models such as Grossman and Helpman (1996), and Dunaway and Munoz-Garcia (2019) where donations are simply a means to an end, used to capture extra voters in a Public Relations campaign. Donations here stand on their own merit and are viewed as a positive in their own right and can be thought of as a gift to the party, where the monetary value of these gifts is directly pocketed by candidates and used to enrich themselves personally, rather than used to finance a campaign. It is probable that such a model makes it less likely for donations to affect public policy, as parties are not forced to rely on donors to win votes. Hence, if the model finds that donations effect policy, it is a stronger result than in models assuming donations are used to sway voters. On one hand we can think of this as lobbyists taking politicians for expensive dinners or other events, while a more cynical reading of this would be to think of these donations as simple bribes. "Bribes" is used here in the same sense as Rasmusen and Ramseyer (1994), meaning payments to politicians in exchange for specific favours, in this case altering policy position, regardless of legality. Again, another interpretation may be that these donations come in the form of job opportunities once a candidate's time in office has ended. For these reasons, the model may be particularly useful in analysing the effects of corruption and bribery of politicians. Parties are not motivated solely by electoral success, unlike in Downs (1957), and have a secondary concern in the form of monetary reward from donations.

The model in this chapter is a modified and extended version of the model in Ellman and Germano (2009), a study examining the effect of newspaper advertising on the accuracy of articles. In that publication, advertisers may wish for certain stories or aspects of those stories to not be accurately reported on, as it may reduce possible

profits of the advertising firms. In this chapter, advertisers are replaced by donors, readers by voters and newspapers by political parties. One of the most important early studies in this field is Downs (1957), a spatial model where policy is modelled along a line, taking inspiration from Hotelling (1929). In Downs' study, it is shown that all candidates will converge on policy position, at the position of the median voter. Welch (1974) was one of the first to examine the economics behind campaign financing. Austen-Smith (1987) creates a model in which campaign donations have a possible effect on policy position and benefit one of two interest groups. Ball (1999) introduces a model where candidates take account of the effect their chosen policy position has on the donations of their opponents. Grossman et al. (1996) identify two motivations for donating, to shift policy position and to aid a party in their election. They find that a party which expects to win a majority, caters more towards special interests and less to voters. This chapter only considers one of these motivations, shifting the policy position of parties, which leads to a different model than much of the literature. In some ways this could be considered a bribery model as well as a donation model. Baron (1994) distinguishes between informed and uninformed voters. Campaign financing can be used to convince uninformed voters, but informed voters decide solely on policy positions. Barber et al. (2016) find that individual donors are more likely to donate to candidates they agree with on policy, perhaps implying donors are more likely to be informed individuals. Herrera et al. (2008) argue that increasing volatility in voter preferences causes campaign finance spending to increase. Coate (2004) argues that campaign financing limits will cause a Pareto improvement to society. Snyder (1991) shows that bribes are more likely to be paid to legislators who are only slightly opposed to an issue, as opposed to those who are strongly opposed.

Stokes (1963) introduced the idea of valence issues to models, non-policy issues which become part of the competitive strategy. Valence issue models and spatial models in the tradition of Downs (1957) have in a sense been in competition with each other since then. Ansolabehere and Snyder (2000) include valence issues in their spatial model and solve for a pure strategy Nash equilibrium. Ashworth and Bueno de Mesquita. (2008) also include valence competition in their model, where candidates choose divergent policy platforms to soften valence competition, such as with campaign advertising. Wu (2019) empirically finds that valence issues are of greater importance than policy issues when it comes to political participation. Similarly, Clarke and Whitten (2013) find that a valence model outperforms a spatial model when analysing the 2009 German Parliament election.

In this chapter, firstly the case of a one-party dictatorship is examined. With no democratic system, and hence less competitive pressures to appease voters, it is found that under a variety of different systems, donors to the ruling party can affect policy issues. There are currently fifty countries ruled by some form of dictatorship (worldpopulationreview.com 2020), which is just over a quarter of all nations, and so it is necessary to look at the dictatorship case as a subject of interest. In addition, comparisons can be made between democratic systems and dictatorships to evaluate the effect of electoral competition on the ability of wealthy donors to affect policy.

Secondly, the case of a multi-party democracy where representatives are elected by the people is examined. Parties must choose their policy platform to maximise a utility function that depends on both votes and donations. As stated previously, to earn donations it is not enough to solely set the policy platform in favour of the donors, as donors also care about the influence the party has. With two or more

parties it is found that parties set policy positions solely in favour of the voters. This is due in large part to the fact that donors care about how popular the party is.

As an extension to the two-party model, I also analyse the effect of donors committing to donate zero if party policy positions reach a level deemed too unfavourable by donors, leading to the possibility that parties set policy positions at a level closer to donors wishes than happens in the case without commitment. Another case examined is that in which a minority of the electorate agree with donors on optimal policy positions. In this case, even a small proportion of voters agreeing with donors can have a drastic effect on policy positions. This case is of particular importance as it illustrates that donations can be crucial in pushing policy position towards a minority held position.

Finally, the possibility of parties colluding and setting policy positions away from voters' wishes is analysed. Under specific circumstances, such as large enough donations, it is shown that it is possible for collusion to be maintained in equilibrium in the case of an infinitely repeated game.

There is some empirical evidence to indicate that donations to parties do in fact have a tangible effect on policy outcomes. Johnson and Livingstone (2020) examine donation data in Australia and find that donations from the gambling sector have a temporal effect on policy positions. Boas et al. (2014) show that a firm which donates to the ruling party can expect to receive a higher value of public works contracts than those who do not donate. Kypri et al. (2018) find that donations are made by the alcohol and gambling sectors for both short term influence and to build long term relationships with politicians. The authors even go as far as to suggest banning corporate donations may be necessary to protect the integrity of policy making. Richter et al. (2009) show that firms which spend on lobbying are rewarded with lower

effective tax rates. Stratmann (2002) finds that changes in campaign contribution levels affect voting behaviour. Mahoney (2007) shows that direct elections and private campaign money leads to outcomes favourable to businesses and wealthy individuals. Stratmann (1991) finds that campaign donations have a causal impact on 8 out of 10 cases examined.

On the other hand, some previous work indicates that donations do not actually influence policy positions. Bronars and Lott (1997) show that politicians' ideological positions do not change even after retirement, implying that donations did not alter their policy positions. Ansolabehere et al. (2003) state that donations are more akin to a consumption good than an investment to sway policy positions. Adams and Somer-Topcu (2009) come to a slightly different conclusion, finding that policies have a lagged effect on support. Voters may update their perceptions of parties slowly, and so policy positions in previous elections may have a greater impact on voter support than current policy positions.

While lobbying activities are legal in most jurisdictions and bribery is explicitly illegal, it may be the case that legal activities undertaken by lobbyists and interest groups are essentially bribes that are offered legally. If lobbying activity is aimed at affecting policy position through providing some benefit to political parties and candidates, in what meaningful sense can it be said to differ from bribery? For this reason, bribery, lobbying and donations must all be considered together when formulating policy. If it is the case that legal donations act identically to illegal bribery, this must be taken into consideration by policymakers. Such activities may fall under the umbrella term of "corruption", although whether politicians enriching themselves through legal methods, such as accepting donations or gifts from interest groups constitutes corruption is a matter of debate. If political corruption is recognised by the

electorate, it may be taken into account when casting votes. Krause and Méndez (2009) find that corruption by those in office is punished by voters, however this differs across democratic systems with less democratic countries reacting more negatively than their more democratic counterparts. In fact, for "mature democracies" there appears to be no voter backlash against corrupt officials. It may also be the case that corruption can have some benefits, specifically it may positively impact economic growth. Méndez and Sepúlveda. (2006) empirically test the effects of corruption on growth. They find that in "free" countries there is a quadratic effect of corruption, at lower levels increasing corruption increases growth and the optimal level of corruption is significantly greater than zero. Ehrlich and Lui (1999) create a model of corruption and differentiate between two types of regime, autocratic and democratic. In democratic regimes there may be a build-up of unnecessary bureaucracy, and, in such a case, corruption may aid firms in navigating this bureaucracy and, hence, increase economic growth.

The value of political donations is truly staggering, particularly in the USA, where the Citizens United ruling has scuppered any attempt by authorities to place legal limits on donations. The Federal Election Commission (FEC) in the US maintains a database detailing the amount and source of donations to politicians and Political Action Committees. Over the two years 2019 and 2020 (recall, 2020 had a Presidential election) there was a total of $25.28 billion raised in political donations. Of that amount, $7.4 billion was raised by candidates directly, $3.4 billion by party committees and $14.4 billion by other committees. Joe Biden received $823,669,347.58 between the same two years, while the other main candidate, Donald Trump, received $459,198,438.91. Biden received 11,366,000 contributions, the largest of which was $45,000,000.00, from a different PAC, the Biden Victory Fund.

Trump, meanwhile, received 6,866,000, the largest of which was $25,457,108.94 from a PAC called the Trump Make America Great Again Committee. In many cases donations are made through several layers of PACs. For example, the largest donation to Trump's PAC above, came from the Trump Make America Great Again Committee, which in turn was largely funded by Winred, which is a Republican online platform for donations. Among Biden's individual donations, which did not come through PACs, some of the more notable donations are $350,000 from Facebook and Thomson Reuters, the media company, donated $105,931.68. The majority of large donations to Trump came from either PACs or Winred.

3.4 Model

There are three agent types: voters, parties and donors. Firstly, parties choose their policy position, donors then donate and finally voters cast their votes.

There are N competing parties which choose a policy position r for each of the K issues. Party n's policy position r on issue $k \in \{1 \ldots K\}$ is denoted by r_{nk} where $n \in \{1 \ldots N\}$. The policy position on issue k, r_{nk}, is represented by a real number between zero and 1, $0 \leq r_{nk} \leq 1$.

3.4.1 Voters

There are I voter types, each differ solely in their taste parameter for K different policies. Voter type i votes for the party which yields the highest utility. Utility of voter i for voting for party n is given by:

3.1

$$V_{in} = \sum_{k=1}^{K} s_{ik} r_{nk}$$

s_{ik} represents the intensity with which type i voters care about policy issue k.

Voter's optimal policy position is r = 1 on each issue k. In later sections, this assumption is relaxed.

3.4.2 Donors

There are L donor types. Each donor type, $l \in \{1 \dots L\}$, differs in their profitability of moving party policy on a given issue closer to their optimal position. For all donor types, optimal policy position is r = 0 for each issue k. Donors can be thought to be corporations or wealthy individuals who benefit from pushing policy in a certain direction. The model does not require a party to win a majority of votes, or even to form part of a government, for donors to benefit from their policy position. This is to reflect that even opposition parties and representatives in a parliamentary system can affect policy and legislative votes. Thus, the model is more representative of a vote for a parliamentary body, or the US House of Representatives or Senate, than it is of a presidential winner take all system.

The profit function for an individual donor type, l, is given as:

3.2

$$\sum_{n=1}^{N}[x_n \sum_{k=1}^{K}(1 - t_{kl}r_{nk}) - D_{nl}]$$

x_n is the number of votes received by party n

D_{nl} is the amount donor type l donates to party n, $D_{nl} \geq 0$

t_{kl} is donor l's distaste for increasing r_{nk}, $t_{kl} \geq 1$

Assume D_{nl} is generated through a bargaining process between the donor and the party, such that:

3.3

$$D_{nl} = \rho x_n \sum_{k=1}^{K} (1 - t_{kl}\, r_{nk})$$

Where $0 \leq \rho \leq 1$. That is, donation to party n by donor type l is a bargained share of l's profits arising from party n's position and votes. It is possible for one donor or donor type to donate to multiple, or even all parties. Donor profits depend on votes, as a party with a favourable policy platform will be of no use to donors unless they have some ability to influence legislation.

In this model, there is a sharp dichotomy between voter and donor optimal policy positions. It is true to say that this is not realistic for all policy positions, however if voters and donor positions aligned perfectly, donations to political parties would serve no purpose. It would be already in the interest of parties and politicians to choose the policy position which is optimal for donors, and thus there is no incentive for anyone to donate to parties. This model works best with issues where there may be a possibility for firms or individuals to profit at the expense of the wishes of voters. One possible example may be laws regarding pollution, where voters in an area prefer their environment to be clean and healthy but local corporations will lose profits if they are held to a higher standard with regard to pollution control.

To study variation in the importance of donors relative to voters, we use M_l to denote the overall number (or mass) of donors of type l . This can also be considered

a size multiplier, M_l increases as donor size gets larger. As the number of donors increases, donations also increase.

Given the above, it is now possible to write parties' objective functions as:

3.4

$$U_n = a_n x_n + \rho b_n x_n \sum_{l=1}^{L} [M_l \sum_{k=1}^{K} (1 - t_{kl} r_{nk})]$$

a_n is the utility party n gains from an additional vote

b_n is the utility party n gains from an additional dollar donated

M_l is the overall number (mass) of donors of type l

x_n now enters the utility function of parties' twice, for the direct benefit of votes and the indirect benefit of votes' contribution to donations. As x_n depends on policy positions, party n's choice variable, r_{nk}, affects the direct term once and the indirect term twice, both in opposite directions.

Note that x_n does not depend on D_n, the donations given to party n. Instead, donations are modelled as a direct benefit to parties and/or their candidates. On the extreme end, this could be interpreted as being donations to a corrupt politician who can embezzle some of this money for their own personal benefit. In this sense, the model can be used to analyse the ability of policy decisions to be influenced through bribery when politicians are corrupt, and it may be applicable to certain regimes or nations where corruption is rife. It may also be the case that politicians and parties gain power and influence from the size of their donation pool. Another possibility is that donations may take on a non-monetary form such as favours given by corporations

or wealthy individuals to politicians. For example, a large corporation might promise a legislator a well-paid position within their organisation after they serve their political term.

3.5 The Dictatorship Case

In this section, the case of a one-party dictatorship, which faces no democratic elections, is examined. It is necessary to examine this case not only as a large fraction of nations exist under such a regime, but also to evaluate the effect of electoral competition on the overall model. While there are no elections in such a system, this does not necessarily mean that the ruling party is free to completely ignore the wishes of citizens, as political instability or even outright rebellions may arise if the populace feels significantly outraged at the regime party. Below, several different possibilities for modelling dictatorship will be examined. In this section, voters are replaced by citizens. The major difference between citizens and voters is that citizens do not have a democratic system to participate in and hence cannot influence policies in the same manner.

In addition to only one party existing, assume there is one donor type, one citizen type of mass 1 and one political issue. This leaves the objective function of party n as:

3.5

$$U_n = ax + M\rho bx(1 - tr)$$

Previously, *x* represented votes but here it instead refers to the sentiment of citizens with regards to the party. A rising *x* implies citizens increasingly approve of the ruling party. As r increases, x increases and an $r = 1$ produces an $x = 1$, as citizens fully

approve of the party's policy position. Similarly, an $r = 0$ produces an $x = 0$. For this section, support levels for the ruling party is given simply as:

$$x = r$$

Dictatorship Scenario 1

If the ruling party does not care about popular support, and can maintain stability through methods other than appeasing citizens through policy positions, possibly through a strong police force or military and if donors do not care about the extent to which citizens support the regime party, the party's objective function in Equation 3.4 boils down to:

3.6

$$U_n = M\rho b(1 - tr)$$

when we evaluate the case where $N = 1$, $L = 1$, and $K = 1$. Recall that a is a parameter which measures the extent to which the party cares about the support of the populace. In this case, $a = 0$.

To maximise U_n, the party sets $r = 0$. Citizens' wishes are completely ignored in favour of donor interests. Scenario 1 is an extreme case of dictatorship and likely does not apply to any nation in the real world, but it does provide an important benchmark to which it is possible to compare other dictatorship scenarios. For a party to face scenario 1 it would be necessary to have very compliant citizens who are controlled by extreme fear and/or propaganda. The potential for rebellion in such a scenario is non-existent, and as such the party can ignore the desires of citizens.

Dictatorship Scenario 2

In this scenario, citizens will rebel against the regime if *r* is not greater than a critical value, r^*. In the case of a rebellion the payoff to the party is 0.

$$U_n = M\rho b(1 - tr), \text{if } r \geq r^* \quad \textbf{3.7}$$

$$\text{Otherwise, } U_n = 0$$

In such a scenario it is optimal for the party to set $r = r^*$. A more rebellion prone population will mean a higher $r^*$and ultimately a policy position closer to the desires of citizens. Scenario 1 can be considered as a special case of scenario 2, where $r^* = 0$.

Dictatorship Scenario 3

The benefit of increasing *r* and appeasing citizens is linear to the policymaker but donors do not care about the size of *x*. This may be the case if the dictator finds it easier to rule with the support of citizens due to a lower likelihood of protests or civil disobedience. It may also be the case that the dictator simply gains satisfaction from being popular or that having a happy populace is a part of their aim as ruler.

$$U_n = ax + M\rho b(1 - tr) \quad \textbf{3.8}$$

Note that *x* is not present in the second term of the objective function. *a, M, ρ* and *b* are fixed and do not depend on the size of *x* or *r*. Let *Δr* be the change in r. Recall that *x* = *r*. If the party raises *r*, they gain *aΔr* while they lose $M\rho bt\Delta r$. As all parameters are fixed, this will lead to extreme results. If $a > M\rho bt$, party sets *r* = 1, if $a < M\rho bt$

party sets $r = 0$. If both terms are equal the party is indifferent between all possible levels of *r*.

Dictatorship Scenario 4

The policymaker benefits from public support which can be generated by increasing *r* and donors care about how much support the party has among citizens. This scenario is essentially identical to the general model, with the exception that citizens cannot vote. In general, donors are likely to pay attention to the popularity of a dictator, as a popular leader is likely to lead to a more stable economic and political climate. Contrast this with an unpopular leader, who may face difficulty in implementing policies, an unstable and uncertain political climate, and possibly even outright revolution and regime change. This uncertainty is highly likely to reduce donor profits.

3.9

$$U_n = ax + M\rho bx(1 - tr)$$

Differentiating U_n with respect to *r*, where $x = r$, gives:

$$\frac{dU_n}{dr} = a + M\rho b - 2M\rho btr$$

Set the above equal to zero to solve for *r*:

$$r = \frac{a + M\rho b}{2M\rho bt}$$

Next, differentiate this term for *r* with respect to *M*, to determine the effect of increasing donors on *r*:

$$\frac{dr}{dM} = \frac{-2\rho bta}{(2M\rho bt)^2}$$

As the above term is negative, this implies increasing amounts of donors decrease the optimal *r* set by the party. In a dictatorship, increasing donors leads to policy positions which further favour donors at the expense of the citizens.

In equilibrium, total donations to the reigning party is given as:

$$M\rho - \frac{a + M\rho b}{2}$$

The model clearly predicts that under a one-party dictatorship it is quite easy for donors to influence policy position. In the next section, a two-party democracy is examined in order to ascertain whether or not democratic systems and electoral competition can lead to an outcome more in line with the wishes of the general population.

3.6 A Two-party Democracy

In this section, the specific case of a two-party system is examined. The model best fits countries with systems of proportional voting systems such as those prevalent in many parts of Europe, such as Ireland and Germany. Under these systems, parties capture a proportion of seats in parliament close to the proportion of the vote they earn. As the gain of increased votes is modelled as a linear increase, these systems are most in line with the model.

Firstly, consider the case of homogenous voters. All voters have the same preference and the same taste parameter, where $s_{ik} = 1$.

Let $R_n = r_{n1} + r_{n2}$. If party 1 sets $R_1 > R_2$, it will win all votes. This will leave U_2, the utility of party 2, equal to zero. Party 2's best response then is to set R_2 just greater than R_1 and capture all votes. In turn, party 1's best response is to set R_1 just greater than R_2 and so on until $R_1 = R_2 = 2$. Because donations are tied to the number of votes a party wins, there is intense competition in *R* ending up in a Nash equilibrium where both parties' policy positions perfectly reflect the views of voters.

Secondly, consider the case of heterogenous voters. Assume, there are two parties with identical objective functions, two voter types, two political issues and one donor type. Let r_{n1} be party n's position on issue 1 and r_{n2} be party n's position on issue 2. Both voter types desire r_{n1} = r_{n2} = 1 but differ in their taste for increasing *r* on each issue. Both voter types have a size of 1, which means the entire electorate is 2. Let party i's strategy set be denoted as R_i.

Assume that voter type 1's utility from voting for party n is:

3.10

$$V_{1n} = s_1 r_{n1} + d_1 s_1 r_{n2}$$

And voter type 2's utility from voting for party n is:

3.11

$$V_{2n} = d_2 s_2 r_{n1} + s_2 r_{n2}$$

Where $d_1 > 1$ and $d_2 > 1$. This implies type 1 cares more about issue 2 and type 2 cares more about issue 1.

In addition, assume donors' distaste for increasing r is equal for both issues and is given by t. Given the above, party n's objective function can be written as:

3.12

$$U_n = a_n x_n + M\rho b_n x_n[(1 - tr_{n1}) + (1 - tr_{n2})]$$

As donors' distaste for increasing *r* is equal for both issues it is possible to add the two terms in square brackets together. Can rewrite as:

3.13

$$U_n = a_n x_n + M\rho b_n x_n[(2 - t(r_{n1} + r_{n2})]$$

Party n must maximise the above with respect to r_{n1}, r_{n2}.

Proposition 1

Both parties setting their respective policy position on both issues equal to one, $r_{nk} = 1$, for all n, k is the Nash equilibrium outcome.

It is not that donors have no effect on the parties' problem regarding the optimal policy position, but in equilibrium, competitive forces lead to an outcome where donors turn out not to affect the policy positions.

Proof of Proposition 1

If party i, has the strategy $R_i = \{r_{i1} = 1, r_{i2} = 1\}$ then the best response of party j is $R_j = \{r_{j1} = 1, r_{j2} = 1\}$, $\forall\ i,\ j \in \{1,2\}$ where $i \neq j$. This leads to a payoff of $U_i(R_i, R_j) = U_j(R_j, R_i) = a$ as both parties win half of the electorate. Any deviation from this equilibrium by party i, such that

$R_i = \{r_{i1} < 1, r_{i2} = 1\}$, $R_i = \{r_{i1} = 1, r_{i2} < 1\}$ or $R_i = \{r_{i1} < 1, r_{i2} < 1\}$ leads to a payoff of $U_i(R_i, R_j) = 0$, as party i wins no votes.

Furthermore, this is a unique Nash equilibrium. There cannot be a symmetric Nash equilibrium where both parties set policy positions on both issues less than one, $r_{i1} = r_{j1} < 1$ and $r_{i2} = r_{j2} < 1$ and capture half of both voter types. Given the strategy of party i, j's optimal response would be to move one of the policy positions towards one and capture both types of voters.

How about a segmentation equilibrium where one party captures voter type 1 and the other captures voter type 2, such that voter type 1 has greater utility from voting for party i ($V_{1i} > V_{1j}$) and voter type 2 has greater utility from voting for party j, ($V_{2j} < V_{2i}$)? Let us postulate such an equilibrium and then prove by contradiction that in equilibrium, parties will not differentiate their platform in such a way that they each attract the support of one voter type.

If R_i is the best response to $R_j = \{f_1, f_2\}$, where either $0 < f_1 < 1$ or $0 < f_1 < 1$, i.e., either f_1 or f_2 is strictly between 0 and 1, R_j is not the best response to R_i.

Given R_j, the best response of party i is to either capture both voter types, or one voter type.

If the best response of party i is to capture both voter types, $R_j = \{f_1, f_2\}$ cannot be party j's best response, as it will win no votes and receive utility of zero.

Recall, voter utility is given by:

$$V_{1n} = s_1 r_{n1} + d_1 s_1 r_{n2}$$

$$V_{2n} = d_2 s_2 r_{n1} + s_2 r_{n2}$$

Where $d_1, d_2 > 1$

If party i's best response is to capture one voter type, there are two possible scenarios.

If, $\frac{f_1}{d1} + f_2 + \varepsilon$ <1, party i can capture type 1 through one issue only. The best response of party i is to set $R_i = \{r_{i1} = 0, r_{i2} = \frac{f_1}{d1} + f_2 + \varepsilon\}$. As $d_1 s_1 > s_1$, capturing type 1 voters through issue 2 leads to a lower loss in donations than would be the case with a positive value issue 1 or a mixture of both issues. The value for r_{i2} is derived from V_{1n}, and is the smallest value of r_{i2} which gives $V_{1i} > V_{1j}$. $R_j = \{f_1, f_2\}$, is not the best response to R_i, as j can set $R_j' = \{r_{j1} = \frac{\frac{f_1}{d1} + f_2 + \varepsilon}{d_2}, r_{j2} = 0\}$, still winning one voter type, type 2, but increasing donations. This gives utility of $U_j(R_j') > U_j(R_j)$:

$$a_j + M\rho b_j \left[\left(2 - t\left(\frac{\frac{f_1}{d1} + f_2 + \varepsilon}{d_2}\right)\right)\right] > a_j + M\rho b_j[(2 - t(f_1 + f_2)]$$

If, $\frac{f_1}{d1} + f_2 + \varepsilon$ >1, party i must set positive values for both issues to capture type 1. As the gain from increasing policy position is greater for issue 2, ($d_1 s_1 > s_1$), best response of i is R_i= $\{r_{i1} = [f_1 - d_1(1 - f_2) + \varepsilon], r_{i2} = 1\}$. There are two possible best responses for j:

$$R_j' = \{r_{j1} = f_1 - d_1(1 - f_2) + \frac{1}{d_2}, r_{j2} = 0\}, \text{ if } f_1 - d_1(1 - f_2) + \frac{1}{d_2} \leq 1,$$

which gives utility of:

$$a_j + M\rho b_j\left[\left(2 - t(f_1 - d_1(1 - f_2)\right)\right]$$

or,

$$R_j' = \{r_{j1} = 1, r_{j2} = 1 - d_2[(1 - f_1) + d_1(1 - f_2)\}, \quad \text{if} \quad f_1 - d_1(1 - f_2) + \frac{1}{d_2} > 1,$$

which gives utility of:

$$a_j + M\rho b_j[\big(2 - t(2 - d_2[(1 - f_1) + d_1(1 - f_2)\big)]$$

Both of which are greater than $U_j(R_j)$. Hence, R_j cannot be sustained in equilibrium.

The final possible case is where $R_j = \{r_{j1} = 0, r_{j2} = 0\}$. The best response of party i to this strategy is to either set $R_i = \{r_{i1} = \varepsilon, r_{i2} = 0\}$ or $R_i = \{r_{i1} = 0, r_{i2} = \varepsilon\}$, ε is infinitesimally small. In other words, party i increases r_{i1} or r_{i2} by the smallest possible amount, capturing both voter types. In turn, the best response of party j is to increase its policy positions by the smallest possible amount, capturing both voter types. Reiterate this argument until $R_i = \{r_{i1} = 1, r_{i2} = 1\}$ and $R_j = \{r_{j1} = 1, r_{j2} = 1\}$.

The Nash equilibrium of this game is the same as it was in the case of homogenous voters. This implies that donors cannot influence policy positions in their favour if it is directly opposed to the will of the people. Also, this case implies that donations will be equal to zero, which is clearly not reflective of the situation in reality. In order to reconcile this model with reality, two cases are examined below, firstly the case where donors can set a hard limit on R_n, such that if a party sets R_i greater than the limit it immediately loses all donations and secondly the case where there is heterogeneity not only in voters taste parameters but also in voters preferred policy positions.

3.7 Two Parties with Donor Commitment

It may be possible that donors can credibly commit to a cut-off point of r_n. A party which set a policy position greater than this cut-off receives donations of zero. Such a strategy could cause a policy position shift in favour of donors. For donors to credibly commit to such a strategy, the cost of not following through in the event the set threshold is breached would need to be greater than the benefit of not following through. This could involve donors publicly backing a policy position, either in the media or in their own publications. In this case, failure to cut donations in line with the strategy could result in backlash from the public or investors, as the donors are seen as untrustworthy. It could also be the case that, as elections are repeated every few years, donors wish to develop a reputation of following through on their commitment to cut donations, in order to benefit in the future. In the previous section, the marginal effect of any increase in r_{n1} or r_{n2} is negligible, due to the fact that parties can set policy positions at any real number between zero and one. However, in the following case, moving from a level just below the threshold set by donors to a level just above it, despite being a very small change, results in a drastic fall in donations, and, hence, party utility.

For this scenario, the model is kept identical to the previous section, save for the fact that donors can now credibly commit to a donation of zero if $t(r_{n1} + r_{n2})$ breaches a certain threshold. Let $\hat{R}$ be the strategy profile with highest r_{n1} and r_{n2} which doesn't breach the threshold set by donors. Previously, any small change in R_n would result in a negligible fall in donations but in this case, a small change to R_n, such that $R_n >$ $\hat{R}$, leads to donations falling straight to zero.

Proposition 2

If donors can credibly commit to a donation of zero if a party breaches a certain threshold in R, it is possible, give certain circumstances, for donors to have an effect on party policy positions in equilibrium.

Proof of Proposition 2:

Assume, R_2=$\hat{R}$, what is the best response of party 1? From Equation 3.1, party 1 can set R_1=$\hat{R}$, capturing half of voters and giving utility of:

$$U_1 = a_1 + M\rho b_1[2 - t(r_{n1} + r_{n2})\,]$$

Or party 1 can move either policy position 1 or 2 closer to the wishes of voters, capturing all votes and leading to utility of:

$$U_1 = 2a_1$$

If, $a_1 > M\rho b_1[(2 - t(r_{n1} + r_{n2})]$, best response of party 1 is to set R_1 such that it breaches the threshold set by donors. In such a case, party 2's best response is to add ε to either r_{n1} or r_{n2} and attempt to capture all voters. The NE in this scenario is the same as without donor commitment.

If, $a_1 < M\rho b_1[(2 - t(r_{n1} + r_{n2})]$, best response of party 1 is to set $R_1 = \hat{R} = R$. In this case donors exert influence over the policy platforms of parties, using donations to elicit favourable policy positions at the expense of the electorate. It is important to note that the value of a_n, the direct benefit of gaining votes, is crucial in determining which equilibrium persists. Increasing a_n makes the competitive equilibrium more likely and this could be achieved by increasing the pay and benefits of elected officials.

On the opposite side, reducing the scope for wealthy donations in politics can also make the competitive equilibrium more likely.

Another issue to consider is whether or not donors can strategically set $\hat{R}$. As donations decrease in R_n, a lower $\hat{R}$ is more likely to lead to a preferable outcome for donors. Put another way, with a low $\hat{R}$ it is more likely that $a_1 < M\rho b_1[(2 - t(r_{n1} + r_{n2})]$. This means that the optimal choice of the limit on R_n is $\hat{R}$=0.

3.8 Voter Heterogeneity in Preferred Policy Position

Up until now, it has been assumed that voters are uniform in their desire for $r_{nk} = 1$, for all issues. In this section, this assumption is dropped and instead voters are split into types which disagree on the optimal policy position. Assuming one issue, type 1 prefers $r_n = 1$, and type 2 prefers $r_n = 0$, which is the same policy position preference as donors. Assume type 1 has a mass of *y* while type 2 has a mass of *qy*, where $0 \leq q \leq 1$. In addition, assume two parties, one donor type and one issue. Voter type 1 utility is given by:

3.14

$$V_{1n} = s_i r_n$$

And voter type 2 has utility of:

3.15

$$V_{2n} = s_i(1 - r_n)$$

From Equation 3.4, utility of party n can be given as:

$$U_n = a_n x_n + M\rho b_n x_n(1 - tr_1)$$

If both voter types are of equal size, q = 1, both parties will set r_n = 0. If $r_2 = 0$, and r_1 = 0 both parties will capture *y* votes (half of both types) and receive utility of:

$$U_n = a_n y + M\rho b_n y$$

If party 1 raises r_1 beyond 0 by the smallest possible amount, ε, utility is given as:

$$U_1 = a_1 y + M\rho b_1 y(1 - t\varepsilon)$$

Which is less than utility if $r_1 = 0$. Hence, if q = 1, $r_1 = r_2 = 0$ is the single pure strategy Nash equilibrium. This means that if voters are evenly split in both types, donors can influence policy position to the extent that both parties set their policies at the optimal level for donors.

Next, what happens if $q < 1$ is examined. For any r_2, party 1's best response is to set $r_1 = r_2 + \varepsilon$ to capture voter type 1 and receive utility of:

$$U_{1A} = ay + M\rho by(1 - tr_1)$$

Or, set $r_1 = 0$, and capture voter type 2 and receive utility of:

$$U_1 = aqy + M\rho bqy$$

At some level of r_2, both of the above will be equal. Define $\hat{r}$ as the level of r_1 which causes both of the above to be equal: $ay + M\rho by(1 - t\hat{r}) = aqy + M\rho bqy$

Hence, $\hat{r}$ can be written as:

$$\hat{r} = \frac{(1 - q)(a + M\rho b)}{(M\rho bt)}$$

The best response of party 1, regardless of r_2, is never higher than $\hat{r}$, as $r_1 = 0$ gives greater utility. Without donations, the Nash equilibrium is for both parties to set $r_n = 1$. This implies that, provided $\hat{r} < 1$, the influence of donors causes a policy position shift of at least 1 to $\hat{r}$ (. If $\hat{r} > 1$, both parties will compete in r fully, $r_1 = r_2 = 1$, and donations have no effect on policy position.

In previous sections it was established that if donors cannot credibly commit to reducing donations to zero if a specific threshold is broken, and all voters desire the same policy positions, it is impossible for donors to have any effect on policy positions. Now it is shown that if a minority agree with donors on policy position there is room for donors to influence policies in favour of the minority voter type. This has strong implications for democratic systems, as the presence of donations can push policy positions away from the wishes of the majority. Whether or not this is a problem is something that must be considered by citizens and regulators.

Something else to be considered is that if donors wish to influence policy through donations, it is not enough simply to give money to politicians, they also must convince a large enough section of the electorate to vote in their interests. While one interpretation of the divide in voter opinion is simply due to ideological reasons or conflicting interests, it is also possible that $r_n = 1$ is in the interest of all voters but a certain section of the electorate has been convinced by donors to vote against their own interest, possibly through advertising, disinformation, or fake news and propaganda.

In particular, this second interpretation is relevant to the climate change debate. Measures intended to reduce emissions and combat the onset of climate change may reduce the profitability of firms and wealthy individuals, particularly those involved

in the production of fossil fuels. Mulvey et al. (2015) use evidence from internal company documents to claim that "Fossil fuel companies have intentionally spread climate disinformation for decades", even while they themselves were fully aware of the negative consequences of fossil fuels. If we accept the scientific consensus on fossil fuels, that they are of great danger to the planet's climate, it is hard to argue that not regulating the use of fossil fuels is in the best interest of almost the entire electorate of all democratic nations. However, Stokes et al. (2015) find that globally a median of only 54% consider climate change to be a serious problem, while in the US this falls to 45% and in China as low as 18%. This is all despite the repeated warnings of possible climate catastrophe within decades by the scientific community. Such widespread beliefs in direct opposition to voters' interests may imply that disinformation on climate change issues has been overwhelmingly successful, meaning the scope for donors to influence government policies in a way which harms voters is quite great indeed. The findings of this section imply that in order to influence policy in their favour, donors must not just spend their vast resources directly on politicians but must also put money into convincing voters to hold specific political opinions, some of which may in fact be against their own self-interest.

The next issue is to solve for the Nash equilibrium in the case that $q < 1$ and $\hat{r} < 1$. In such a case there is no pure strategy Nash equilibrium, as the best response of party 1 is $r_1 = r_2 + \varepsilon$, if $r_2 + \varepsilon < \hat{r}$, or 0, if $r_2 + \varepsilon > \hat{r}$. At no point is the best response of party 1 the best response to party 2. Instead, we must look for a mixed strategy equilibrium. Firstly, recall that no party will set $r_n > \hat{r}$. Between 0 and $\hat{r}$ there are an infinite number of possible levels of r_n along a continuous distribution. This means that the probability of party n choosing any specific value of r_n is approximately equal to zero. This also implies that the probability of $r_1 = r_2$ is also

approximately equal to zero, meaning there is no chance of both parties choosing the exact same value for r_n. This then leaves two possible payoffs to party 1 for every value possible value of r_1, corresponding to a payoff if $r_2 > r_1$ and a payoff if $r_2 < r_1$.

In order for there to be a mixed strategy Nash equilibrium, the expected payoff of any r_1 must be equal to the expected payoff of all other possible values. The payoff of setting $r_1 = 0$ is:

3.16

$$U_1 = aqy + M\rho bqy$$

The expected payoff of all levels of r_1 then must be equal to the above. In general, the payoff for any value of r_1 is given as:

3.17

$$U_1 = [ay + M\rho by(1 - tr_1)]\left(P_{r_2<r_1}\right) + [aqy + M\rho bqy(1 - tr_1)](1 - P_{r_2<r_1})$$

Where:

$P_{r_2<r_1}$ is the probability that $r_2 < r_1$

As all expected payoffs must be equal under a mixed strategy NE, can sub in for $U_1$from Equation 3.15 in Equation 3.16. It is then possible to solve for $P_{r_2>r_1}$, which gives an expression for the probability that r_i is below a certain level. This expression is:

3.18

$$P_{ri} = \frac{M\rho bq(tr_i)}{(1 - q)[a + M\rho b(1 - tr_i)]}$$

The above holds for any level of $r_i < \hat{r}$. A higher value of P_{ri} indicates that a lower r_i, closer to the optimal position for donors, is more likely. P_{ri} is increasing in $M, \rho, b,$ q and t and decreasing in a. If total donations increase through either a greater bargained share of profits going to parties, or number of donors increasing, the likelihood of a lower r_i increases. This can be interpreted as policy positions being closer to the desires of donors on average. Legal limitations on donations could cause policy positions to move closer to the desires of the majority of the population.

3.9 Collusion Equilibrium

Collusion between political parties refers to a situation where parties agree to set policy positions closer to the wishes of donors than the equilibrium which would prevail in the absence of such an agreement. In this case, parties would agree to a maximum level of r_n which neither party would surpass. This would allow both parties to achieve a greater level of utility, due to higher donations, at the expense of the electorate.

Assume, two parties, two voter types (each of mass 1), one donor type and one issue. In addition, assume there are an infinite number of time periods, during each of which there is a vote. This repeated aspect of the game is a key feature, as collusion cannot occur with a non-repeated game. Finally, assume both parties agree to set $r_n = 0$. If one party defects from this by setting $r_n > 0$, the agreement breaks down and parties engage in the normal competitive equilibrium as detailed above for all periods.

If both parties stick to the collusion agreement, they receive:

3.19

$$U_n = a_n + 2M\rho b_n + \frac{a_n + 2M\rho b_n}{1-\delta}$$

Where δ, $0 \leq \delta \leq 1$, is the discount rate parties apply to future time periods.

If a party defects from the agreement it receives all votes, 2, in the first period by setting r_n slightly greater than zero resulting in utility of:

3.20

$$U_n = 2a_n + 4M\rho b_n + \frac{a_n}{1-\delta}$$

That is, $2a_n + 4M\rho b_n$ in the first period and a_n for each subsequent period.

In order for collusion to be an equilibrium outcome, it must be the case that (**3.19**) > (**3.20**):

$$a_n + 2M\rho b_n + \frac{a_n + 2M\rho b_n}{1-\delta} > 2a_n + 4M\rho b_n + \frac{a_n}{1-\delta}$$

This can be simplified to:

3.21

$$2M\rho b_n \left(\frac{1}{1-\delta} - 2\right) > a_n$$

Firstly, note that δ must be at least 0.5 for collusion to be a possible equilibrium and the larger it is the more likely collusion is to be sustained. Secondly, collusion is more likely to occur if donor numbers, M, are higher and if the share of profits donated to

parties, ρ, is higher. Finally, as the gain from votes, a_n, increases, collusion becomes less likely. This implies that higher wages and benefits for politicians would work to deter collusion.

3.10 Conclusion

The key premise of democratic governance is citizens having a say on policy issues through the voting process. If special interests, such as corporate donors, are able to subvert this process and unduly affect policy decisions at the expense of the population, it may lead to the degeneration of democracy and a less representative government. In turn, this may lead to an apathetic populace who feel divorced from the democratic process and regard voting as a pointless act. In extreme cases, a system which is perceived as not being representative of the people may even lead to rebellion. The ability of political donors to influence policy decisions is of utmost importance to democratic nations and an analysis of its effects could provide important insights to inform policy.

The model makes clear that a dictatorial regime has significant scope to align policy decisions with wealthy special interests in return for donations to the party. It is then shown that similar circumstances under a democratic system drastically reduces the power of government parties to set policies against the wishes of voters, as electoral competition and the desire of donors to support parties which are likely to win a large number of votes drives parties to set policy positions completely aligned with voter preferences in equilibrium, despite the fact this means they earn no money from donations. The next three sections of the chapter deal with extensions which may overturn this extreme result, namely donor commitment, heterogenous voter preferences and collusion between parties.

If it is possible for donors to credibly declare that they shall donate nothing to a party that breaches a certain threshold in policy position, it is possible, depending on factors such as number of donors and benefits of winning votes, for donors to shift policy positions in their favour. In order to avoid this equilibrium, the benefits of winning votes, such as parliamentarian wages, must be increased or the ability of individuals and firms to donate to political parties must be curtailed.

If there is heterogeneity of voter preferences, in the sense that some portion of the electorate favours policies which benefit donors, parties may set policy positions more aligned to donor preferences than the majority of voters. The proportion of voters in agreement with donors need not be large, in fact anything above 50% leads to parties always setting policy positions which are considered optimal by donors, and a small minority of voters can shift policy positions significantly closer to those desired by donors. While this may be interpreted as simply being due to a diversity of opinion among voters, it also could be the case that a section of the electorate is misinformed and are voting against their interests due to false or misleading information. An example of this, as mentioned, may be in the case of climate change, where a significant proportion of people don't believe in climate change and as a result vote against measures which could mitigate the problem. In this case, it is in the interest of donors to also use their wealth to spread propaganda and false information to convince voters to vote against their best interests, as the more voters they convince, the more influence they have over policy matters.

Finally, in the last section the possibility of parties to collude and set policy positions in favour of donors is examined. It is shown that under the right circumstances a collusive agreement against the desires of the electorate can be

maintained in equilibrium. The more forward-looking the parties are, represented by their discount rate, and a greater mass of donors there are, the more likely it is for a collusion agreement to be maintained by two parties. Such an outcome may prove disastrous for democracies, as rather than a competitive election it amounts instead to essentially a democracy where parties which are perfectly aligned masquerade as two separate groups, despite the fact that they do not compete against each other and offer exactly the same policy positions. This may be considered more like a dictatorial system than a democracy, where elections are simply for show and have no actual effect on policy decisions.

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