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18 OR 21: THE ECONOMIC IMPLICATIONS OF THE MINIMUM LEGAL DRINKING AGE IN THE UNITED STATES

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Abstract

This paper will provide an economic analysis of the implications of lowering the minimum legal drinking age from 21 to 18. The minimum legal drinking age (MLDA) has long been a point of contention in American society as both economists and politicians alike vet their ideas for the optimal MLDA. Given the fact that the United States is only one of a few developed nations to enforce a 21 year old MLDA, people who oppose the current system argue that 18 year old MLDA models established in other developed nations, such as those in the European Union (EU) have resulted in better social outcomes, such as lower levels of excessive or "binge" drinking. Another point of debate surrounds externalities, or the negative costs that one imposes on others through their actions, which include the risk of being exposed to drunk drivers. Furthermore, since the minimum enlistment age for the U.S. military as well as the legal voting age is 18, those in favor of a lower MLDA argue that our laws should consistently reflect the idea that 18 years old represents the age of adult maturity in the United States.

Moreover, given the budget crises that we have faced recently, enfranchising 18-20 year olds with the ability to drink legally may lead to an increase in alcohol consumption, which could boost government tax-revenue. Simultaneously, an age-18 MLDA would also reduce enforcement costs of the 21 year-old MLDA. Thus, the research problem that this paper will attempt to address is whether lowering the MLDA from 21 to 18 makes sense from an economic perspective. Specifically, a cost-benefit analysis that quantitatively analyzes the effect of lowering the MLDA will be presented. Rather than dive into both the costs and benefits of a potentially lower MLDA, this paper will assess the increase in both private and social costs as a result of allowing the 18-20 year old age group legal access to alcohol. The conclusion of the

paper will illustrate that, although we cannot make any concrete determinations, the economic analyses overwhelmingly favor maintaining the current 21 year-old MLDA.

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I. Introduction

The minimum age law for alcohol purchase and consumption has long been a contentious point in modern-day American society. The history of the minimum legal drinking age (MLDA) has been turbulent and includes both state and federal mandates that have attempted to control this important aspect of American culture.

Most recently, this issue has been brought back into the national spotlight due to our current recession and the looming U.S. debt crisis. According to economic data, our current recession has been worse than any other recession in recent history due to its length as well as the continuing high levels of unemployment.[1] With regards to duration, the recession has lasted approximately 18 months which is longer than any economic downturn since World War II.[2] Moreover, in July of 2011, the United States Department of Labor estimated that the current unemployment rate sits at a staggering 9.1%.[3] A government jobs report recently indicated that over 7.9 million jobs had been lost since the recession began in late 2007.[4] Thus, the question of whether a reduction in the minimum legal drinking age could increase alcohol purchase and help boost government tax revenue while stimulating the economy has emerged.

As of August 2011, the federal government faces a national debt of over $14.3 trillion which represents about 95% of the country's total output of goods and services or GDP.[5] This debt is perpetuated by the looming Social Security, Medicare, and Medicaid crises resulting from the retiring of millions of baby boomers.[6] Having nearly defaulted on trillions of dollars of debt in July of this year, the U.S. government is searching for ways to increase government revenues over the long-term. Additionally, states are also feeling the pinch when it comes to their own

[1] Willis 1.
[2] The National Bureau of Economic Research's Cycle Dating Procedure 1.
[3] United States Department of Labor 1.
[4] Isidore 1.
[5] Meesuk 1.
[6] Meesuk 1.

budgets. According to the Center on Budget and Policy Priorities, in fiscal year 2012, 42 states and the District of Columbia will attempt to close approximately $103 billion in budget gaps.[7] In addition to raising revenues, these states will have to cut expenditures from their fiscal budgets. According to research conducted by Wolfson, Wagenaar, and Hornseth, enforcing the current age-21 MLDA incurs high costs and is ineffective.[8] Their research indicates that funds could be more effectively used in alcohol education programs to better combat underage drinking.[9] Thus, supporters of a reduction in the MLDA argue that it would assist states in reducing enforcement costs and balancing their budgets.

Moreover, our current wars in Afghanistan and Iraq have prompted numerous legislators to contend that, if an 18 year-old man or woman can die for their country, they are responsible enough to purchase and consume alcohol legally. This situation is reminiscent of the Vietnam War-era logic in which the MLDA was reduced in most states from 21 to 18. At the time, a greater focus on enfranchisement of youth by allowing 18-20 year olds to vote with the passage of the 26th amendment as well as the military service that our young men and women were providing in Vietnam, triggered a shift towards reducing the MLDA.[10]

Importantly, this issue has also been gaining momentum due to the Amethyst Initiative, a coalition of over 100 college presidents and chancellors that have been urging Congress to re-think the National Minimum Drinking Age Act passed in 1984. This initiative, which includes signatures from leaders of prominent universities such as Dartmouth, Duke, Johns Hopkins, and Virginia Tech, argues that the 21 year old MLDA is currently not effective on college campuses. Specifically, this initiative notes that "A culture of dangerous, clandestine "binge-drinking"—

[7] McNichol et. al 1.
[8] Wolfson et. al 9.
[9] Wolfson et. al 9.
[10] Miron et. al 1.

often conducted off-campus—has developed."[11] This increase in the prevalence of underground and underage binge drinking on college campuses across the country has bred disregard for the law and elevated the dangers associated with underage binge drinking. Supporters of the initiative have also pressed Congress to encourage a national public debate about this controversial issue.

[11] Amethyst Initiative 1.

II. Background Information

Prior to laying out the economic implications behind a reduction in the MLDA, this section will focus on basic information with regards to alcohol. Thereafter, a background of alcohol control laws and the evolution of the history of alcohol legislation will be provided.

Alcohol, also known as ethyl alcohol, pure alcohol, grain alcohol, or drinking alcohol is a flammable and volatile colorless liquid. Although alcohol has been known to be used as fuel, in thermometers, or as a solvent, it is most widely used as a recreational substance. Ethanol's empirical formula is C_2H_6O. Alcohol is a byproduct of the fermentation process in which the yeast cells within sugars are converted to ethyl alcohol. Hard alcohol which has a stronger concentration of alcohol is subsequently produced through the distillation process. Once alcohol is consumed, it has different widespread physical and chemical reactions on the body and affects people differently. It is also absorbed into the bloodstream at varying speed depending on several factors including the concentration of alcohol, the type of drink consumed, how full the stomach is, as well as the weight of an individual. The alcohol is carried by the blood throughout the body and dissolves in human tissue.

The unit used to measure how much alcohol is in a person's bloodstream is the Blood Alcohol Content (BAC). Figure 1 illustrates how a person's BAC changes with consumption of varying amounts of alcohol and the levels of intoxication associated with those BACs. Moreover, Figure 1 indicates that there are transient dangers associated with the consumption of alcohol. Although moderate alcohol consumption can yield long-term health benefits such as a reduction in the likelihood of cardiovascular disease, its abuse can have damaging effects on a person's body. Specifically, these effects include liver disease, alcohol-related heart disease, alcohol-

related cancer, brain damage, pancreatitis, and alcoholism.[12] Finally, Figure 2 presents a summary of common specific behaviors that a person may exhibit at differing BAC levels.

[12] Alcohol Information 1.

III. Arguments For and Against a Lower MLDA

This section of the paper will focus on economic and social arguments for and against establishing a lower minimum legal drinking age (MLDA). The basic economic arguments of this discussion will provide evidence both in favor and against a lower MLDA by assessing the externalities associated with a lower MLDA and the data regarding the protective effects of the age-21 MLDA. The social arguments both for and against a lower MLDA will also be presented reflecting a wide range of views on the issue. The cases for and against a lower MLDA are divided into economic, social, and other arguments below.

A. Arguments Against a Lower MLDA

a. Economic Arguments

The key economic argument against legalization is that it creates negative externalities. Simply defined, negative externalities are the result of one's actions imposing a negative cost on another individual/third party. It arises in a situation where an individual does not pay for the full cost of his action. A simple example would be a factory that pollutes nearby rivers because the cost of doing so is so low. As a result, fishermen are not able to fish and people are unable to swim in those rivers because they have been polluted by the factory. Thus, the factory made a decision which imposes negative costs on others (the fishermen and swimmers) while not paying the full costs of those actions. From a minimum legal drinking age standpoint, lowering the MLDA would create externalities by increasing the number of potentially drunk drivers on the road, imposing additional costs to those not part of the private transaction (i.e. drinking alcohol). Thus, if there are a greater potential number of drunk drivers on the road, this situation creates an externality for those that do not drink and drive and rely on the safety of the roads. In this case, the person who drinks and drives does not fully take into account the costs imposed on others by

his reckless behavior. The cost-benefit analysis of this paper will focus on attempting to quantify the per-drink externality cost in deducing some conclusions about the effectiveness of the current MLDA. Since externalities are one of several scenarios where the market operates inefficiently (a market failure), it is often a suitable entry point for government intervention.

b. Social Arguments

There are numerous arguments that are made by the supporters of our current age-21 policy. Those supporters operate under the assumption, that if it isn't broken, there is no need to fix it. The first of these considerations is that since older teens are often exposed to physical changes, peer pressure, new and unusual situations and impulses, they may be more prone to becoming engaged in substance abuse, not just of alcohol, but also of illicit drugs. Moreover, these factors, by increasing the probability of substance abuse, also elevate the likelihood of engaging in unplanned or unprotected sex, depression, and violence.[13] Another factor to consider, according to the U.S. Department of Health and Human Services, is that adolescents in their late teens are more likely to binge drink than those above the age of 21, illustrating that teens may be more vulnerable to abusing alcohol and the costs therein.[14] Moreover, the Federal Trade Commission notes that late teens that do drink have a higher chance of failing academically, and therefore, providing them with legal access to alcohol will arguably inhibit the academic performance of many students.[15]

Furthermore, a principal point, usually made in response to an argument from the opposing side, is with regards to cultural similarities between many of the European age-18 or below MLDA models. Supporters of the age-21 MLDA note that attempting to compare how alcohol policies affect youths in Europe versus how alcohol policies affect youths in the United

[13] Dangers of Teen Drinking 1.
[14] United States Department of Health and Human Services 1.
[15] Dangers of Teen Drinking 1.

States is like comparing apples to oranges. Specifically, they argue that because American teens generally start driving at earlier ages and drive at a significantly higher level than their European counterparts, American teens are often at greater risk of drinking and driving. If the drinking age were lowered in the United States, these teens who by cultural differences, naturally tend to drive more than European teens, would have greater ease of access to alcohol and thus increase their probability of driving after drinking.[16] Lastly, a central argument that has sustained much of the debate regarding the MLDA relies on data from the Mothers Against Drunk Driving (MADD) organization. They argue that, the earlier a person is exposed to alcohol use, the greater the likelihood that "they will fall victim to alcoholism later in their life, harming their brain during its development, and suffering negative physical withdrawal symptoms."[17]

[16] Wagenaar et. al 1.
[17] Underage Drinking and the 21 MLDA Law 2.

B. Arguments For a Lower MLDA

a. Economic Arguments

The main economic argument against a lower MLDA is that it would reduce the costs of enforcing the age-21 MLDA. Often times, police forces, especially in college towns, will spend a significant amount of their efforts in enforcing the age-21 MLDA by seeking out and issuing citations to underage drinkers. According to a study by Wolfson, Wagenaar, and Hornseth where they interviewed numerous law enforcement officials, they concluded that youth and teen drinking are prevalent issues in many communities and that the age-21 MLDA does not serve to constrain teens from drinking.[18] They argue that enforcing the age-21 MLDA is ineffective and that resources allocated to enforcement could be more wisely utilized. Instead, the authors conclude that the money spent on the enforcement of drinking laws for the 18-20 year old age group could be better spent on alcohol education programs specifically targeted at America's youth. Another key economic argument to be made for lowering the MLDA is that taxes on alcohol in tandem with an age-18 MLDA are substitutable to the age-21 MLDA. Specifically, in a research paper that examined the effects of alcohol taxes on prices and subsequently on consumption, Chaloupka et. al concluded that, under a lower MLDA policy (such as the one present in the early 1980s), adolescents were significantly more elastic to changes in prices than they were in a higher MLDA system.[19] They note that for an underage youth, the full price of consuming alcohol is actually the monetary price plus the indirect costs of illegally obtaining the alcohol. The indirect costs include the MLDA law itself, time and money spent securing false identification, and the time spent obtaining the alcohol. They provide the following insight:

[18] Wolfson et. al 9.
[19] Chaloupka et. al 5.

> "When the average MLDA and, consequently, the associated indirect costs of alcohol, are relatively low (as in the 1982 sample), a given increase in alcohol taxes will have a relatively large impact on the full price of alcohol and thus on consumption. Conversely, when the average MLDA and the associated indirect costs of alcohol are high (as in the 1989 sample), a similar increase in alcohol taxes will have a relatively small impact on the full price of alcohol and on consumption. Accordingly, high school seniors in 1989, who faced higher indirect costs of obtaining alcohol than their 1982 counterparts, responded less to changes in the monetary costs."[20]

Since taxes are usually reflected in the prices charged to consumers, the increase in monetary costs in this scenario represents the increase in the indirect costs of alcohol when similar taxes are put into place. Therefore, an argument can be made for taxes being an effective and substitutable method of the age-21 MLDA, possibly in tandem with an age-18 MLDA.

b. Social Arguments

There a several arguments to be made for a lower MLDA from a social perspective. Specifically, the consideration that opponents of the current system bring up is that turning 18 represents the age of adulthood. Specifically, at age 18 people are given the right to vote in elections, sign legally-binding contracts, get married, or enlist in the United States military. The last item regarding enlisting in the U.S. military is particularly significant. If a soldier is given the responsibility to defend himself and his fellow soldiers in the line of fire, it is difficult to justify an argument that this man or woman is not mature or responsible enough to consume alcohol, regardless of his/her age. Given the fact that the age of maturity in the United States seems to be 18 based on the liberties granted to people at that age, critics of the age-21 MLDA policy say that current MLDA laws are not consistent with those liberties.

[20] Chaloupka et. al 5.

Another common argument against the status quo is that the current system makes drinking alcohol a taboo in society and creates a stronger desire for underage youth to attempt to purchase and consume alcohol to fit in. Namely, lowering the drinking age to 18 would mitigate or eliminate the "thrill" also known as the forbidden fruit argument that young people receive from breaking the law and often engaging in "binge" drinking (where "binge" is defined as consuming five or more drinks in one sitting). Along these lines, drinking in social settings will teach moderation and simply make alcohol consumption a normal activity.

Furthermore, another important social issue in favor of lowering the MLDA is that, by setting the drinking age at 18, our laws marginalize the role of parents and school teachers by forcing youths to learn how to drink on their own, often in dangerous settings during their collegiate years. By not having the ability to teach their kids how to drink responsibly and in moderation, parents are often unable to shape how their kids perceive alcohol abuse.

The final argument that will be made presently in favor of a lower MLDA is an issue relating to the circumstances surrounding underage drinkers. Specifically, by prohibiting 18-20 year olds from drinking alcohol, our current system forces these adolescents to engage in underground, unsupervised and often dangerous drinking situations. When these adolescents or their friends suffer alcohol-related injuries or accidents, they are often hesitant to seek medical attention due to fear of self-incrimination. There have been numerous nationwide instances of such scenarios occurring where, due to the unfortunate circumstances that our youth are placed in, they often fail to make the right decision to seek medical help often times resulting in the tragic deaths of themselves or their friends.

IV. History of Alcohol Regulation

A. Early History and the Progressive Reform Era

Alcohol regulation began in the late 18th century in the United States with the imposition of a tax on whiskey distilleries. The first known major form of government regulation on alcohol came in 1791, when the Act of 1791 also known as the "Whiskey Tax" levied a tax on "both publicly and privately distilled whiskey."[21] Two years later, when it was discovered that certain distilleries were not paying the required taxes on their products, the "Whiskey Rebellion" took place in which government troops arrested those distillery leaders who failed to pay the necessary taxes.[22] By 1802, Thomas Jefferson had repealed the Whiskey Tax noting that it was infringing upon the freedom of the American people.[23] Approximately ten years later, a new alcohol tax was temporarily imposed to help the United States fund the War of 1812 against the British. However, this tax was only in effect until 1817. Thus, tax regulation of alcohol began to decrease after 1817 and by the 1860s, alcohol distilleries in the United States were producing 88 million gallons of liquor per year.[24] In 1862, Abraham Lincoln, through the Act of July 1, imposed a new tax on liquor to help defray the costs of the Civil War in the United States. This act essentially established the Office of Internal Revenue, which began to collect an alcohol tax of $0.20 per gallon in 1862 and rose to $2.00 per gallon by 1864.[25]

The next major milestone in the history of alcohol regulation in the United States came in the form of Prohibition, when in December of 1917, the Congress passed the 18th amendment to the Constitution. There were several forces in play that contributed toward the idea of Prohibition gaining its momentum. Advocates of alcohol temperance formed two major

[21] Loyola Marymount University 1.
[22] Loyola Marymount University 1.
[23] Loyola Marymount University 1.
[24] Loyola Marymount University 1.
[25] Loyola Marymount University 1.

organizations which fostered Prohibition in the United States. The most prominent of these organizations was the Women's Christian Temperance Union (WCTU) whose explicit goal was to "persuade all states to prohibit the sale of alcoholic beverages."[26] The WCTU was founded in Cleveland, Ohio during the late 1800s and grew to comprise nearly 150,000 mainly Protestant, middle class members by 1900. This organization was focused on combatting the negative influence of alcohol on families and society.[27] One of the key beliefs of members of the WCTU was that alcohol abuse was not a result of personal weakness or lack of control but rather an issue embedded in the greater social problems of the Progressive Reform Era. Just like many progressives of the time, the WCTU included activists who believed that social reform was necessary to curb the effects of urbanization and industrialization of America in the last quarter of the 19th century.

Specifically, many social issues emerged as American society became increasingly technological and industrial. Since a significant portion of the American population had been born and raised mainly on farms, the drastic growth in cities, the increasing importance of large-scale industry, and the transformation of the workforce due to an influx of immigrants made it difficult for many people to adjust to the changing face of the American economy.[28] Although progressives took aim at improving many critical aspects of society, such as local government, finance, insurance, industry, railroads, education, churches, and medicine, a strong emphasis was placed specifically on the purification of government. It was felt that local bosses who owned saloons had too much influence and political power and were a key cause of corruption in the political system. Thus, an effort was made to expose the corruption of these local bosses. Simultaneously, women's suffrage was being brought into the national spotlight. The

[26] Wisconsin Historical Society 1.
[27] Wisconsin Historical Society 1.
[28] Wisconsin Historical Society 1.

combination of these forces in late 19th century American society helped spur the creation of the WCTU as well as the push for Prohibition. The WCTU found alcohol to be the cause of many social ills including poverty. Moreover, the WCTU believed that the most effective way to eliminate poverty would be to abstain from alcohol consumption.

Additionally, the WCTU felt that immigrants were more prone to alcoholism and thus focused on this perceived issue by allocating most of their budget in the early 1900s to their center on Ellis Island where immigrants first entered the United States. [29] As part of the entry process, the WCTU encouraged new members to abstain from drinking alcoholic beverages because of the dangers it poses to one's "morality." Specifically, the WCTU was concerned that foreign immigrants would be contaminating American society with ideas of lenience towards alcohol consumption. In fact, many of the WCTU members were "largely anti-foreign, anti-Catholic, anti-German, and anti-Semitic and promoted eugenics."[30] Moreover, the Ku Klux Klan (KKK) was an active promoter of Prohibition and had many associations with the WCTU as many women held leadership positions in both organizations.[31] Members of the WCTU utilized somewhat "extreme tactics to convince Americans to abstain from alcohol such as the picketing of bars and saloons, praying for the souls of the bar patrons, and trying to block the entryways of establishments that sold liquor."[32] The radical actions of the organization served as a key driving force behind the eventual passage of the 18th Amendment in 1919.

The second key organization to advocate for Prohibition was the Anti-Saloon League (ASL). The ASL was also a key temperance movement and saw itself as a fundamentally Protestant church movement. This organization was distinctly different from the WCTU in that

[29] Schultz et. al 1.
[30] Schultz et. al 1.
[31] Hanson (Woman's Christian Temperance Union) 1.
[32] Hanson (Woman's Christian Temperance Union) 1.

"it did not discriminate against men and was much more effectively organized as a political pressure group in that it utilized bureaucratic methods to build a strong organization."[33] Moreover, the ASL differed from the WCTU in the methods that it utilized to achieve its key goal of increasing and focusing anti-alcohol sentiment. Ultimately, the group was neo-prohibitionist in its ideology in that it was focused on eliminating per capita alcohol consumption by lobbying for more restrictive legislation regarding alcohol sale and consumption.[34] Moreover, one of the ASL's main goals was to influence the public's perception of alcohol in such a way that it would reduce the social acceptability of drinking.[35]

The Anti-Saloon league used a variety of effective methods in achieving their goals as they were commanded by strong and influential leaders during their most prominent years. The first such method was the ASL's establishment of the American Issue Publishing Company (AIPC). In only three years after its establishment, the AIPC was producing 250 million book pages per month which advocated the ASL's ideas and beliefs regarding the acceptability of purchasing and consuming alcohol.[36] One of the ASL's early leaders, Purly Baker engaged in a campaign of demonizing alcohol producers, most of which were of German descent. When he assumed the role of the organization's leader in 1903, the League began to utilize posters that "vilified the 'Huns' who were portrayed as ape-like Neanderthals threatening the U.S. and its way of life. Stigmatizing German brewers proved to be a highly successful strategy of disenfranchising producers of alcohol as World War I approached." [37]

Once the United States became engaged in World War 1, the ASL leader, William H. Anderson attempted to make synonymous the Prohibition crusade with patriotism. Reminiscent

[33] Hanson (Anti-Saloon League) 1.
[34] Hanson (Neo-Prohibitionism and Neo-Prohibitionists) 1.
[35] Hanson (Neo-Prohibitionism and Neo-Prohibitionists) 1.
[36] Hanson (Anti-Saloon League) 1.
[37] Hanson (Anti-Saloon League) 1.

of the national sentiment at the time, he was quoted as saying that, "The challenge to loyal patriots of America today is to demand the absolute prohibition of the liquor traffic."[38] Anderson went so far as to delineate that certain ethnic backgrounds such as Jews, Irish, and Italians, whose cultures generally accept alcohol consumption, were the "unwashed and wild-eyed foreigners who have no comprehension of the spirit of America."[39] However, Anderson's greatest point of contention was with the Catholic Church. Given that cities were becoming increasingly populated by southern and eastern European Catholic immigrants, a cultural clash of ideas and beliefs was brewing.

To a certain extent, many historians believe that the temperance and prohibition movement was "a part of the cultural war between the largely Protestant rural residents from northern Europe and the newer and culturally different immigrants."[40] Anderson went so far as to accuse the Catholic Church of attempting to bring down law and order and accused the Church of "engaging in efforts to destroy the Prohibition victory and bring back the Saloons."[41] The ensuing ASL leader, William E. "Pussyfoot" Johnson also used unorthodox tactics to further endorse the goals of his organization. For example, he would write to the "wet" leaders, those who didn't believe in the Prohibition cause, asking them for advice on how to defeat the temperance or "dry" activists. [42]

Eventually, the actions of the WCTU, the ASL, the KKK and many other structured organizations aided in the passage of Prohibition. The WCTU had succeeded in convincing the American public that alcohol was destroying families and marriages. They argued that men would spend their money in the saloons rather than providing food and clothing for their

[38] Hanson (Anti-Saloon League) 1.
[39] Hanson (Anti-Saloon League) 1.
[40] Hanson (Anti-Saloon League) 1.
[41] Hanson (Anti-Saloon League) 1.
[42] Hanson (Anti-Saloon League) 1.

families. Furthermore, they argued that alcohol was the cause of men abusing and beating their wives and children, and as such it was seen as the driving force behind household abuse.[43] Women argued that, even when they did have jobs, men were the breadwinners and thus, it was difficult to manage the household when men were spending their paychecks on alcohol.

The ASL was probably the driving organization behind Prohibition by increasing anti-alcohol sentiment throughout the United States. The organization, by publishing millions of pages supporting their agenda, was able to intensify emotion against the negative impact of alcohol and saloons in American society. Moreover, by demonizing German-Americans in the period leading up to World War 1, many of whom were saloon owners, the ASL was able to successfully convince people to reduce their patronage at many alcohol-serving establishments. Moreover, the League successfully exploited the difficulties of new immigrants assimilating into America by stating that their cultures' acceptances of alcohol was to blame for many of the alcohol-related problems in society at the time. Ultimately, the League also sought to use the Catholic Church as a scapegoat for these problems, although their extreme tactics and radical views eventually did not sustain the Prohibition movement in the long-run.

The KKK also played a significant role in Prohibition by supporting the WCTU and ASL. In fact, many prominent leaders held positions in both the KKK and either the WCTU or ASL. Although their role in the passage of prohibition was much more muted than the other two organizations, the KKK played a much greater role in the strict enforcement of Prohibition once it was passed by Congress in 1919.[44]

[43] National Archives 1.
[44] National Archives 1.

B. Prohibition: America's Failed Noble Experiment

The strong organization of the dry forces, the WCTU and the ASL, the argument that the alcoholic beverage industry was diverting grain away from the war effort, and the clear xenophobia directed toward German-Americans, all contributed to the passage of the 18th Amendment in the United States.[45] For many years, prohibition of alcohol was perceived by many as the path toward a utopian society. Alcohol was often blamed for many of society's problems including domestic abuse, crime, poverty, and violence. Thus, there had been strong national momentum toward attempting the social experiment of Prohibition in the United States.

The 18th amendment specifically prohibited the "manufacture, sale, transportation or importation of intoxicating liquors in the United States." [46] However, since the amendment did not provide a definition of "intoxicating liquors" or provide penalties for breaking this law, Congress introduced the Volstead Act or the National Prohibition Act in 1919 to address these issues. Despite President Woodrow Wilson's veto of this bill, Congress utilized a three-fourths override clause to pass the Volstead Act in October of 1919. The three specific purposes of the Act were as follows:

1. To prohibit intoxicating beverages.
2. To regulate the manufacture, production, use and sale of high-proof spirits for other than beverage purposes.
3. To ensure an ample supply of alcohol and promote its use in scientific research and in the development of fuel, dye and other lawful industries and practices, such as religious rituals.[47]

[45] Hanson (The Noble Experiment) 1.
[46] Digital History 1.
[47] The Eighteenth Amendment and the National Prohibition Act 1.

Specifically, the Act defined as "intoxicating liquor" any beverage which contains more than 0.5% alcohol by volume. Although proponents of Prohibition argued that the alcohol consumption domestically was diverting grain from the war effort, by the time it was enacted, World War 1 had already ended.[48] Although the passage of Prohibition was meant to be beneficial to American society, it inadvertently created many disastrous consequences which later led to its repeal.

Prohibition was a social failure in the United States due to its unenforceable nature, its unintended increase in crime, the availability of alcohol at speakeasies, and the easy nature by which alcohol could be obtained from doctors with a prescription.

One of the key reasons that Prohibition was not a successful policy decision in the United States was due to the fact that the nature of the 18th amendment made it almost impossible to fully enforce. Advocates, both congressional and ordinary citizens naively underestimated the difficulties associated with stopping the masses from consuming a beverage that had long been ingrained into American culture. An astounding example of this callow behavior is that Congress initially allocated a mere $5 million for enforcement of the 18th amendment. Only a few years later, the government estimated that the true costs of full enforcement would equal $300 million.[49] Initially, the government assigned the enforcement responsibilities to the Internal Revenue Service (IRS) and never hired more than 2,500 federal agents to enforce the law.[50] Thus, these agents who often destroyed moonshine stills were dubbed "revenuers." It became overwhelming difficult for IRS agents to enforce the law because of the widespread nature of bootlegging and smuggling of alcohol as well as the presence of illegal alcohol-serving establishments known as "speakeasies." Even with the aid of both the Coast Guard and the

[48] History of Alcohol Prohibition 1.
[49] Digital History 1.
[50] Digital History 1.

Immigration Service, the forces gathered to enforce Prohibition were scanty at best.[51] Charles Merz, an ordinary citizen during the Prohibition era closely documented his experiences of the efforts by the Federal Government to enforce the 18th amendment. As he so graphically described, "if the whole army of federal agents in 1920 had been mustered along the coasts and borders--paying no attention for the moment to medicinal alcohol, breweries, industrial alcohol, or illicit stills-there would have been one man to patrol every twelve miles of beach, harbor, headland, forest, and river-front."[52]

Moreover, in 1920 the salaries of these federal agents were between $1,200 and $2,000, rising to between $2,300 and $2,800 in 1930.[53] These very modest pay figures, representing a salary of between $35 and $50 a week did not bode well for the federal government employing these agents.[54] At these low earnings figures, it is highly unlikely that these agents would possess the in-depth technical expertise necessary to supervise the intricate chemical operations of industrial alcohol plants or to be able to successfully outwit the powerful and elusive bootleggers backed by the various organized crime syndicates.[55] To make matters worse, the agents' low pay figures made it extremely unlikely for them to successfully resist accepting bribes from the deep pockets of organized crime gangsters. Moreover, even when agents were able to infiltrate the speakeasies and other sources of illegal alcohol supply, bureaucracy and corruption at the most important levels of the judicial system jeopardized the prosecution of law-breakers. One estimate states that, in New York City, out of approximately 7,000 arrests for liquor law violation, only 17 resulted in actual criminal convictions.[56]

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[51] Alcohol and Al Capone 1.
[52] Alcohol and Al Capone 1.
[53] Alcohol and Al Capone 1.
[54] Alcohol and Al Capone 1.
[55] Alcohol and Al Capone 1.
[56] Alcohol and Al Capone 1.

Thus, it is evident that many of the judges were often bribed by organized crime leaders and other reputable figures in society to the extent that the judicial system was not carrying out its purpose in prosecuting these criminals. Ultimately, the inherent corruption present in the judiciary system, the government's inability to muster up a sizable and intelligible force of agents to crackdown on illegal behavior regarding alcohol, and the insufficient salary of these agents resulted in the efforts of agents being futile.

Within just one week of the passage of Prohibition, it was obvious that the tougher regulations of alcohol consumption and manufacture would not deter, and in fact, even encourage brazen behavior in acquiring and consuming alcohol. The underground drinking establishments known as "speakeasies" were established all across the nation to accommodate the demand for alcohol consumption. "The specific reason for being called speakeasies was due to the fact that, to order alcohol without drawing attention, bartenders asked customers to remain quiet and 'speak easy.'"[57] According to one estimate, for every legal bar that closed due to Prohibition taking effect, six speakeasies opened up for business.[58] Speakeasies quickly became one of the key methods by which to access alcohol in America in the 1920s and 1930s. By the mid 1920's, it was estimated that New York City alone was operating thousands of speakeasy clubs.[59] The speakeasies often were able to deter federal agents cracking down on these illegal establishments, by ensuring that their whereabouts were kept secret and that all patrons provide a secret password before being granted entrance.[60] Moreover, the profit opportunities available from running a speakeasy were palpable. "One New York City proprietor estimated that his cost of operating a speakeasy was $1,370 per month. Of that $1,370, around $400 was used to bribe

[57] Vintage Periods 1.
[58] Vintage Periods 1.
[59] Speakeasies 1.
[60] Speakeasies 1.

federal prohibition agents, police officers, and the New York District Attorney."[61] In addition, cops would be paid $40 to look the other way whenever a delivery of alcohol was being made to the speakeasy.

Additionally, some speakeasy owners, rather than bribe public officials, looked to create elusive and expensive concealing systems in preparation for raids by federal prohibition agents. Speakeasies were gaining popularity and momentum, so much so, that by 1927, it was estimated that there were 30,000 speakeasies in operation.[62] This figure shockingly represents approximately twice the number of legal bars that were open for business before prohibition. In the city of Cleveland, there were approximately 1,200 bars in business just before Prohibition. By 1923, a mere four years after the passage of the 18th amendment, there was an estimated 3,000 illegal speakeasies and 10,000 stills in the city. Moreover, 30,000 of the city's residents illegally sold alcohol during Prohibition and 100,000 other citizens "made homebrew or bathtub gin for themselves and friends."[63]

In this regard, it was evident that many of these underground drinking establishments were created due to their aforementioned lucrative financial benefits. Therefore, although these bar owners were serving public demand for alcohol, they were also profiting handsomely due to the reduced availability of alcohol and also because the government did not fully enforce its prohibition.

Prohibition was also a tremendous failure because it promoted disregard for the law and an increase in corruption and organized crime. During the Prohibition era, ordinary citizens could not access alcohol but numerous gangsters established organized criminal syndicates to step in and meet the public's demand. These gangsters, the ranks of which include the infamous

[61] Speakeasies 1.
[62] Digital History 1.
[63] Digital History 1.

Al Capone, the Detroit Purple Gang, and the Owney Madden Ring of New York City stepped in and became "bootleggers" or illegal transporters and providers of alcohol during the Prohibition Era. Bootlegging had existed prior to Prohibition but had skyrocketed after the 18th amendment passed because gangs were willing to take on relatively small risks in return for a high reward. This reward came in the form of incredulous financial opportunities. Quite simply, bootlegging turned an enormous profit. One estimate notes that the sum total of professional bootleggers' profits during the crest of Prohibition was nearly $4 billion.[64]

One of the key cities that saw an increased concentration in organized crime and the bootlegging of alcohol during Prohibition was Chicago, where Al Capone's mob conducted its operations. Capone's mob was so efficient and profitable that according to estimates, by 1927 his income from alcohol sales alone was an astounding $60 million.[65] The total sum profits of his illegal mob yielded him about $105 million in that same year.[66] Although Capone pulled in astonishing figures for his illegal behaviors, he did spend approximately $75 million on bribing both the police and public officials in the city of Chicago, as he believed that these key investments were necessary for his gang to continue to survive and be viable. It is believed that Capone had "city aldermen, mayors, legislators, governors, congressman, and over half of the Chicago police force on his payroll."[67]

The fact that furnishing alcohol illegally to the public became such a profitable business created fierce competition between the organized crime gangs that fought for territory in Chicago and other major metropolitan areas. This increased hostility put many more Americans at risk of being caught in the crossfire of gang violence than had previously been the case. In an effort to

[64] Hales et. al 1.
[65] Trueman 1.
[66] Trueman 1.
[67] Angelfire 1.

kill Bugs Morgan in 1929, Al Capone made his biggest mistake of all when he ordered the execution of seven of rival Bugs Moran's gang members. In what would become known as the St. Valentine's Day Massacre, this highly publicized event was seen as the crucial turning point that further solidified the public's view about the necessity to take on organized crime.

Up until that point, although the public's view of organized crime had likely been negative, organized crime syndicates were also seen as the key supplier of illegal alcohol to the public. By this point, the violence and death count as a result of the gang wars had become too unbearable for the public and the tide began to turn against the public's acceptance of Prohibition.

Specifically, Prohibition led to an increase in two specific forms of homicide. The first was gang killings as a result of gang wars for territory in the illegal liquor business. The second was liquor law enforcement killings, whereby federal agents who attempted to crackdown on gangs that were operating speakeasies or illegally distributing alcohol by other means, were killed in the line of duty. Due to the fact that organized crime members paid massive bribes to politicians and the police force, the criminals responsible for these increased killings often escaped with no convictions. For instance, in a study of homicides for the 1926-1927 period in the city of Chicago, a researcher looked at 130 gang murders. Out of that population of murders, only 26 of them resulted in court action against the offenders.[68] As such, most of the offenders escaped with no punishments, while few received very minor sentences for their heinous actions. With regards to the increase in liquor law enforcement killings, these homicides did not begin with Prohibition but certainly experienced a drastic rise with the passage of the 18th amendment.

[68] Landesco 8.

In one specific study, it is concluded that for the 1920-1930 period, the total homicides resulting from Prohibition are 1,550 which includes 494 officers and 1,056 civilians.[69]

Figure 3 summarizes data collected on homicides in the United States for the 1910-1930 period. If we can conclude that homicides are an accurate benchmark for social disorder and general crime levels, then it can be deduced that crime significantly increased from 1900 to 1930. Although the most drastic increase in this level occurred between 1900 and 1910, when the number of homicides per 1,000 people per year rose 225%, a continuation of this trend continued throughout the Prohibition era in the United States.

Moreover, crime-specific data for males collected for the period of the early 1900s also illustrates an alarming rise in the number of people involved in various crimes. Figure 4 summarizes the rate of prisoners received from courts by state and federal prisons and correctional facilities per 100,000 people in the United States. As can be illustrated from the Figure 4, the overall rate of male prisoners in state prisons and correctional facilities rose significantly from 55.5 per 1,000 people in 1910 to 88.1 per 1,000 people in 1928. It is clear that some of this increase in incarcerations is partially attributable to the rise in violation of liquor laws, which undoubtedly became more stringent after the passage of the 18th amendment.

However, the increase in the liquor law violations is only part of the story and the general upward trend in imprisonment as a result of serious criminal offenses can surely be tied back to the role of organized crime during Prohibition. As previously noted, the intense and violent competition between gangs, especially in large cities such as Chicago and New York, undoubtedly led to an increase in homicides. However, how much of the total trend in imprisonments can be traced back to Prohibition is a more complex question to answer. The author of the study that collected data in the above table, John Landesco, points out that other

[69] Landesco 8.

factors coincident with national prohibition such as the dislocation of society during and after World War 1 could have played a role in the increased violence and crime statistics.[70] Other factors such as the increasing prevalence of cars in society may have resulted in increased robberies due to the now more facile method by which to escape from a robbery. However, one thing is clear; there is a correlation between the increase in organized crime activities during Prohibition and the uptick in rates of crime and imprisonment in the United States following the passage of Prohibition in 1919. Undoubtedly, many including Landesco would conclude that Prohibition's repeal did not empty the jails and perfect society's ills but did lead to the elimination of the fuel of organized crime in 1920s America: illegal alcohol.

Ultimately, Prohibition was America's Noble Experiment that attempted to serve Progressive Reform Era supporters who believed that alcohol was to blame for many of society's problems. As the industrialization and urbanization of American society took place in the late 19th century, many Americans accustomed to earning their living as farmers, were disillusioned and often struggled to adapt to society's changing ways. As part of this era of attempting to alleviate society's issues with government reforms, several organizations also promoted the idea that it was necessary to simultaneously improve the "morality" of Americans. One of the methods that these groups, such as the WCTU believed was necessary was to abstain from drinking alcoholic beverages due to its perceived degradation of a person's morality as well as its causation of many domestic violence issues. Although the intentions of Prohibition were positive, it ultimately failed as a social reform due to its unenforceable nature, its increase in the availability of alcohol through illegal channels such as speakeasies, as well as its fueling of organized crime activities such as the mafia and gangs in large cities.

[70] Landesco 11.

C. Repeal of Prohibition and Onward

Given Prohibition's failure in American society on numerous levels, popular momentum began to shift towards repealing the 18th amendment to the Constitution. Ironically, many of the women who had originally lobbied for Prohibition's passage due to moral reasons such as protecting the family and children from the effects of alcohol abuse came to believe that repeal was even more important to protecting these same values. In addition, women had become an increasing political force and voice for the American population having gained the right to vote with the passage of the 19th amendment in 1920. These factors all contributed to women playing a pivotal role in the repeal of Prohibition in order to preserve the morality of the family from the abuse of alcohol.

The key force behind the passage of repeal was Pauline Sabin, who in 1929 founded the Women's Legion for True Temperance which later was re-named The Women's Organization for National Prohibition Reform (WONPR).[71] Prior to Prohibition, Sabin, like many other women, was a fierce advocate of prohibiting alcohol in society. In fact, her belief at the time was that a "world without liquor would be a beautiful thing" for herself and her two young boys.[72] However, like much of the electorate, Sabin started to grow distraught with the passage of time following Prohibition. She noted that the hypocrisy of politicians who would vote for measures in favor of Prohibition but illegally drink alcohol themselves, the increasing prevalence of "binge" drinking, widespread political corruption, the emergence of bootleggers, as well as the increase in mob violence and organized crime syndicates all favored the idea of repeal. Ms. Sabin went so far as to testify with the following statement to Congress for her beliefs regarding Prohibition and the increased danger that it placed on American families:

[71] Hanson (Repeal of Prohibition) 1.
[72] Hanson (Repeal of Prohibition) 1.

> "In pre-Prohibition days, mothers had little fear in regard to the saloon as far as their children were concerned. A saloon-keeper's license was revoked if he was caught selling liquor to minors. Today in any speakeasy in the United States you can find boys and girls in their teens drinking liquor and this situation has become so acute that the mothers of the country feel something must be done to protect their children."

Moreover, the stock market crash in 1929 as well as the onset of the Great Depression changed the attitudes of millions of Americans.[73] People needed to find employment and the government needed to find sources of revenue. Thus, it was tacit that the legal marketing and distribution of alcohol could create new jobs for people as well as fiscally support the government in the form of tax revenue. Thus, as millions of women and other supporters of repeal started to gain political traction, numerous other organizations sprang up that would serve critical in doing away with the 18th amendment. Two of these groups were the Association Against the Prohibition Amendment and the Voluntary Committee of Lawyers. The combined efforts of these organizations as well as the shifting national sentiment all provided an unwavering force for repeal.

In addition, repeal was aided by one of the platforms of the Democratic Party on which the candidate Franklin Delano Roosevelt (F.D.R) ran for president in 1932. Specifically, F.D.R made it clear that, if elected, he would ensure that repeal of Prohibition became a reality. His opponent Herbert Hoover from the Republican Party, was a backer of Prohibition, so in many ways, the Presidential election was a vote for either repeal or the continuity of Prohibition. Fortunately for Roosevelt, the American people wanted him as President as well as repeal. The 21st amendment to the constitution which signified the repeal of Prohibition was finally passed in December of 1933 and contained three important clauses. These items are as follows:

[73] Rosenberg 1.

Section 1: "The eighteenth article of amendment to the Constitution of the United States is hereby repealed."[74]

Section 2: "The transportation or importation into any State, Territory, or Possession of the United States for delivery or use therein of intoxicating liquors, in violation of the laws thereof, is hereby prohibited."[75]

Section 3: "This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by conventions in the several States, as provided in the Constitution, within seven years from the date of the submission hereof to the States by the Congress."[76]

Essentially, Section 1 was simply the clause that overturned the 18th amendment to the Constitution and made it legal to once again manufacture, import, and sell alcohol. Section 2 is interesting in that it allocates to individual states the right to determine how to regulate alcohol laws. Thus, Section 2 allowed for inter-state differences in alcohol control policy as we will show later in this section. Section 3 describes the process of state ratification of the amendment using the uncommon state convention ratification approach rather than the state legislature ratification approach.[77] Ultimately, the state conventions worked in such a way that they would represent the views of the popular vote much like electoral colleges vote based on the popular vote within each state during Presidential elections. In terms of the national popular vote for Repeal of Prohibition, a staggering 74% voted in favor of repeal while 26% voted in opposition to repeal.[78] The American people had spoken and approved repeal by a wide 3-1 margin.

[74] Meredith 1.
[75] Meredith 1.
[76] Meredith 1.
[77] Meredith 1.
[78] Hanson (Board of Temperance Strategy) 1.

The issue regarding how states would regulate the consumption of alcohol was only just beginning and experimentation of state alcohol policies would take many forms over the next several decades. It is important to note that, although the 21st amendment repealed Prohibition, many states decided to stay "dry" well after its passage. Missouri was the last state to remain dry until 1966, while Kansas did not allow public bars to operate until 1987.[79] Part of each individual state's responsibilities to regulate alcohol was to mandate a minimum legal drinking age (MLDA). Following Prohibition, most states set their MLDA at age 21. Specifically, 33 states set their MLDA at age 21, 16 placed it a level younger than age 21, and two states had other policies (it was still illegal in Alabama, and Colorado had no defined MLDA).[80] The only significant outlier following Prohibition was the state of Ohio which enforced an age-16 MLDA which was later raised to age-18 in 1935. Thus, there was not much experimentation around a below-21 MLDA.

During the Vietnam War-era, a focus on enfranchising the 18-20 year old segment of the population by giving them the right to vote in addition to the service that our young troops were providing in the war in Vietnam prompted a shift towards states becoming more lenient in their MLDA laws. The data on the MLDA across the 50 states and the District of Columbia does indeed show that the tide had turned with most states favoring a lower MLDA. In the 1970s, 39 states had opted to lower the MLDA below 21 at some point in the decade for either beer/wine, liquor, or both. Thus, the 1970s seems to be a logical starting point for analyzing the effects of a lower MLDA by studying the behaviors of those under 21 in states where they were allowed to legally consume alcohol. During the Cost-Benefit analysis of this paper, we will turn to one study that uses a panel fixed effects model that utilizes data from the 1970s that takes advantage

[79] Understanding the 21st Amendment 1.
[80] Understanding the 21st Amendment 1.

of the fact that young adults may have been very close in age but were subject to different legal drinking ages due to the political nature of that decade. By comparing these two groups of people, the model is designed to estimate how a lower MLDA (age-18) increases the incidence of mortality, non-fatal injury and crime rates.

However, we first must understand how we arrived at our current nationwide, age-21 MLDA. In the late 1970's and early 1980's a series of highly publicized reports came to light that revealed that teenage alcohol abuse was becoming out of control and that the brains of adolescents were not fully developed relative to those who were over 21 years old. [81] Moreover, Candy Lightner, a mother of a daughter who was killed by a drunk driver in 1980 formed the Mothers Against Drunk Driving (MADD) organization which lobbied the federal government to raise the MLDA to 21 years old. As president of MADD, she grew the organization to over 300,000 members in 44 states.[82] Her organization made it its' prime goal to raise the drinking age state by state, finally culminating with attempts to influence Congress so a bill could be passed that would raise the MLDA on a national level. MADD inundated the offices of members of Congress with thousands of letters and telegrams advocating for their support of proposing or agreeing to legislation that would raise the MLDA to 21.[83]

Moreover, the strong lobbying efforts of MADD were aided by President Ronald Reagan's position on the MLDA. Having initially threatened to veto a bill that would mandate that states lower their drinking age to 21, Reagan formally changed his view on this matter by announcing his support in June of 1984.[84] On the Senate floor in 1984, the key amendment that

[81] Legislative Analysis of the National Minimum Drinking Age Act 1.
[82] Koroknay-Palicz 1.
[83] Koroknay-Palicz 9.
[84] Koroknay-Palicz 1.

was proposed to house bill H.R. 4616 was raised by Senator Frank Lautenberg (D-NJ).[85] The key set of statistics used to support the passage of the amendment was obtained from Thomas' Senate Vote Analysis, and stated the following:

"Young drivers are involved in one of every five fatal auto accidents. Almost 60 percent of fatally injured teenagers were found to have alcohol in their blood; 43 percent of those were legally intoxicated."[86] Moreover, the analysis went on to discuss the numbers of teenagers that were killed on highways each year. "Five thousand of those killed on our highways each year are teenagers– a fifth of all auto fatalities–although teenagers account for only 10 percent of all drivers and travel only 9 percent of all miles driven."[87] Ultimately, the support of Congressional members in favor of the lower MLDA spurred by the lobbying efforts of MADD allowed for the amendment to pass and the bill to be approved by President Reagan on July 17, 1984. The name of the bill was the Federal Highway Act also known as the National Minimum Drinking Age Act and was an unfunded federal mandate. Simply put, the new law mandated that the states raise their respective MLDAs to age-21 with no federal funding support. In fact, those states that did not comply with the new law within two years would be penalized approximately 10% of their federal highway funding.[88] By 1988, all 50 states and the District of Columbia had raised their drinking age to 21 while Puerto Rico and the Virgin Islands maintained the MLDA at age 18 despite the loss of federal highway funding. Given that most states had a below age-21 MLDA at some point in the 1970s and subsequently, all states had raised their MLDA to age-21 by 1988, we have a large body of evidence to critically analyze and compare the role of the MLDA on mortality, crime, and nonfatal injury rates. We now turn to a research study conducted by

[85] Koroknay-Palicz 1
[86] Koroknay-Palicz 10.
[87] Koroknay-Palicz 10.
[88] Hanson (The National Minimum Drinking Age Act of 1984) 1.

Thomas Dee and William Evans in which they analyze the trends of traffic safety for teenagers from the last 30 years. First, Figure 5 is reproduced from the work of Dee and Evans which summarizes the passenger-vehicle fatality rate trends of 16-19, 20-24, and 25+ year olds starting in 1983. As illustrated in Figure 5, the fatalities per 100,000 people and fatalities per billion car miles of travel were all trending downward at a time that coincided with most states raising their MLDAs to age 21 due to the National Minimum Drinking Age Act. However, this correlation between the higher MLDA in all states by the late 1980s and the decreasing trend of traffic fatalities for teens and young adults may not necessarily indicate that the former was the cause of the latter.

To address this issue, we can look at the results of the fixed effects negative binomial model that Dee and Evans used to estimate the portion of the decrease in traffic fatalities that was explained by a higher MLDA. These results are summarized in Figure 6. Given that the actual change in fatality rates of the age group in question (18-19 year olds) was -38.4%, but the predicted change with no increases to an MLDA of 21 was -36%, the percent of the actual decline in fatality rates that is explained by the increases of the MLDA to 21 by all states by 1988 is equal to 6.4% [(38.4-36.0)/38.4].[89] To clarify this result, the -36% predicted change to fatality rates is the authors' estimate if "MLDA laws had stayed at their 1980 values" when the majority of states enforced a below age-21 MLDA. Although this 6.4% decline explained by MLDA laws is somewhat minor, it could still be concluded that the age-21 MLDA did save lives by reducing the traffic fatalities among 18-19 years olds for the 1979-1992 period. However, other research studies which include those of Cook and Tauchen (1984), Evans et. al (1991),

[89] Dee et. al 38.

Ruhm (1996), and Dee (1999), have "established a clear link between the state-specific timing of movements to higher MLDAs and reduction in traffic fatalities."[90]

Knowing that much of the research of the 1980s, 1990s, and early 2000s presented evidence in support of the age-21 MLDA, the next logical question to ask is how the MLDA debate came back into the national spotlight. The answer is with the Amethyst Initiative, a group of over 100 college presidents and chancellors who formed in 2008 to lobby congress to re-think the age-21 MLDA. The group has collected signatures of support from leaders of prominent universities including Duke, Johns Hopkins, Dartmouth, and Virginia Tech. The organization argues that the age-21 MLDA has created an underground, dangerous culture of "binge-drinking" which elevates the dangers associated with drinking. And so, the issue has come back to the forefront whereby politicians and lobbying organizations such as the Amethyst Initiative and MADD all vet their ideas for the optimal MLDA. Thus, we will now turn to a cost-benefit analysis which will quantitatively provide some conclusions on the effects of the age-21 MLDA on the mortality, crime, and nonfatal injury rates of 18-20 year olds.

[90] Dee et. al 30.

V. Cost-Benefit Analysis

Prior to presenting the empirical evidence with regard to the effectiveness of the age-21 MLDA, it is important to frame the issue in terms of the costs associated with potentially lowering the drinking age. By allowing 18-20 year olds legal access to alcohol, it is necessary to understand the two types of costs associated with such a change. First, we have the private external costs which represent the costs borne by the individual drinker that he overlooks when making the decision to drink or not. Next, we have the social external costs which can be thought of as the spillover effect or the costs borne on third parties by lowering the MLDA to 18. These externalities provide the fundamental basis for determining the economic costs associated with a lower MLDA and subsequently comparing those costs with the perceived benefits of such a policy move.

To illustrate the role of externalities in a cost-benefit analysis, we turn to a simple example. Let us first look at Figure 7 which illustrates the role of consumer surplus and producer surplus in a welfare analysis. It is important to note that the marginal cost curve represents society's supply curve or the price at which it costs the producer to produce an additional unit of each good. The marginal benefit curve represents society's demand curve or the price which individual consumers are willing to pay for the good. In a market equilibrium where supply is equal to demand (marginal cost is equal to marginal benefit), P_0 represents the market-clearing equilibrium price while Q_0 represents the market-clearing equilibrium quantity. Consumer surplus is the shaded green area below the demand (marginal benefit) curve but above the equilibrium price of the good. It represents the additional benefit to consumers, over and above the price they paid for the good. On the other hand, producer surplus is the shaded blue area above the supply (marginal cost) curve but below the equilibrium price of the good. It represents

the difference between the market (equilibrium) price for the good and the marginal cost of producing the unit. Under certain assumptions, producer surplus represents the gross profit of producing Q_0 units.

Now, we will add in two additional curves, the marginal private cost curve and the marginal social cost curve. Figure 8 will help us in analyzing the welfare differences between operating at a private equilibrium compared to operating at a social equilibrium. Let us return to our previous example where a factory (producer) decides to pollute a nearby river because the marginal cost of doing so is so low that it is lower than all the alternatives. This producer is operating at the private equilibrium of supply and demand which is different from the social equilibrium of supply and demand. The social equilibrium takes into account all the costs of production which include the costs imposed on fishermen, swimmers, boaters, and thus, the marginal social cost curve lies above the marginal private cost curve. The area of triangle ABC represents the deadweight loss to economic welfare when those imposing the negative externality (the producers) are free to pollute the nearby river and take advantage of the common good. This "tragedy of the commons" illustrates how there is a conflict between the interests of the producers and the interests of the public or common good. In terms of a potential reduction in the minimum legal drinking age, 18-20 year olds will be operating at the private equilibrium even though the socially optimal level of alcohol consumption may be lower. Specifically, the socially optimal level of alcohol consumption is Q2 which is lower than the private optimal level of alcohol consumption (Q1). By allowing 18-20 year olds to drink, that cohort will impose a higher marginal cost per drink to society than the one they privately bear. This is the case because the 18-20 year olds will create numerous negative externalities by drinking due to the increased risk and thus higher costs associated with killing another person while drinking and

driving, inpatient hospital stays and emergency room visits related to alcohol, and crime such as assaults and robbery where alcohol played a role. Ultimately, in the case of the lower MLDA, area ABC represents the loss to social welfare because producers are producing at a level and consumers are consuming at a level higher than the social optimal level, where the marginal social cost is equal to the marginal social benefit. This section will illustrate the total welfare implications by including a separate demand curve for 18-20 year olds and by utilizing estimates of the increases in the previously mentioned externality costs. By comparing the increased costs with the potential benefits of a lower MLDA, we can make inferences about the optimal level of the MLDA in the United States.

A. Estimated Effects of the age-21 MLDA on Mortality Rates

a. Panel Fixed Effects Approach

The MLDA issue from an economic perspective is whether legalizing alcohol for the 18-20 year old age group would spur an increase in the rates of crime, nonfatal injury, and mortality for this cohort. To first understand the effects of a lower drinking age, we examine empirical data which identifies the behaviors of those in the age group under consideration (18-20 year olds).

According to the 2006-2007 National Health Interview Survey, adults age 18-25 report that they drank on average, 36 days in the previous year and consumed approximately 5.1 drinks in each sitting.[91] Since the consumption of five drinks in a single sitting meets the clinical definition of binge drinking, it is clear that this behavior may lead to significant health problems. Thus, it is no surprise that the leading cause of death and injury in the 18-25 year old age group is motor vehicle accidents which is highly correlated with alcohol consumption.[92] Moreover, other forms of injury and death which we will denote "external causes" such as homicides, suicides, falls, and other accidents have also been found to have a high correlation with alcohol consumption.[93] Since approximately 80 percent of the deaths of these young adults are a result the aforementioned external causes (as opposed to internal causes such as cancer and disease), government regulation of alcohol can arguably have a significant impact on the mortality rate of this age group.

The key question that must be addressed is whether the consumer surplus or perceived total value of alcohol consumption justifies the increase in both private and social costs as a result of this age group being allowed to drink alcohol legally. That is, we must look at the

[91] Carpenter et. al 134.
[92] Carpenter et. al 137.
[93] Carpenter et. al 134.

economic costs of crime, nonfatal injury, and mortality and to what degree they would be affected by allowing the 18-20 year old age group legal access to alcohol.

We begin by looking at data that analyzes the effects of a potential age-18 MLDA on mortality rates for the 18-20 year old age group. Research conducted by Chris Carpenter and Carlos Dobkin attempts to estimate the effect of allowing 18-20 years olds to drink on the average mortality rate for that same group.[94] First, they look at the historical trends of the death rate of 18-20 year olds and 25-29 year olds during both daytime and nighttime motor vehicle accidents following the passage of the 1984 National Minimum Drinking Age Act which raised the legal drinking age to 21 years old. These trends are illustrated in Figure 9. It is necessary to distinguish between nighttime and daytime motor vehicle accidents when analyzing the data because "67% of fatal motor vehicle accidents occur in the evening hours (defined as between 8:00pm and 5:59am)."[95] The reason that the percentage of 18-20 year olds allowed to drink did not fall from 100% to 0% immediately was due to "some states increasing their drinking age from 18 to 19 and then from 19 to 21 a few years later, while other states allowed people who could drink legally when the drinking age was increased to continue to drink legally."[96] From Figure 9, it is clear that the sudden and sharp fall in the percentage of 18-20 year olds that were legally allowed to purchase and consume alcohol is associated with a general downward trend in the death rate of 18-20 years olds during nighttime motor vehicle accidents.

Even though the graphical evidence supports the idea that raising the drinking age to 21 years old significantly reduces motor vehicle fatalities for the 18-20 year old age group, there are some caveats to this trend. First, the 18-20 year old motor vehicle mortality rate began to fall before the passage of the 1984 National Minimum Drinking Age Act. In addition, this rate did

[94] Carpenter et. al 137.
[95] Carpenter et. al 138.
[96] Carpenter et. al 138.

not fall as sharply as the percentage of 18-20 year olds that were allowed to drink. Due to these two disparities, Carpenter and Dobkin employed a state-level panel regression analysis to determine the precise effect of the minimum legal drinking age on the number of motor vehicle fatalities for the 18-20 year old age group.[97] They used the following regression model:

$$Y_{st} = \alpha MLDA_{st} + \theta_s + \mu_t + \psi_{st} + \varepsilon_{ist}$$ [98]

The authors attempted to estimate Y_{st} which is the number of motor vehicle fatalities per 100,000 people in a year, by using the national minimum legal drinking age (MLDA), a dummy variable for each state ($\theta_{s)}$, and dummy variables for each year (μ_t), while accounting for state-specific linear time trends (ψ_{st}) and possible errors in the model (ε_{ist}). This regression model is designed to estimate the effects of a rise in the minimum legal drinking age in state (s) during time (t) on the motor vehicle fatality rate in that same state during the same time period. Of particular interest is the parameter α which measures the sensitivity of the motor vehicle fatality rate to changes in the MLDA. Ex-ante, we expect that α will likely take on a value that is less than zero if we assume that the MLDA and the motor vehicle fatality rate are inversely correlated.

The model allows for a cross-state and intertemporal analysis of the mortality rate for people who were born only a few years apart, in the same state, but who were subject to different legal drinking ages. By analyzing this cohort of people who are very close in age but were subject to different MLDAs, we can attempt to estimate the effects of a higher MLDA on the mortality rate for those who were subject to the increased MLDA requirements.

Ultimately, the analysis builds upon much of the economic literature on this topic which suggests that a higher MLDA plays a significant role in lowering the mortality rates of young adult drivers. Such research includes the work of Thomas Dee (1999) where he concludes that

[97] Carpenter et. al 139.
[98] Carpenter et. al 139.

the MLDA being raised to 21 decreased youth traffic fatalities by 9%-11%.[99] Alexander Wagenaar and Traci Toomey found a significant inverse relationship between the MLDA and traffic fatalities.[100] Their conclusion ultimately noted that the higher the MLDA, the lower the prevalence of traffic fatalities. When focusing on the highest quality studies, Wagenaar and Toomey found that 58% of these studies revealed an inverse relationship between the MLDA and traffic fatality rates while 42% found no relationship and none found a positive relationship.[101] Moreover, of all the analyses that the authors studied, 98% concluded that an inverse relationship between the MLDA and traffic fatality rates existed.[102] Clearly, the literature review in this regard suggests strong evidence that a higher MLDA reduces driving fatalities.

The research of Carpenter and Dobkin differed from the existing research by analyzing the precise magnitude effects of a lower MLDA. Specifically, they examined the relationship between an 18 year old MLDA (allowing 18-20 year olds to drink) and the motor vehicle mortality rate per 100,000 people per year for the same cohort. Relative to a 28.1 person (per 100,000 people per year) base death rate, the model estimates that the lower MLDA results in an increase in the night time motor vehicle fatality rate of 4.74 people (per 100,000 people per year) and a rise in the daytime motor vehicle fatality rate of 0.78 people (per 100,000 people per year). This nighttime motor vehicle fatality rate, which is the critical figure, translates into an increase of approximately 17% percent (4.74/28.1) and is statistically significant at the one percent level. Thus, this data which passes some substantial statistical rigor suggests that an 18 year-old MLDA translates into a notable increase in both daytime and nighttime motor vehicle fatalities, likely resulting from increases in drunk driving for the 18-20 year old age group.

[99] Dee 2.
[100] Wagenaar et. al 1.
[101] Wagenaar et. al 1.
[102] Wagenaar et. al 1

The study then looked at the effect of an 18 year-old MLDA on deaths due to both internal, external and then all causes. For the purposes of this paper, “internal causes” of death are those that are due to problems within the body such as infectious diseases and cancer. As previously mentioned, “external causes” refers to all those modes of death external to a person’s body such as motor vehicle accidents, suicides, homicides, alcohol-related deaths such as alcohol overdose, and other external causes. Figure 10 is reproduced from their paper and summarizes these results. As is evident from Figure 10, the effect of implementing an MLDA of 18-years old is an increase in deaths due to all causes, both external and internal, by 7.76 people (per 100,000 people per year), although this result is not statistically significant.

These results do however, find a statistically significant relationship between the lower MLDA and suicide as well as the aforementioned motor vehicle fatality rate. It is important to note that the effect of the lower MLDA on motor vehicle accidents in a rise of 4.15 people (per 100,000 people per year) differs from the previously mentioned 4.76 people (per 100,000 people per year) figure because the latter looks specifically at nighttime motor vehicle fatalities while the former accounts for all motor vehicle fatalities. Even so, the all-encompassing 4.15 people (per 100,000 people per year) increase is statistically significant at the five percent level. Moreover, what is equally troubling is the effect of the lower MLDA on suicide rates. The study determines that an MLDA of 18 years old results in an increase in suicides of 1.29 people (per 100,000 people per year) for the 18-20 year old cohort. Relative to a base suicide death rate of 12.8 people (per 100,000 people per year), this figure suggests an increase of approximately 10% (1.29/12.8) in suicides for the 18-20 year old age group and is statistically significant at the one percent level.

Ultimately, the evidence suggests that there are substantial negative effects of a lower drinking age on mortality rates and a widespread number of other categories. What is more troublesome is that the data suggests that allowing 18-20 year olds access to alcohol has the most adverse effect on mortality rates attributable to suicide and motor vehicle accidents which are the two leading causes of death for the 18-20 year old age group.

b. Regression Discontinuity Approach

Using data collected from the Vital Statistics mortality records from 1997-2003, Carpenter and Dobkin also employ a separate regression discontinuity approach to estimate the effects of the MLDA on mortality rates. By realizing the fact that the drinking age "turns off" at age 21, and the fact that people just below age 21 and those just above age 21 share similar characteristics except for their ability to consume alcohol legally, Carpenter and Dobkin used a model to estimate the effect of an increase in mortality rates due to the drinking age.[103]

Specifically, the authors looked at discrete rises in mortality rates attributable to various causes by comparing the 19-21 year old age group and the 21-23 year old age group. The comparisons of mortality rates for these two cohorts are represented graphically in Figure 11. To estimate these discrete increases in mortality rates as a result of people being given the right to consume alcohol legally once they turn 21 years old, the authors of the study turned to the following model:

$$y = \beta_0 + \beta_1 MLDA + \beta_2 Birthday + f(age) + \varepsilon$$ [104]

In this model, y represents the age-specific mortality rate that the model is designed to estimate. *MLDA* is a dummy variable which takes the value of 1 if an observation is 21 years old or older and 0 otherwise. The *Birthday* variable is a dummy variable representing the month that an

[103] Carpenter et. al 143.
[104] Carpenter et. al 144.

individual turns 21 years old and is supposed to minimize the effect of 21-year old birthday party celebrations on the morality rate. The f(*age*) variable attempts to adjust for changes in outcomes that are age-specific. In this model, β_1 represents the causal effect or increase in mortality rates that occur when young adults turn 21 and are allowed to legally drink alcohol. The results of the regression model are summarized in Figure 12.

Ultimately, the results suggest that there is an increase in mortality rates due to all causes as a result of the drinking age "turning off" at age 21 of 8.06 people (per 100,000 people per year). Relative to a base overall mortality rate of 93.07 people (per 100,000 people per year), this figure suggests that the overall mortality rate attributable to the drinking age rises by 8.66% (8.06/93.07) post-age 21 and is statistically significant at the one percent level. Moreover, we notice that once again, there is also a key relationship to be observed between the MLDA and suicide rates. The data suggests that suicides increase at 2.37 people (per 100,000 people per year) when a person turns 21. Relative to a base suicide rate of 11.70 people (per 100,000 people per year), this figure suggests that when people turn 21 and are no longer subject to the MLDA, their suicides rate rise by 20.26% (2.37/11.70) which is statistically significant at the one percent level. Moreover, it is also important to point out that there appears to be a critical relationship between the behaviors of people after they turn 21 years old and the mortality rates due to motor vehicle accidents. The model results suggest that motor vehicle accidents for people after they turn 21 increases by 3.65 people (per 100,000 people per year) relative to a base motor vehicle fatality rate of 29.81 people (per 100,000 people per year).[105] Essentially, this figure leads the authors to conclude that the motor vehicle fatality rate rises by 12.24% (3.65/29.31) for people after they turn 21 and are no longer subject to the MLDA and is statistically significant at the one percent level.

[105] Carpenter et. al 145.

Finally, these results also suggest that there is a connection between the death rates of young adults when they turn 21 due to incidents involving alcohol. The model presented by Carpenter and Dobkin estimates that, relative to a base mortality rate due to alcohol-related causes of 0.99 people (per 100,000 people per year), the mortality rate for this category rises by 0.41 people (per 100,000 people per year) due to young adults turning 21 years old.[106] Although this increase is minor from an absolute standpoint, it suggests that the mortality rate attributable to alcohol-related causes rises by a staggering 41.41% (0.41/0.99) and is statistically significant at the conventional ten percent level. This empirical evidence of a link between alcohol-related deaths, most likely due to alcohol overdose, and the fact that people turn 21 is interesting because this is the only model in the research carried out by Carpenter and Dobkin that finds a statistically significant effect in this specific mortality category. Moreover, the fact that the research provides for an approximately 41% increase in alcohol-related deaths due to people turning 21 is quite troubling, and adds to the mounting data presented by Carpenter and Dobkin against reducing the age-21 MLDA.

In essence, the results of the regression analyses carried out by Carpenter and Dobkin complements the evidence presented by the Panel Fixed Effects model. Namely, the regression discontinuity model suggests that both suicides and motor vehicle accidents rise when a person turns 21 and is no longer subject to the MLDA, at the substantially statistically significant one percent level. Moreover, this model also estimates that deaths due to all causes will rise as a result of those turning 21 being allowed to consume alcohol legally, at a statistically significant one percent level.

Essentially, both the Panel Fixed Effects model and the Regression Discontinuity model compellingly support the stance that the 21 year old minimum legal drinking age saves lives, by

[106] Carpenter et. al 145.

reducing the mortality rates for young adults attributable to suicides and motor vehicle accidents. We now turn to estimates of the effect of the current age-21 MLDA on the rates of nonfatal injury, crime, and alcohol consumption for young adults.

B. Estimated Effects of the age-21 MLDA on Crime and Nonfatal Injury

Separate from its effect on mortality rates, alcohol consumption has also been associated with other negative outcomes such as crime and non-fatal injury. Thus, it is comprehensible that, in order to formulate a complete view of the costs and benefits of the MLDA, we should also assess the impact of the MLDA on crime rates as well as the rates of nonfatal injury. Once again, Carpenter and Dobkin were able to use a similar approach to estimate the effects of the MLDA on these rates. Although a Panel Fixed Effect estimates model could not be utilized due to the lack of age-specific data for injury rates in the 1970s and 1980s when most states enforced an MLDA below age 21, the authors relied on the estimates from a regression discontinuity model.

By collecting administrative data on inpatient hospital stays and emergency department visits, Carpenter and Dobkin were able to estimate the effect of "turning off" the drinking age at 21 on visits to the emergency room and hospital visits that requires at least one overnight stay. The authors concluded that, at age 21, emergency room visits increase by 408 people (per 100,000 people per year) while inpatient hospital stays increase by 77 people (per 100,000 people per year). Although injuries have lower total costs per event than do fatal accidents, the occurrence of nonfatal injury is extremely more common than fatal injuries. The results of this analysis are summarized in Figure 13 and include a comparison to the effect on mortality rates attributable to all causes.

When comparing the data in Figure 13, the relatively minor percentage effects of the MLDA on inpatient stays and emergency room visits, compared to an approximately nine percent increase in deaths due to all causes implies "that alcohol plays a disproportionate role in more serious injuries."[107]

[107] Carpenter et. al 147.

Furthermore, Carpenter and Dobkin also looked at the effect of the minimum legal drinking age on crime, which encompasses nuisance, property, and violent crime. They found similar results to the study carried out by Joksch and Jones in 1993, where the latter two authors found that increasing the MLDA had a significant impact on reducing nuisance crimes, such as disorderly conduct and vandalism.[108] By looking at data from arrests in the state of California between 2000-2006, Carpenter and Dobkin also discovered an inverse relationship between the MLDA and crime rates. Specifically, they found an 11 percent increase in arrest rates due to mainly nuisance and violent crimes attributable to young adults being legally allowed to drink at age 21.[109]

Moreover, out of the crimes for which Carpenter and Dobkin found statistical significance at conventional levels, the two with the highest costs to society were assault and robbery where the latter is defined as "larceny with force or threat of force."[110] Their estimated effects of providing young people with legal access to alcohol at age 21 results in increases of arrests attributable to assault and robbery of 63 percent (per 100,000 people per year) and 8 percent (per 100,000 people per year) respectively. Since minimal research has been done on the causal effects of the MLDA on non-fatal injury and crime, there has been less emphasis in this area in the literature. However, given the empirical data presented above, by overlooking the effect of the MLDA on non-fatal injury and crime and placing the most emphasis on its effect on mortality rates will certainly lead to an "underestimate of the protective benefits of the minimum legal drinking age."[111]

[108] Carpenter et. al 147.
[109] Carpenter et. al 147.
[110] Carpenter et. al 147.
[111] Carpenter et. al 147.

C. Estimated Effects of the age-21 MLDA on Alcohol Consumption

Measuring the effect of the minimum legal drinking age on the actual consumption of alcohol is a key analysis that needs to be evaluated when analyzing the optimal MLDA. Measuring the specific effect of the legal drinking age on alcohol consumption presents additional challenges, namely, the lack of high-quality data that is available. While mortality rates, rates of nonfatal injury, and rates of crime were based on more reliable data such as death certificates and administrative records, there is a lack of specific, available, and accurate measures of alcohol consumption. The lack of critical measurements such as the blood-alcohol concentration (BAC) rates of large quantities of people makes it more difficult to estimate the variation in alcohol consumption due to the MLDA. Thus, researchers have often had to rely on self-reported measures of alcohol consumption which provide serious data quality issues. One such issue was one discovered by Jurgen Rehm in his 1998 study where he concluded that "self-reported measures of drinking participation and intensity are subject to underreporting on the order of 40-60 percent."[112] This issue is compounded by the fact that, even when guaranteed confidentiality of answers by survey administrators, 18-20 year olds typically underreport at rates higher than the average level due to the fact that it is illegal for them to drink. Despite these limitations, Carpenter and Dobkin use their standard panel fixed-effects and regression discontinuity approaches to estimate the effects of the MLDA on consumption of alcohol.

Carpenter and Dobkin used data from high school seniors who were 18 years old and over in the "Monitoring the Future" study that was carried out between 1976 and 1993 in the panel-fixed effects model.[113] This survey provided them with three distinct categories of alcohol-consuming behaviors. These three groups were: (1) the percentage of people who drank in the

[112] Rehm et. al 1.
[113] Carpenter et. al 147.

past 30 days, (2) the percentage of people who drank heavily in the past two weeks, and (3) the number of times people drank in the past 30 days. In category (2), "heavy" drinking is defined as consuming five or more drinks in a single setting. The results of the Panel Fixed Effects model is presented in Figure 14 and suggests that providing 18-20 year olds with legal access to alcohol will increase drinking participation by 6.1%, heavy episodic drinking by 3.4%, and occurrences of drinking in the past month by 0.94 times or 17.4% (0.94/base rate of 5.4 times).[114] Carpenter and Dobkin find that all three categorical estimates are statistically significant at the one percent level and that these estimates have similar conclusions to other research findings that use a similar method. (Dee, 1999, Kloska, O'Malley, and Johnston; 2007, and Miron and Tetelbaum; 2009).[115]

Since the regression discontinuity approach required data on the drinking behavior of those people very close to age 21, Carpenter and Dobkin used the National Health Interview Survey as their data source for this model.[116] This survey asks respondents specific questions relating to number of days in the last month when people consumed alcohol, general levels of drinking participation as well as how often they engaged in heavy or "binge" intermittent drinking.

The authors applied the regression discontinuity approach to three separate categories of drinking: (4) the percentage of people who consumed 12 or more drinks in the past year, (5) the percentage of people who engaged in any heavy drinking in the last year and (6) the number of days people drank in the last 30 days. In category (5), "heavy drinking" is defined as consuming five or more drinks on a single day at least once in the previous year. It is important to note that Carpenter and Dobkin used a regression discontinuity model similar to the previously utilized

[114] Carpenter et. al 148.
[115] Carpenter et. al 148.
[116] Carpenter et. al 148.

one that analyzed mortality rates, but with several additional controls. Their new enhanced model took into account controls for "demographic characteristics such as gender, race, region, and employment status."[117]

The results of this approach are exhibited in Figure 14 and suggest that, at age 21, the causal effect of "turning off" the drinking age is an increase of 6.1% in the probability of people consuming 12 or more drinks in the past year and an increase of 4.92% in the probability that a person engaged in heavy drinking in the last year.[118] Moreover, Carpenter and Dobkin estimate that this model suggests that the number of drinking days in the previous month increased by 0.55 days.[119] Relative to a base number of times that people drank in the last 30 days of 2.8 times, their model estimates a 19.6% (0.55/2.8) increase in alcohol consumption in the previous 30 days as a result of the drinking age "turning off" at age 21.[120]

Carpenter and Dobkin convert these figures into total additional drinks that will be consumed if the current MLDA is changed to an age-18 MLDA. The panel estimates suggest that youths would drink alcohol on 0.94 more occasions in the previous month.[121] The regression discontinuity estimates suggest that the number of days that youths drank in the previous month would increase by 0.55 days.[122] If we can assume that instances of drinking are comparable to days of drinking, then a simple average of the two figures implies that an age-18 MLDA increases alcohol consumption by approximately 0.745 drinking days every month. In order to convert this figure in terms of our previous estimates which were per 100,000 per year, we can compute: 0.745 * 12 (months) * 100,000 (people) = 894,000 additional drinking days that would

[117] Carpenter et. al 148.
[118] Carpenter et. al 149.
[119] Carpenter et. al 149.
[120] Carpenter et. al 149.
[121] Carpenter et. al 150
[122] Carpenter et. al 150

occur with an age-18 MLDA.[123] Carpenter and Dobkin estimate that, on average, young adults consume 5.1 drinks each, denoting that: 894,000 drinking days * 5.1 drinks = 4.56 million additional drinks would be consumed if the MLDA were lowered to age-18. [124] These analyses suggest that lowering the drinking age will have a large effect on the number of additional drinks that people in the 18-20 year old category. We now turn to a discussion of the cost-benefit analysis where we will utilize the estimates produced in this section.

[123] Carpenter et. al 150.
[124] Carpenter et. al 150.

D. Discussion

Given the large body of empirical data gathered from Carpenter and Dobkin and other research studies, we now attempt to quantify the potential costs of an age-18 MLDA on a per-drink basis.

The first and largest cost to consider is that of the drinker dying of any cause as a result of consuming alcohol. As previoulsy mentioned, the panel fixed effects model produced by Carpenter and Dobkin concluded that allowing 18-20 year olds to drink will increase the mortality rate of this age gorup by 7.76 people (per 100,000 people per year). The regression discontinuity model suggests that this figure is equal to a mortality rate of 18-20 year olds of 8.06 people (per 100,000 people per year). However, since the regression discontinuity estimate of 8.06 deaths passes greater statistical rigor by being significant at the one percent level, we will use 8 deaths as the increase associated with an age-18 MLDA. Next, we must determine the current value of a statistical life. Figure 15 summarizes four estimates of the current value of a statistical life according to four different sources.

By averaging the estimates of the value of a statistical life from the Environmental Protection Agency, the Food and Drug Administration, the Transportation Department, and a highly-cited Professor from Vanderbilt Law school (Dr. Viscusi who has done extensive research in this field), we can come up with an average of the value of a statistical life of $7.93 million. Given that we estimate an increase of 8 deaths (per 100,000 people per year), this translates into a cost of $63.44 million (8*$7.93 million) per 100,000 people per year. Since, in part C of the Cost-Benefit analysis, we noted an age-18 MLDA would increase the number of drinks consumed by the 18-20 year old cohort of 4.56 million drinks; the cost of each drink associated with mortality risk is $13.91 ($63.44 million/4.56 million drinks). This $13.91 cost figure is a

lower-bound estimate because there are other risks associated with each drink such as "injuries, reduced productivity, and reduced health." [125]

The next major cost of drinking are those that are borne by third parties who are not the ones consuming alcohol. We will assess three key categories of these social external costs. The first is the estimate of increased mortality of other people caused by drinking and driving. In Carpenter and Dobkin's 2009 paper, they estimate that every young adult killed while driving will kill another person 21% of the time.[126] From the regression discontinuity estimates provided earlier in this paper, the increased mortality risk attributable to motor vehicle fatalities is 3.65 people (per 100,000 people per year). Thus, lowering the drinking age will increase the mortality rate for people other than the ones who drink and drive by 0.77 people (0.21*3.65 people) each year for every 100,000 18-20 year olds that are legally allowed to drink alcohol.[127] Converting this figure into a cost amount by multiplying by the value of a statistical life derived above will yield a cost of $6.08 million (0.77*$7,930,000). Once again, this figure represents a lower-bound because it does not include instances of deaths due to drunk drivers where the drunk driver survives.[128]

The next major social external cost is that of increased risk of the drinker committing a robbery or assaulting someone. Carpenter and Dobkin estimate that by lowering the MLDA to age-18, there will be "63 additional arrests for assault and 8 additional arrests for robbery annually for every 100,000 newly- legal drinkers."[129] Since not all crimes result in an arrest, these two figures need to be adjusted based on the number of assaults and robberies that are cleared by an arrest. Specifically, 54 percent of assaults are cleared by arrests, and 25 percent of

[125] Carpenter et. al 153.
[126] Carpenter et. al 153.
[127] Carpenter et. al 153.
[128] Carpenter et. al 153.
[129] Carpenter et. al 153

robberies are cleared by arrest. Therefore, the actual number of increases in crimes of assault and robbery are 117 (63/0.54) and 32 (8/0.25) respectively. Carpenter and Dobkin estimate the costs per assault and robbery at $20,500 and $17,800 respectively.[130] Therefore, the cost imposed on others is equal to $2.4 million ($20,500 * 117 assaults) for assaults and $570 thousand ($17,800 * 32 robberies) for robberies.

The final external cost to consider is that of the 18-20 year old drinker becoming injured in an alcohol-related incident and requiring medical attention. The two costs associated with these incidents are inpatient stays (hospital visits requiring at least one overnight stay) and emergency room (ER) visits. Assuming that the costs of hospital or ER visits are either covered by medical insurance or absorbed by the hospital, the expenses associated with these incidents will be borne by people other than the drinker.[131] Given that the average cost of an alcohol-related ER visit is $3,387 and the average cost of an alcohol-related inpatient stay is $12,562, the total costs associated with increased alcohol-related ER visits and inpatient stays is $1.38 million ($3,387*408 ER visits) and $967 thousand ($12,562 *77 inpatient stays) respectively.[132] This provides us with a sum total of $2.35 million ($1.38 million + $967 thousand) in increased externality costs attributable to rises in ER visits and inpatient stays as a result of an age-18 MLDA.[133] Summing all the externality costs associated with an age-18 MLDA provides us with a grand total cost of $11.39 million per 100,000 people per year ($6.08 million + $2.4 million + $0.57 million + $2.35 million). We had previously calculated the increase in alcohol consumption associated with a lower age-MLDA of 4.56 million drinks per 100,000 people per year. Thus, our externality cost per drink equates to $2.50 ($11.39 million/4.56 million).

[130] Carpenter et. al 153.
[131] Carpenter et. al 153.
[132] Carpenter et. al 154.
[133] Carpenter et. al 154.

Our estimates of the externalities suggest that the private external cost, the one that the drinker bears privately, is equal to $13.91 plus what the drinker paid for the drink. In addition, we estimate that, the social external cost, the one that the drinker imposes on others is equal to $2.50. Given that the private external cost is $13.91, it is fairly unlikely that the drinker values a drink this highly and suggests that the drinker does not fully comprehend the embedded costs associated with consuming the alcoholic beverage. Even so, based on our estimates of the total costs (private external plus social external) of $16.41 plus the cost of each individual drink, it is unlikely that the value the drinker places on the drink meets or exceeds $16.41 and suggests that the drinker does not fully take into account the costs that he incurs in addition to the one he imposes on others. Figure 16 contains all of the presented information graphically. By looking at the graph of Figure 16, we have several key items to assess. First, it is important to note that the demand curve for an age-21 MLDA will shift to the right signifying an increase in demand once we incorporate a potential age-18 MLDA because there will be more potential alcohol consumers in the marketplace. Namely, we move from a market-clearing quantity of Q1 in an age-21 MLDA environment to a higher market-clearing quantity of Q2 in an age-18 MLDA environment. Point A represents the intersection of the age-18 MLDA demand curve and the Marginal Cost (Supply) curve. This is the cost at which producers can produce an alcoholic beverage at the margin. For the purposes of simplicity, we have decided to utilize a rough average of the price of an alcohol drink nationwide with a figure of $3.50. Given this price, in an age-18 MLDA scenario ignoring social costs, the private market equilibrium occurs at Q2 (point A). Moving up the age-18 MLDA market clearing quantity line (Q2), point B represents the marginal private cost that the 18-20 year old drinker will face in an age-18 MLDA environment. As previously calculated, $13.91 plus the price of the drink ($3.50) is the cost that the drinker

bears privately and includes the increased risk of death due to all causes that are alcohol-related. Moving further up the age-18 MLDA market-clearing quantity line (Q2), point C denotes the marginal social cost that the 18-20 year-old drinker will impose on others in society due to his consumption of alcohol. We calculated that the marginal social cost is equal to $2.50 per alcoholic beverage. When we sum both the marginal private and the marginal social cost, we arrive at a total cost to society including the drinker of $19.91 ($13.91+$2.50+$3.50). For reference purposes, point D represents the social equilibrium which occurs at a higher price and lower quantity than the private equilibrium, point A.

The shaded grey area denoted by the area (E,A,Q2,0) is the total benefit or value to society of an age-18 MLDA. The area containing the yellow-filled stars denoted by the area (E, A, Q2, 0) and the triangle (ADC) symbolizes the total costs to society. The consumer surplus or the value that consumers place on the drink over and above what it costs, is presented by the triangle (EAF) containing the red-filled diamonds. Ultimately the costs to society outweigh the benefits to society by an area equal to triangle (ADC). Our graphical analysis supports our previous conclusion that it is unlikely that the consumer surplus meets or exceeds the marginal private cost for each individual drink ($17.41) let alone the marginal social cost of each individual ($19.91). Therefore, from a welfare standpoint, our economic analysis suggests that the value to society is greater with the current age-21 MLDA rather than a potential policy move to an age-18 MLDA.

VI. Conclusion

A. Summary of Findings

Having explored the economic arguments for a potential lower-MLDA, this paper has argued that the welfare of society is greater with the current age-21 MLDA. Given that our estimates of the costs to society, both private and social, are also lower-bound estimates because of the other risks associated with drinking such as injuries, reduced productivity, and reduced health, we provide a conservative analysis that provides a strong validation for our conclusion. After presenting a summary of the results from the panel fixed effects and regression discontinuity models carried out by Carpenter and Dobkin, we then moved to quantifying the specific costs associated with a potential lower-MLDA.

The first cost data provided were those regarding the costs of 18-20 year old drinkers dying of any cause as a result of consuming alcohol. The following table presents the estimates related to a drinker killing himself due to all causes where alcohol plays a role.

Increased Costs Related to Private External Causes

Estimate of Increase in Deaths (All Causes)	8.0 Deaths
Value of a Statistical Life from Table below	$7.39 million
Total Costs Associated with Increase in Deaths (All Causes)	$63.44 million
Estimate of Increase in Alcoholic Beverages Consumed	4.56 million drinks
Cost-per Drink Associated with Increase in Deaths (All Causes)	$13.91

The value of a statistical life provided in the table above is computed as an average of the following figures.

Estimates of the Value of a Statistical Life

Environmental Protection Agency	Food and Drug Administration	Transportation Department	Professor Viscusi (Vanderbilt Law School)	Simple Average
$9.1 million[134]	$7.9 million[135]	$6.0 million[136]	$8.72 million[137]	$7.93 million

We then presented the costs of drinking that the drinkers impose on others in society, also known as the social external costs. The costs that we assessed were those related to three key categories which include the estimates of increased mortality of other people caused by drinking and driving, increased crimes of assault and robbery, and increased injury in alcohol-related incidents. A summary of these social external costs is presented below:

Cost of Increased Deaths due to Drivers Drinking and Killing Others

Estimate of Increase in Deaths (Drivers Drinking and Killing Others)	0.77 Deaths
Value of a Statistical Life	$7.39 million
Total Costs Associated with Increase in Deaths (All Causes)	$6.08 million

[134] Appelbaum 1.
[135] Appelbaum 1.
[136] Appelbaum 1.
[137] Carpenter et. al 152.

Estimate of Increased Costs Due to Assaults

Estimate of Increase in Assaults	117
Estimated Cost per Assault	$20,500
Total Costs Associated with Increase in Assaults	$2.39 million

Estimate of Increased Costs Due to Robbery

Estimate of Increase in Robberies	32
Estimated Cost per Robbery	$17,800
Total Costs Associated with Increase in Robberies	$569,600

Estimate of Increased Costs Due to Inpatient Hospital Stays

Estimate of Increase in Inpatient Hospital Stays	77
Estimated Cost per Inpatient Hospital Stay	$12,562
Total Costs Associated with Increase in Inpatient Hospital Stays	$967,724

Estimate of Increased Costs Due to Emergency Room Visits

Estimate of Increase in Emergency Room Visits	408
Estimated Cost per Emergency Room Visit	$3,387
Total Costs Associated with Increase in Emergency Room Visits	$1.38 million

Increased Costs Related to Social External Causes

Sum of all Social Externalities	$11.39 million
Estimate of Increase in Alcoholic Beverages Consumed	4.56 million drinks
Social Externality Cost Per Drink	$2.50

Ultimately, the economic data presented supports the notion that the age-21 MLDA saves lives and is welfare improving relative to an age-18 MDLA. Through a cost-benefit analysis, we determined that it is highly unlikely that the consumer surplus or the value that consumers place on a drink in excess of the price of the drink is valued equal to or greater than the marginal private cost of $13.91 plus the price of the drink or the marginal social cost of $16.41 plus the price of the drink. Our graphical analysis determined that the costs to society outweighed the benefits to society by a value equal to triangle (ADC). We concluded that our economic welfare analysis suggests that the optimal MLDA in the United States is the current age-21 MLDA.

B. Future Research

This thesis has looked at the increase in key costs associated with a potentially lower MLDA and did not take into account all the costs associated with such a move such as reduced productivity, reduced health, and injuries that were not accounted for by inpatient stays and emergency room visits. Although including these additional costs would further solidify our conclusions, they nevertheless represent opportunities for future research so that we can implement the cost-benefit analysis in a more comprehensive manner.

Another area of research which could strengthen the cost-benefit analysis would be an assessment of the consumer surplus or the specific dollar figures that consumers in the 18-20 year old cohort place on an alcoholic beverage. Such a valuation would reinforce the cost-benefit analysis by allowing us to compare specific dollar figures side by side rather than making assumptions regarding the value that 18-20 year olds place on an alcoholic beverage.

Moreover, another interesting area of study would be a scenario analysis which compares the cost-benefit figures under different MLDAs. Specifically, a comprehensive cost-benefit analysis that was carried out for an age-19 MLDA and an age-20 MLDA might reveal that either of these MLDAs is welfare-improving relative to age-21 MLDA in which case the optimal MLDA in the United States may be either 19 or 20 years of age.

Although it may be difficult to predict whether our public policy makers in the House and Senate will seriously consider proposing a bill to reduce the current age-21 MLDA in the near future, it will be interesting to see whether the public's perception of a lower MLDA will gain momentum in the next generation. Given that the United States is slowly becoming more liberal or open in the arena of social issues with highly debated matters such as the legalization of gay marriage and marijuana gaining an increasing share of public acceptance; it would not be

unlikely to envision the United States with an MLDA below age-21 in the near future. On the other hand, given our current economic recession and troubling global economic issues, most of the Congressional focus has justifiably been on helping our economy recover and creating jobs in the United States. However, once we hopefully completely recover and return to an environment with full employment and stable economic growth, the attention of our policy-makers may once again turn to hot-topic social issues such as the potential lowering of the MLDA.

Given our current environment, it is therefore difficult to predict if and when we may enforce an MLDA below age-21 in the United States. If we do see policy interest in this area, rather than passing a bill federally mandating a lower-MLDA, we are more likely to see an elimination of the 10% reduction in federal highway funding clause in the National Minimum Drinking Age Act of 1984. Such a move would signify that the federal government believes that states should have the right to set their MLDA in their respective states which would certainly provide some modern-day social experiments regarding the possible effectiveness of a reduced MLDA in the United States.

VII. List of Graphs and Figures

Figure 1.[138]

One drink equals:
1 oz. 86 proof Liquor, or
3 oz. wine, or
12 oz. Beer

Levels of intoxication:
BAC less than .05% - Use Caution
BAC .05 to .079% - May be Impaired
BAC .08% & above - Presumed Under the Influence

Body Weight	Number of Drinks								
	1	2	3	4	5	6	7	8	9
100	0.032	0.065	0.097	.0129	.0162	0.194	0.226	0.258	0.291
120	0.027	0.054	0.081	0.108	0.135	0.161	0.188	0.215	0.242
140	0.023	0.046	0.069	0.092	0.115	0.138	0.161	0.184	0.207
160	0.020	0.040	0.060	0.080	0.101	0.121	0.141	0.161	0.181
180	0.018	0.036	0.054	0.072	0.090	0.108	0.126	0.144	0.162
200	0.016	0.032	0.048	0.064	0.080	0.097	0.113	0.129	0.145
220	0.015	0.029	0.044	0.058	0.073	0.088	0.102	0.117	0.131
240	0.014	0.027	0.040	0.053	0.067	0.081	0.095	0.108	0.121

This table shows the effects of alcohol within one hour on a average person of a given body weight. Please do not take this information as a license to drink irresponsibly. Everyone is different, and alcohol effects each person in a different way. Only you know your limits. Please drink responsibly.

[138] Arizona Department of Public Safety 1.

Figure 2: Progressive Effects of Alcohol on the Body[139]

Blood Alcohol Content (% by volume)	Behavior	Impairment
0.010–0.029	• Average individual appears normal	• Subtle effects that can be detected with special tests
0.030–0.059	• Mild euphoria • Relaxation • Joyousness • Talkativeness • Decreased inhibition	• Concentration
0.06–0.09	• Blunted feelings • Disinhibition • Extraversion	• Reasoning • Depth perception • Peripheral vision • Glare recovery
0.10–0.19	• Over-expression • Emotional swings • Anger or sadness • Boisterousness • Decreased libido	• Reflexes • Reaction time • Gross motor control • Staggering • Slurred speech
0.20–0.29	• Stupor • Loss of understanding • Impaired sensations	• Severe motor impairment • Loss of consciousness • Memory blackout
0.30–0.39	• Severe central nervous system depression • Unconsciousness • Death is possible	• Bladder function • Breathing • Heart rate
0.40-0.50	• General lack of behavior • Unconsciousness • Death is possible	• Breathing • Heart rate
≥0.50	• Death	

[139] FlightPhysical 1.

Figure 3[140]

Number of Homicides Per Year Per 1,000 Population		
Year	Entire Registration Area	Registration Area of 1900
1900	1.2	2.1
1910	3.9	5.9
1920	4.2	7.1
1925	5.0	8.6
1926	5.1	8.8
1927	5.0	8.8
1928	4.8	8.8
1929	5.0	8.5

[140] Landesco 10.

Figure 4[141]

Male Prisoners Per 100,000 Population received by State and Federal Prisons					
Offense	Rate per 100,000 People				
	1910	1923	1926	1927	1928
Homicide	5.4	5.7	4.6	4.4	4.8
Rape	2.3	2.6	3.0	3.1	3.0
Robbery	2.6	5.1	6.9	7.2	8.3
Assault	5.5	3.2	3.9	3.9	3.9
Burglary	12.7	11.1	13.7	14.3	16.7
Forgery	3.4	4.5	5.1	5.7	6.2
Larceny and related offenses	16.3	14.8	21.9	23.5	23.7
Sex offenses except rape	1.7	2.0	2.2	2.2	2.3
Violating Liquor Laws	0.6	4.5	6.2	6.7	6.1
Violating Drug Laws	N/A	3.5	3.4	3.1	3.6
Carrying Weapons	0.3	0.4	0.7	0.8	0.8
Nonsupport or neglect of family	0.2	0.4	0.8	1.0	1.2
Other	4.2	3.9	5.5	6.3	7.0
Not reported	0.1	0.3	0.5	0.4	0.6
Total Males	**55.5**	**61.9**	**78.3**	**82.7**	**88.1**

[141] Landesco 10.

Figure 5[142]

Table 3.2	Passenger-Vehicle-Occupant-Fatality Rates, 1983, 1990, and 1995		
Age Group	Annual per Person Car Miles of Travel	Fatalities per 100,000 People	Fatalities per Billion Car Miles of Travel
	1983		
16–19	5,861	32.06	54.22
20–24	9,773	31.21	31.62
25+	7,972	14.00	17.40
	1990		
16–19	8,218	33.78	40.74
20–24	10,177	30.85	30.01
25+	9,293	14.63	15.64
	1995		
16–19	11,498	29.48	25.43
20–24	12,656	27.20	21.29
25+	13,503	13.59	9.97

Sources: Fatalities are taken from the FARS. Occupant miles are taken from the 1983, 1990, and 1995 NPTS.

Figure 6[143]

Table 3.10	Percentage of Drop in 18–19-Year-Old Passenger-Vehicle-Fatality Rate Explained by State Interventions	
	% Change in Fatality Rate, 1979–92	% of Change Explained by Law Changes
Actual change	−38.4	
Predicted change with no adoption of belt-use laws	−32.6	15.0
Predicted change with no increases to an MLDA of 21	−36.0	6.4
Predicted change with no adoption of belt-use laws and no increases to an MLDA of 21	−30.9	19.5

[142] Dee et. al 1.
[143] Dee et. al 38.

Figure 7[144]

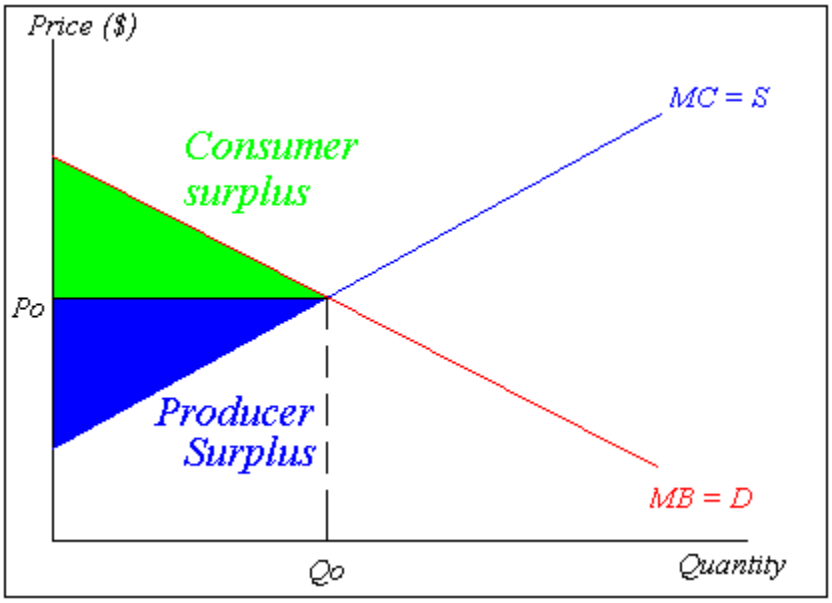
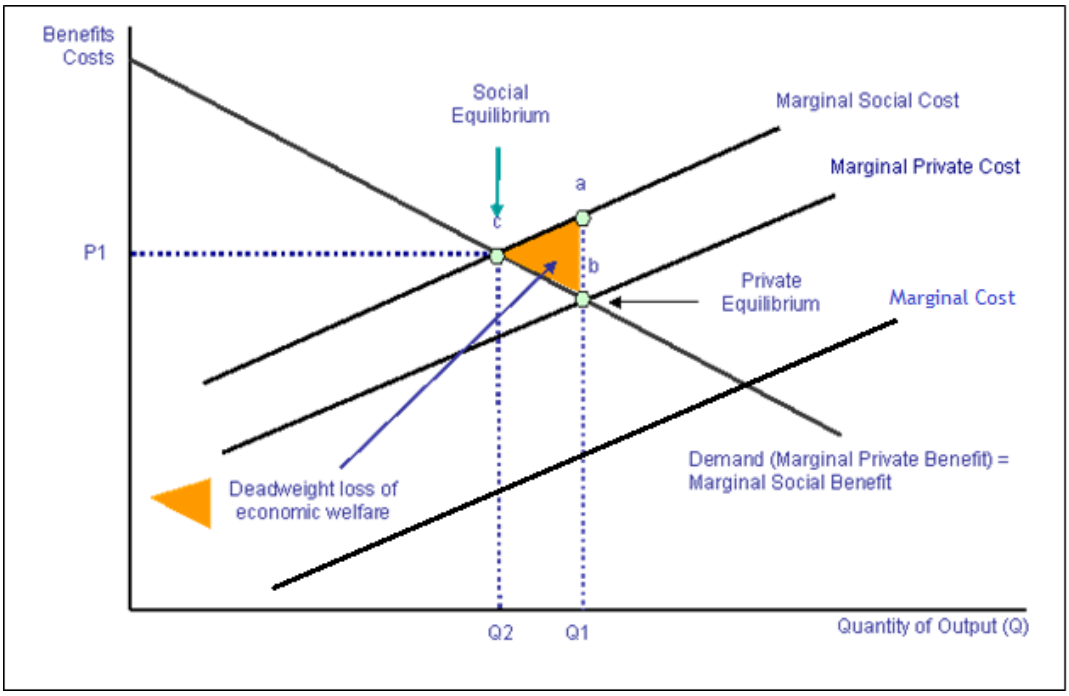
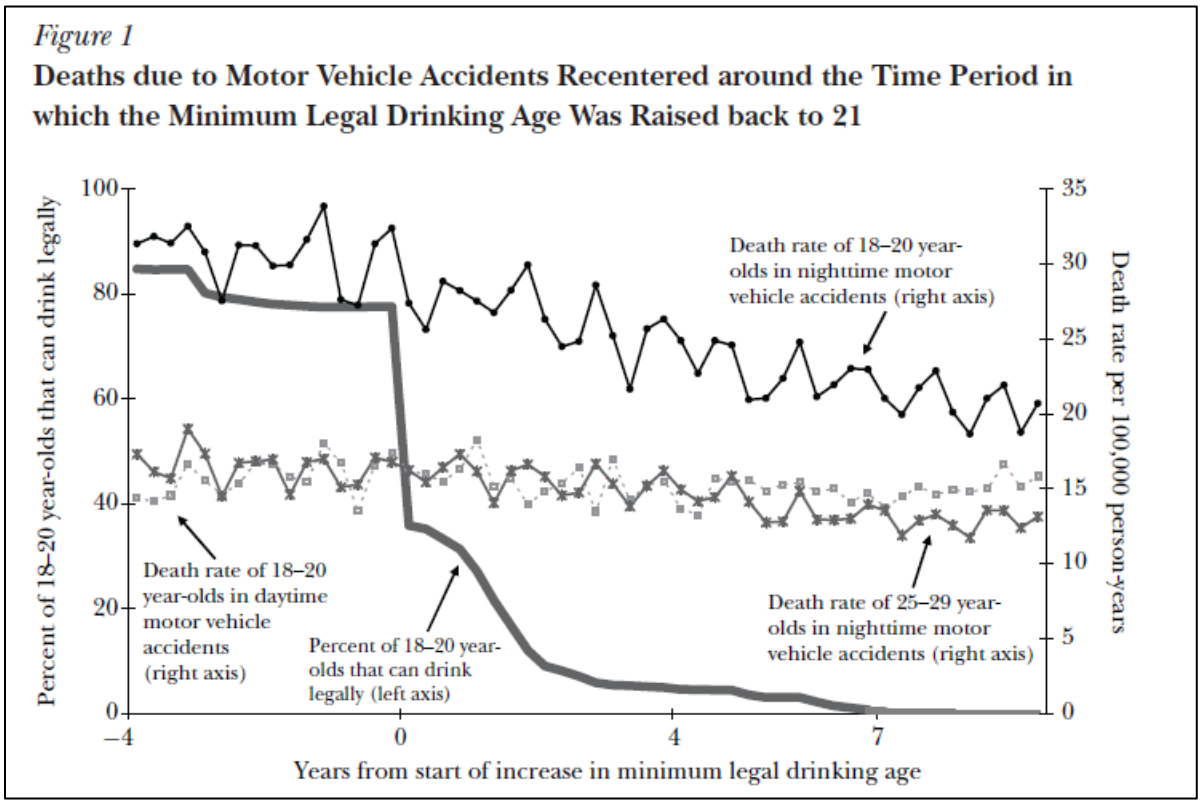


Figure 8[145]



[144] Allocative Efficiency in a Perfectly Competitive Market 1.
[145] Externalities Overview 1.

Figure 9 [146]



[146] Carpenter et. al 139.

Figure 10[147]

Table 2

Panel Estimates of the Effect of the Minimum Legal Drinking Age on Mortality Rates

(deaths per 100,000)

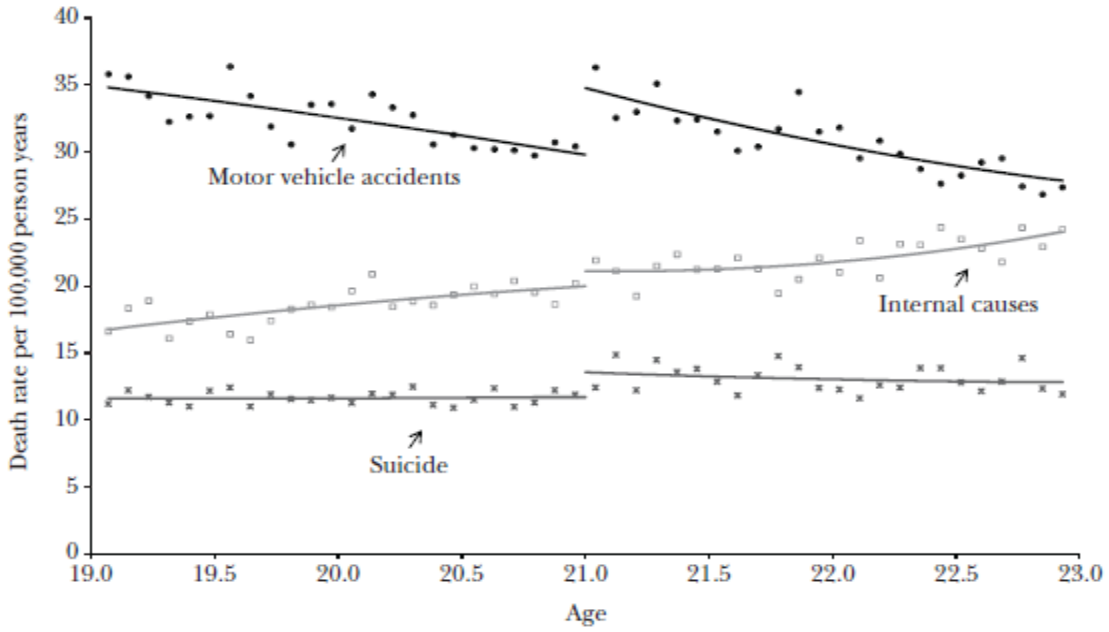
			Deaths due to external causes				
	Deaths due to all causes	*Internal causes*	*Suicide*	*Motor vehicle accident*	*Homicide*	*Alcohol*	*Other external*
Effect of proportion of 18–20 year-olds legal to drink on mortality rates of 15–17 year-olds	2.33 [1.61]	0.65 [0.56]	0.37 [0.35]	1.35* [0.76]	0.28 [0.62]	–0.03 [0.06]	–0.29 [0.44]
Average mortality rate 15–17 year-olds	42.7	11.0	4.0	16.0	4.4	0.1	7.2
Effect of proportion of 18–20 year-olds legal to drink on mortality rates of 18–20 year-olds	**7.76 [4.92]**	**1.64* [0.97]**	**1.29*** [0.47]**	**4.15** [2.07]**	**–0.75 [2.31]**	**–0.03 [0.07]**	**1.46* [0.83]**
Average mortality rate 18–20 year-olds	**112.6**	**22.5**	**12.8**	**45.5**	**16.3**	**0.3**	**16.2**

[147] Carpenter et. al 142.

Figure 11[148]

Figure 2

Age Profiles for Death Rates in the United States



Notes: The death rates are estimated by combining the National Vital Statistics records with population estimates from the U.S. Census.

[148] Carpenter et. al 144.

Figure 12[149]

Table 3

Regression Discontinuity Estimates of the Effect of the Minimum Legal Drinking Age on Mortality Rates

(deaths per 100,000)

			Deaths due to external causes				
	Deaths due to all causes	*Internal causes*	*Suicide*	*Motor vehicle accident*	*Homicide*	*Alcohol*	*Other external*
Increase at age 21	8.06***	0.66	2.37***	3.65***	–0.10	0.41*	1.37*
	[2.17]	[1.01]	[0.76]	[1.25]	[0.58]	[0.21]	[0.77]
Mortality rate	93.07	20.07	11.70	29.81	17.60	0.99	13.40

Notes: In the table above, we present estimates of the discrete increase in mortality rates that occurs at age 21 with the associated standard error directly below in brackets. The regression estimates are from a second-order polynomial in age fully interacted with an indicator variable for being over age 21. All models also include an indicator variable for the month the 21st birthday falls in. Since the age variable has been recentered at 21, the estimate of the parameter on the indicator variable for being over 21, which we present in the table, is a measure of the discrete increase in mortality rates that occurs after people turn 21 and can drink legally. The mortality rates are estimated from death certificates and are per 100,000 person-years. The fitted values from this regression are superimposed over the means in Figure 2. The mortality rates presented below the standard errors are the rates for people just under 21. Deaths are catgorized slightly differently than for Table 2. Whereas Table 2 focused on the primary cause of death listed on the death certificate, Table 3 considers all factors mentioned on the death certificate and imposes the following precedence order: homicide, suicide, motor vehicle accident, alcohol, other external, internal. *, **, and *** represent statistical significance at the 10, 5, and 1 percent levels, respectively.

[149] Carpenter et. al 145.

Figure 13: Effect of Turning 21 on Inpatient Hospital Stays, Emergency Room Visits, and Mortality Rates

(Regression Discontinuity Estimates)

	Absolute Effect (# of people per 100,000 people per year)	Percentage Effect (Rounded % Figures)
Inpatient Stays	+ 77	3.0
Emergency Room Visits	+ 408	1.0
Mortality Rate Attributable to All causes (Internal and External)	+ 8.06	9.0

Figure 14[150]

Table 4

The Effect of the Minimum Legal Drinking Age on Alcohol Consumption

	Panel estimates			*Regression discontinuity estimates*		
	% who drank in past 30 days (1)	*% who drank heavily in past two weeks (2)*	*Times drank in past 30 days (3)*	*% with 12 or more drinks in one year (4)*	*% with any heavy drinking in last year (5)*	*Days drank in last 30 days (6)*
Effect of proportion of 18–20 year-olds that can drink legally	6.10*** [1.35]	3.41*** [1.30]	0.94*** [0.27]	6.11** [3.01]	4.92* [2.91]	0.55** [0.28]
Average	64.8	38.4	5.4	58.7	32.9	2.8

Notes: The independent variable of interest for the regression results presented in the first three columns is the proportion of 18–20 year-olds who can drink legally. These regressions are estimated using responses of high school seniors age 18 and older at the time they completed the Monitoring the Future survey. The regressions include state fixed effects, year fixed effects, state-specific time trends, and dummies for male, Hispanic, black, or other race. The regressions are estimated using a sample of 121,279 high school students from 1976–2003. The estimates in the last three columns are regression discontinuity estimates of the discrete increase in each drinking behavior that occurs after people turn 21. These are estimated using responses of 16,107 19–22 year-olds in the 1997–2005 National Health Interview Survey. These regressions include a quadratic polynomial in age interacted with a dummy for being over 21 at the time of the interview and the following covariates: indicator variables for census region, race, gender, health insurance, employment status, 21st birthday, 21st birthday + 1 day, and looking for work. People can report their drinking for the last week, month, or year, and 71 percent reported on their drinking in the past week or month. All the regressions include population weights. Standard errors for the panel fixed-effects analysis are clustered on state and reported in brackets below the point estimates in the first three columns. Robust standard errors for the regression discontinuity analysis are reported in brackets below the point estimates in the last three columns.

*, **, and *** represent statistical significance at the 10, 5, and 1 percent levels, respectively.

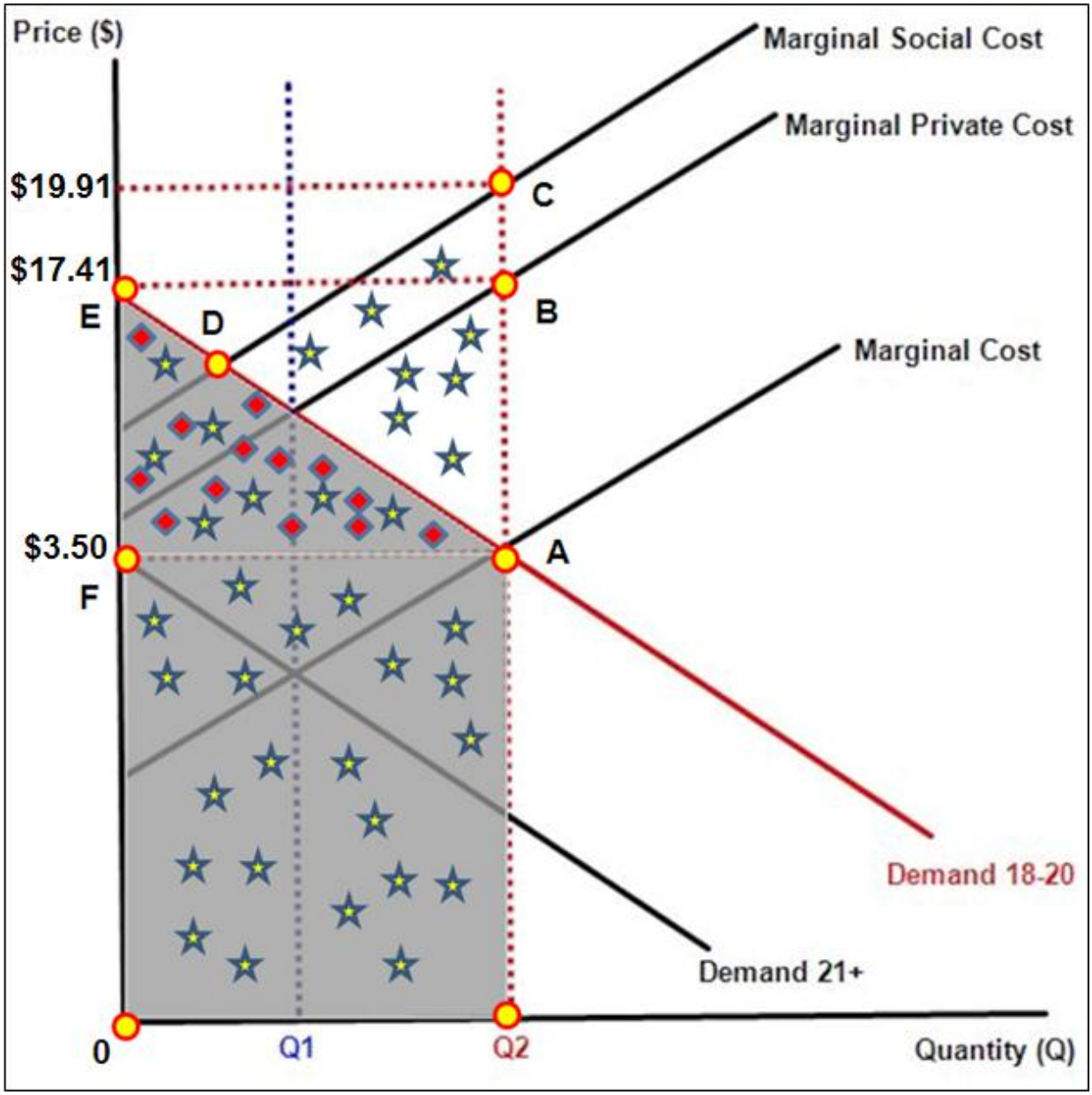
[150] Carpenter et. al 149.

<u>Figure 15</u>: Value of a Statistical Life (2011 Dollars)

Environmental Protection Agency	Food and Drug Administration	Transportation Department	Professor Viscusi (Vanderbilt Law School)	Simple Average
$9.1 million[151]	$7.9 million[152]	$6.0 million[153]	$8.72 million[154]	$7.93 million

[151] Appelbaum 1.
[152] Appelbaum 1.
[153] Appelbaum 1.
[154] Carpenter et. al 152.

Figure 16


Price ($)
Marginal Social Cost
Marginal Private Cost
$19.91
C
$17.41
E
D
B
Marginal Cost
$3.50
A
F
Demand 18-20
Demand 21+
0
Q1
Q2
Quantity (Q)

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Academic Vita

Aly G. Crowley

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EDUCATION

The Pennsylvania State University, Schreyer Honors College — **University Park, PA**
Bachelor of Science in Finance and Economics — Expected Graduation: December 2011
Dean's List Every Semester

EXPERIENCE

Deloitte Consulting — **Pittsburgh, PA**
Strategy and Operations Business Analyst Summer Scholar — May 2011- August 2011

- Conducted extensive patient co-payment sensitivity research and provided team with high-level findings
- Improved analytical and technical skills while learning about the client and pharmaceutical industry

Morgan Stanley — **New York, NY**
Financial Control Group Summer Analyst — May 2010- August 2010

- Assisted with Federal Reserve Bank Holding Company review to meet new regulatory banking procedures
- Established model to streamline integrated risk assessment system and improve financial control

Johnson and Johnson — **New Brunswick, NJ**
International Treasury Services Co-Op, Vice President Intern Co-op Association — June 2009- December 2009

- Oversaw Cash Visibility Initiative and achieved a 19% improvement by communicating with international affiliates to identify high-risk investments, and provided guidance to optimize affiliate current accounts
- Managed sovereign risk analysis by providing key updates regarding high risk countries, and strengthened analysis through development of Excel-based eight-quarter historical analysis tool

The Pragma Corporation — **Falls Church, VA**
Finance and Accounting Intern — Summers, 2007 and 2008

- Audited expense reports and reconciled vouchers with general ledger and summary sheets
- Performed document and internet research (in Russian and English) to meet project goals
- Designed and implemented a Property Plant and Equipment (PP&E) tracking system using Microsoft Excel

United States Agency for International Development (USAID) — **Kiev, Ukraine**
Financial Management Office Intern — June 2005- July 2005

United States Embassy Consulate — **Almaty, Kazakhstan**
Consulate Intern — June 2006- July 2006

LEADERSHIP ACTIVITIES AND AWARDS

Business Administration 301: Principles of Corporate Finance — August 2010-December 2010
Teaching Assistant

- Support a class of 1,000+ students by facilitating their understanding of core concepts and issues
- Prepare student assessments through research and collaboration with professor of course

Penn State Investment Association (PSIA) September 2007-present

Financials Sector Analyst

- Acquire experience in Bloomberg, Reuters and other financial analysis tools to become PSIA certified
- Identify and track stock performance for the Nittany Lion Fund, a $4.8 million alumni investment portfolio

Delta Sigma Pi Professional Business Fraternity February 2008-present

Business Roundtable Representative

- Collaborated in a teamwork setting to raise more than $1,200 for the fraternity's charity fund
- Streamlined the budgeting process of social functions for fraternity members

Ernst and Young Summer Leadership Program, Washington DC June 2009

Philip Morris USA Sophomore Leadership Development Program December 2008-April 2009

Phi Beta Kappa Honor Society, Beta Gamma Sigma International Honor Society, Phi Kappa Phi Honor Society Johnson and Johnson Case Competition: 1st place, Shell Case Study Challenge: 1st place
President's Freshman Award and Evan Pugh Junior and Senior Scholar Award (Awarded to top 0.5% of class)

SKILLS

Computer: Bloomberg Certified, Microsoft Sharepoint, Excel, PowerPoint, Word, Access, and Outlook
Language: Proficient in French, working knowledge of Italian and Arabic, basic understanding of Russian