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Essays on Transportation Safety, Economics, and Policy

by

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ABSTRACT

Essays on Transportation Safety, Economics, and Policy

By

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The rational allocation of transportation resources involves both the evaluation of the effectiveness of programs designed to improve transportation systems, as well as the formulation of policies representing a balance of competing public interests in those systems. Such interests often include: curbing automobile emissions, expanding highway infrastructure, providing affordable transit services for inner-city residents, and extending commuter rail services to sprawling suburban areas. Designing policies that cost-effectively further each these objectives can attenuate the degree of inherent tradeoffs between them and expand the frontier of achievable policy goals. This dissertation presents a set of essays addressing two such aspects of transportation policy decisions: 1) an evaluation of programs aimed at increasing transportation safety and public health, and 2) an examination of the processes through which competing public interests and agendas are mobilized in the legislative arena by transportation agencies.

Chapter One: Graduated driver license programs (GDL), which progressively move teens through three stages of licensing while limiting driving to lower risk conditions, have become an increasingly popular approach in the past decade to address the high rate of teen driving related fatality and injury crashes. Teens are 2 to 6 times as likely as adults, per mile driven, to die in motor vehicle accident, and teen crashes tend to involve more fatalities per crash than for any other age group. Driving at night past 9pm or with young passengers under the age of 20 are significant risk factors for teen crashes.

This research uses a panel data set of teen driver involved fatal vehicle crashes among 16 to 17 year old drivers in 742 counties and 137 commuting zones straddling state borders for the years 1996 to 2009. I use a cross-state policy discontinuity design with an ordinary least squares fixed-effects regression model to identify the effects of graduated driver license laws on teen driver error related fatal crashes and associated fatality counts. Additionally, I analyze the impacts on crash characteristics most likely associated with teen driving mistakes, such as presence of young occupants and those occurring at night or involving alcohol. By taking into account local heterogeneities, the policy-discontinuity design provides more credible identification than previous studies. Importantly, the findings indicate much larger GDL effects than in the extant literature.

I find that the strongest GDL programs, as rated by the Insurance Institute for Highway Safety, reduce teen driving related fatal crash rates by 25 to 34 percent and teen *driving error* related fatal crash rates by 34 to 45 percent. The most effective components of the GDL were early nighttime driving curfews beginning between 6pm to 10pm at night. Passenger restrictions had statistically significant effects only when controlling for the number of licensed teens on the road. For example, the zero to one passenger limit reduced quarterly county-level young teen driver involved fatal crash rates per 100,000 by -6.388 points, relative to a mean rate of 9.5 in state-periods without restrictions. These passenger limits were also highly effective at reducing nighttime crashes among teens, with a reduction in these crash rates of -5.909. Finally, the extended practice period during which newly licensed teens are only allowed to drive under adult supervision were effective in reducing fatal crashes per unit population but only were statistically significant for *nighttime* crashes that occur after 9pm when controlling for the number of licensed teen drivers.

Chapter Two: Government transportation agencies spend considerable amounts of money attempting to influence state and federal legislation, through their own legislative staff, and the efforts of appointed officials and hired lobbyists. Almost none of the literature to date has examined how transportation agencies use their funding and political influence to shape state and federal policy. By looking at what topics agencies choose to lobby on, or not to lobby on, we can better understand how transportation agencies attempt to shape the transportation legislation, and how potential biases in their agendas are mobilized. This analysis includes four agencies in the San Francisco Bay Area Metropolitan region: the Metropolitan Transportation Commission (MTC), a regional Metropolitan Transportation Planning Organization, the Bay Area Rapid Transit District (BART), the region's commuter rail operator, Alameda-Contra Costa Transit (AC Transit), a local bus agency serving two counties in the East Bay, and the Santa Clara Valley Transit Authority (VTA), a bus and light-rail transit operator in the southern portion of the region. Collectively, these four agencies account for approximately 80 percent of the total spending on lobbying activities by San Francisco Bay Area transportation agencies.

This research draws on government reports filed by the agencies, in-house agency legislative agenda records, and interviews with legislative and agency staff. Descriptive statistics and a probit analysis of lobbying data are applied to compare the substance of each agency's lobbying activities to the set of pressing transportation issues the agencies themselves have identified in their planning documents, and the set of transportation issues and needs identified by other key stakeholders including business groups, social justice advocates, and environmentalists. All of the transportation agencies lobbied heavily for finance bills that increase revenue and flexibility in fund use as well as funding redistribution. Equity related bills that address transportation for low-income populations have a significantly higher marginal probability of gaining both MTC and AC Transit support, relative to bills that do not address these issues. Overall, VTA was *less* likely to support highway bills but did not have biases toward any other particular bill issues. BART overwhelming supported bills promoting smart growth principles and transit oriented development, two strategies believed to increase transit ridership. Both the Santa Clara VTA and BART were strategic in the bills they chose to support, having a greater likelihood of supporting bills authored by transportation committee chairs, perhaps in an effort to both build political capital and to expend resources on bills with a greater chance of passage. MTC was *more* likely to take a supporting position on social equity related bills; however, the degree of effort in that support is unknown. Notably, MTC did not support bills specific to expanding public transit, a mode important to low income groups.

Dedicated to my daughter, Emily Jones

To my sister, Christine Foglietta

and

In loving memory of my mother, Virginia Wilson

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Overview

The rational allocation of transportation resources involves both the evaluation of the effectiveness of programs designed to improve transportation systems, as well as the formulation of policies representing a balance of competing public interests in those systems. Public welfare enhancing transportation systems increase the efficiency of mobility of both passengers and goods, and are affordable and accessible to all demographic and income groups, while preserving resources for future generations and minimizing environmental harm or externalized costs. Key elements of such systems also include the increasing of the safety of the users, and the inclusion of policy interests of underrepresented groups such as low-income populations and minorities. Yet, in the policy formulation process, policy makers are often faced with conflicting objectives such as, providing affordable public transit services for low-income inner-city residents, expanding highway infrastructure, and extending commuter rail services into sprawling suburban areas. Designing policies that cost-effectively further each these objectives can attenuate the degree of inherent tradeoffs between them and expand the frontier of achievable policy goals. Thus, central to sound public policies is an understanding of both the relative efficacy of various policy options and the processes through which tradeoffs are negotiated by actors in the policy sphere. This dissertation provides a set of essays evaluating two such aspects of such transportation policy decisions. I first evaluate state programs aimed at increasing transportation safety and public health: graduated driver license programs for young teen drivers. I then examine the processes through which competing public interests and agendas are mobilized in the transportation legislative arena.

Chapter one presents an evaluation of the effectiveness of graduated driver licensing (GDL) programs designed to reduce the high rate of teen driver involved fatal crash rates in the United States. Motor vehicle accidents are the leading cause of death among teens age 15 to 19 in the U.S. Although teens are at a prime age for learning and exhibit faster reflexes, their immaturity combined with lack of driving experience, paradoxically leads them to make more driving errors and take more risks, resulting in higher crash and fatality rates than any other age group. Novice teen drivers ages 16 to 17 are 2-3 times more likely, relative to their population, to die in a motor vehicle accident; per mile driven, the relative risk increases to 2 to 6 times, depending upon the age groups compared. In addition, teen drivers involved in fatal crashes are more likely compared to adult drivers to be in single vehicle crashes or to have made a driving error, including failing to scan the road, driving too fast for conditions, and becoming distracted (Curry, 2011). They are also more likely to have an accident when carrying other teen passengers or when driving at night.

Graduated driver license (GDL) systems have become a wide spread approach to reducing the high rate of teen driver accidents. GDL programs require teens to move through three stages of progressive driving privileges in which they must satisfy a set of requirements before moving onto the stage. These programs aim to strike a compromise between allowing teens to gain experience needed to become safer drivers, while at the same time limiting high risk contexts, such as carrying young passengers and driving at night. In the learner stage, teens may drive only under the supervision a licensed adult for the first 3 to 6 months, and are often required to complete a driver education course, while logging a minimum amount of supervised practice driving hours. During the intermediate stage, which usually lasts from 6 months to a year, teen drivers may drive on their own, but with passenger and nighttime driving restrictions. Passenger restrictions limit the number of young passengers (under 20-21 years of age) teen drivers may carry, while nighttime restrictions prohibit young teens from driving after a given hour at night. Passenger and nighttime restrictions vary considerably over states, with most nighttime curfews ranging between 9pm and midnight, with

12am being the most common time. Passenger limits range from 0 to 3 passengers allowed, with one passenger limit being the most common.

Prior studies on GDL systems have found large reductions in teen traffic fatalities from such programs ranging from 5 to 40 percent, depending upon the methods and the policy and outcome measures used. However, several questions remain unanswered in the literature. First, many prior studies use generalized outcome measures that include *all* teen driving accidents and teen fatalities, and fail to identify the impacts on the types of crashes GDL laws seek to reduce, those related to driving mistakes made by teens. Many studies also use the rating system by the Institute for Highway Safety (IIHS) as an indicator of policy strength. While this is an important measure, it masks important differences in the relative effects of specific GDL program components on teen driving errors. Moreover, prior studies may be vulnerable to biases due to unobserved heterogeneity in regional factors such as local road conditions, road design, access to emergency services, speed limits, traffic law enforcement levels, economic trends, and travel patterns.

This study is the first to the author's knowledge to control for heterogeneity in local factors affecting fatal vehicle crash rates. I employ a cross-state policy discontinuity design, in which groups of counties straddling state borders serve as control and treatment groups in states with and without GDL systems or with variations in GDL program strengths. Using a national data set of all county-level fatalities within cross-state commuting zones for the years 1996-2009, I use an ordinary least squares estimator with controls for several economic and policy variables such as non-teen adult driver crashes at the county-level, seat-belt and alcohol laws, unemployment rates, and the share of licensed teens. I construct outcome measures more closely tailored to the policy objectives of the programs, crashes in which a teen made a driving error, such as single-vehicle crashes, and crashes where the teen driver swerved off the road, sped, became distracted. Additional outcomes studied are those involving young passengers and occurring after 9pm at night. The relative effects of overall system strength using the IIHS rating as well as the relative effects of specific GDL system components, such as supervised practice periods and passenger and nighttime restrictions are identified. Finally, the county level disaggregation allows for tests for heterogeneous treatment effects among rural and urban commuting zones, which carry starkly different traffic risk profiles, are conducted.

Among the most highly rated programs (rated as good by the IIHS), young teen driver involved fatal crash rates were reduced by 25 to 34 percent and those involving teen driving errors, fell even more, by 34-45 percent. These are substantially larger findings than prior national level panel data studies that do not control for unobserved local heterogeneity in trends that may affect crash rates. The months of holding period, in which teens were prohibited from driving without adult supervision, was a consistently statistically significant and important measure in reducing crash rates, up to a percentage point for each month of holding period. When licensure rates for young teens were included, the holding period effect disappears, except in the case of nighttime accidents. This may imply that for *daytime* accidents, the effect of holding period is mostly due to reduced exposure or fewer teens on the road versus the effect of safer driving while under supervision.

Nevertheless, reduced exposure is only part of the story. Even accounting for the number teens on the road, nighttime restrictions beginning before 10pm, dramatically reduce the number of fatal vehicle accidents involving young passengers and those occurring at night, with declines ranging from 48 to 89 percent. This finding was consistent throughout the study, with the 10pm and earlier GDL component being large and statistically significant in almost all specifications including robustness checks for rural and urban areas.

Earlier teen driving curfews are particularly salient to reducing accidents involving driving mistakes and those occurring at night after 9pm. The effect on crashes related to teen driving errors was remarkable, falling by 89 percent compared to those rates in commuting-zone-state-periods with no night restrictions. Controlling for the share of licensed teens in the population, early curfews reduced almost all types of crashes studied, including young passengers, daytime before 9pm, and the number of fatalities per crash. Curfews later than 10pm, beginning anytime from 11pm to 1am, were not shown to be effective and in fact the estimates of coefficients on this variable had positive, although insignificant, signs. Among the types of passenger limits, restrictions ranging from zero to one passenger were the most effective, reducing teen driver errors related fatal crash rates per licensed driver, by -6.388 points, relative to a mean rate of 9.5 in state-periods without restrictions. These passenger limits were also highly effective at reducing nighttime crashes among teens, with a reduction in these crash rates of -5.909.

Chapter two examines how transportation agencies use their legislative staff and lobbying resources to shape metropolitan surface transportation agendas and legislation. Transportation agencies spend substantial sums of money attempting to influence state and federal legislation, through their own legislative staff, appointed officials, and hired lobbyists. While lobbying as a broad topic has been studied in some detail, almost none of the literature to date has examined how transportation agencies use their funding and political influence in to shape state and federal policy. By looking at what topics agencies choose to lobby on, or not to lobby on, we can better understand how transportation agencies attempt to shape the transportation legislation, and how potential biases in their agendas are mobilized. This analysis includes four agencies in the San Francisco Bay Area Metropolitan region: the Metropolitan Transportation Commission (MTC), a regional Metropolitan Transportation Planning Organization, the Bay Area Rapid Transit District (BART), the region's commuter rail operator, Alameda-Contra Costa Transit (AC Transit), a local bus agency serving two counties in the East Bay, and the Santa Clara Valley Transit Authority (VTA), a bus and light-rail transit operator in the southern portion of the region. Together, these agencies account for roughly 80 percent of the total spending on lobbying activities by Bay Area Transportation agencies. Agency lobbying activities are examined through analysis of reports filed by the agencies, as well as through interviews with legislative and agency staff. Using a set of descriptive statistics and a probit model estimated with maximum likelihood methods, the substance of each agency's lobbying activities is compared to the set of pressing transportation issues that agencies have identified in their planning documents, and those identified by other key stakeholders in the region.

A substantial share of total governmental lobbying expenditures comes from transportation agencies. Over half of the bills tracked by the agencies studied fell under four subject areas, including, public transit (15%), smart growth or transit oriented development (TOD) (14%), transportation finance (14%), and highways and roads (13%). All of the transportation agencies, in particular, the regional planning authority, MTC, lobbied heavily for finance bills that increase revenue and flexibility in fund use as well as funding redistribution. Equity related bills that address transportation for low-income populations have a significantly higher marginal probability of gaining both MTC and AC Transit (the East Bay bus service) support, relative to bills that do not address these issues. Overall, VTA was *less* likely to support highway bills but did not have biases toward any other particular bill issue. BART overwhelming supported bills promoting smart growth principles and transit oriented development, two strategies believed to increase transit ridership. Both the Santa Clara VTA and BART were strategic in the bills they chose to support, having a greater likelihood of supporting bills authored by transportation committee chairs, perhaps in an effort to both build political capital and to expend resources on bills with a greater chance of passage. Contrary to allegations by local social justice groups, MTC was *more* likely to take a supporting position on social equity bills, however, the degree of effort in that support is unknown. Notably, MTC did not support bills specific to expanding public transit, a mode important to low income groups.

The regional planning agency had considerable influence in Sacramento. That is, the bills they supported had a statistically significantly higher chance of passage at the state and federal levels. Since MTC has considerably more funds to hire full-time lobbyists, it is likely that its agenda wins greater lobbying time in Sacramento and DC relative to smaller agencies and transit operators. However, while BART was the largest spender on lobbying among the four, they did not seem to have strong influence. Given that MTC is a regional planning organization it may have more political power relative to the other agencies per dollar spent. MTC's considerable influence in shaping transportation legislative outcomes raises institutional questions of regional planning agency board structure and fair representation of regional transportation interests, as transit operators are not represented on MTC's board and some counties are over represented relative to their population share in the region.

Chapter 1: The Effect of Graduated Drivers License Programs and Teen Driving Error Related Fatal Crashes

1.1 Introduction

Motor vehicle accidents are the leading cause of death among teens age 15 to 19 in the U.S. At a prime age for learning and with faster reflexes, their immaturity combined with lack of driving experience, paradoxically leads them to make more driving errors and take more risks, resulting in higher crash and fatality rates than any other age group. Relative to their population size, novice teen drivers are 2-3 times more likely to die in a motor vehicle accident. Per mile driven, the relative risk ratios increase to 2 - 5.8 (Table 1-1).[1] Teens are particularly vulnerable to peer effects that magnify their propensity for risk taking and also substantially increase the levels of in-vehicle distractions when carrying teen passengers. Three stage programs that grant teens increasing driving privileges over time, graduated driver license (GDL) systems attempt to strike a compromise between allowing teens to gain experience needed to attain driving skills, while at the same time limiting high risk contexts, such as carrying young passengers and driving at night.

While GDL programs have reduced the number of fatalities among teens, by 5 to 40 percent, there are some unanswered questions in the literature about the particular effects GDL systems on vehicle crashes caused by teen driving errors versus other causes, the relative effects of specific components, and differences in impacts on teen crashes in rural versus urban areas. Further, some of the decline in teen motor vehicle fatalities appears to be correlated with concomitant reductions in licensure rates among 16 year olds associated with the implementation of GDL programs, raising the question to what extent have teen accident rates declined through reduced risk exposure compared to other program elements.

This study improves upon past research in several ways. First, I use outcome measures more closely tailored to the policy objectives of GDL laws. Past studies on GDL laws attempt to measure the impact on *all* teen driving accidents and teen fatalities, but fail to differentiate the effect on accidents related to driving mistakes made by teens versus other causes. Moreover, some research uses all teen traffic fatalities as a measure, without differentiating between cases where a teen was a driver or a passenger. In contrast, I identify to what extent GDL laws are effective in reducing teen driving error related fatal accidents as well as fatal crashes occurring in contexts found to be associated with increased driving errors, such as, drunk driving, presence of young passengers, and after 9pm at night. Moreover, the methodology I use provides improved controls for geographic heterogeneity in causal factors related to teen driving crashes. Prior studies aggregate teen crashes to the state level, failing to account for unobserved trends in local and regional factors affecting crash rates such as local road conditions, road design, access to emergency services, speed limits, traffic law enforcement, and travel patterns, introducing possible biases due to spurious trends in teen driver traffic fatalities. This study is the first to examine the effects of GDL systems by using local-level cross-state policy discontinuity design, with groups of counties straddling state borders serving as control and treatment groups in states with and without GDL systems or with variations in GDL

1 Depending upon the reference age group.

program components. I use a national data set of county-level teen driver ages 16-17 involved fatalities within cross-state commuting zones from 1996-2009. This local level approach allows for testing of heterogeneous treatment effects in rural versus urban commuting zones. Additionally, many studies[2] do not control for concurrent policies that affect teen crash rates, such as seat belt and alcohol laws. This study includes controls for the rate of non-teen driver involved adult (ages 25-64) crash rates, zero-tolerance alcohol, drunk driving (BAC) and seatbelt laws. Finally, since the implementation of GDL systems is highly correlated with reduced licensure rates among 16 year olds, some of the reduction of teen fatalities may be due to decreased or delayed exposure. This research estimates the degree to which teen driving fatalities have been reduced through delayed licensure rates versus other program components.

1.2 Background

Unintentional injuries are the primary cause of death among teens among teens age 15 to 19 with motor vehicle accidents account for 41 percent such injuries (Baker, Susan, Chen, Li-Hui, and Li, Guohua 2007).[3] Over 3,000 teen drivers in the United States aged 15–19 were killed and more than 350,000 were treated in emergency departments for injuries due to motor-vehicle crashes in 2009. Almost half of all fatalities are among younger teens age 16 and 17 with 1,437 or the 3,000 teen driver fatalities in 2008 occurring among those aged 16 and 17. In 2006, 59.5 teen drivers age 15-20 were involved in a fatal crash, compared to 32 among drivers ages 25-34 per 100,000 licensed drivers. Fatal crash rates are even more significant considering the fact that teens drive significantly fewer miles than adults. For example, in 2007, while teen drivers age 16 to 19 represented 5 percent of the driver population and only 3.6 percent of vehicle miles traveled, they represented 10 percent of driver fatalities (3.6 per 100 million miles driven).[4] Even more die as passengers. Forty percent of teens age 16-19 killed in passenger vehicles in 2005 were riding as passengers (Ferguson, Teoh & McCartt, 2007).

Table 1-1. Fatal passenger vehicle crash involvements per 100 million miles traveled by driver age, April 2001-March 2002

Age	Crash involvements	100 million miles traveled	Fatal Crash Rate	Relative Risk to Age 16 Ratio
16	1,021	110	9.3	1.00
17	1,410	170	8.3	1.12
18	1,790	276	6.5	1.43
19	1,885	261	7.2	1.29
20-24	7,184	1,671	4.3	2.16
25-29	4,873	2,151	2.3	4.04
30-59	21,831	13,969	1.6	5.81
60-69	3,094	1,936	1.6	5.81
≥ 70	4,716	1,161	4.1	2.27

Source: IIHS using NHTS & FARS data:
http://www.iihs.org/research/fatality_facts_2008/teenagers.html

While teens generally have quicker reflexes and greater aptitudes for learning new skills than adults, they are lacking in both driving experience and maturity, leading them to often underestimate

2 For examples of those that do include such controls, see for Dee et al., 2008, Carpenter 2005.
3 Injuries are the primary cause of death among teens age 15 to 19.
4 http://www.fhwa.dot.gov/policyinformation/statistics/2007/nhts1231.cfm

dangerous situations and hazardous conditions. Sixteen year old drivers involved in fatal crashes are more likely compared to adult drivers to be in single vehicle crashes or to have made a driving error, including failing to scan the road, driving too fast for conditions, and becoming distracted (Curry, 2011). They are also less likely to wear seat belts and more likely to drink and drive, to speed, to have been carrying young passengers, or to have been traveling at night (Williams, et al. 2005). They are most likely to crash in the first year of driving, with 16 year olds having 3 times the crash rate as 19 year olds (Triplett 2005).

Several studies on adolescent brain development have documented that, at a biological level, their capacity to assess risk is still developing, leaving them vulnerable to making often fatal errors in the perception and assessment of driving risks (Males, 2006). However, the degree to which elevated crash rates in this age group are due to inexperience versus age is unclear. While younger teens have higher accident rates than older ones, they also have less driving experience. The confounding factor in studies of the effects of age versus experience, however, is that while teens gain more experience they are also increasing in age, making it difficult to separate out the relative effects these two factors. One study has compared older and younger novice drivers and found that while their crash rates are still substantially higher than their older counterparts (novices 20 years of age and older), crash rates for teens drop dramatically with each additional month of driving experience among new teenage drivers in the first six months of driving (Mayhew, Simpson, and Pak 2003). Nevertheless, at 24 months of driving, their crash risk was still considerably higher than the older group (49 versus 27 crashes per 100,000 drivers). The proportions of nighttime and weekend crashes are much higher among teen than non-teen learners, however, these shares decline rapidly in the first few months of driving. The reason for the rapid learning curve among teens may be either due to faster learning or to differences in exposure, such as different travel patterns - differences in the types of roads teens tend to take or differences in the times of day they travel compared to adults.

Teen driver crash risk increases substantially with each additional teen passenger, particularly male passengers (Williams, 2003). Studies of adult drivers with adult passengers have found improvements in driving behavior due to passengers assisting drivers spot potential hazards and perhaps positive peer influences (driving safely may be seen as more socially favorable). However, the opposite effects occur among teens. Teen passengers may directly or indirectly incite more risk taking behavior, either by the perception of a teen driver that driving more dangerously will win peer approval or through direct encouragement by peers to engage in risky behaviors. Moreover, teen passengers may increase the number of in-vehicle distractions through a number of ways. In interviews, teens have recounted a variety of distracting behaviors from peer passengers, such as touching the driver, the steering wheel, or mirrors as well as encouraging the driver to speed up, to pass or catch up to other cars, as well as drinking alcohol, and/or not wearing seatbelts (AAA Foundation for Traffic Safety, 2010).

A study that videoed drivers in traffic, found that teen drivers with teen passengers kept shorter headways (distances between vehicles) and drove faster, especially when carrying male teenage passengers (Morton et al., 2005). The rate of risky driving, defined as speed greater or equal to 15mph of the speed limit or headway of one second or less, was double the rate of general traffic given male driver-male passenger combination. The presence of female passengers resulted in less risky driving behavior among males and females. The general rate of risky behavior was about one third higher than that of observed by drivers in general traffic for both male and female teen drivers without passengers.

Night time driving risk ratios are especially high because teens have less experience driving at night, driving at night is inherently more difficult, and because they are more likely at this time to carry passengers and drive for recreation. As a result, fatal crashes at night are significantly more likely to involve speeding, driver error, alcohol, multiple passengers, and to be a single vehicle crash (Williams, 1997). The risk of a fatal crash is 3 times higher after 9pm than during the day for 16 year old drivers and 40 percent of teen driving accidents occur at night (CQ researcher). Moreover, per mile driven, crash risk is 4 times higher. A variety factors contribute to these higher risk rates. Driving at night is inherently more difficult due to reduced visibility and teens have less experience driving at night, and also tend to be more sleep deprived; as well, high risk scenarios such as drinking, driving with friends, and or driving for recreational purposes are more likely to occur at night.

In summary, teen crash rates are 2 to 3 times higher per population[5] relative to adults who are more mature and experienced drivers, particularly in the first year of driving. Several factors contribute to the marked risk differentials. Teens lack of on road experience and their inability to accurately perceive and assess risk, greatly increase the likelihood of their naively committing driving mistakes such as driving too fast for conditions or over-braking. Additionally, they are also more likely to actively engage in risky behaviors such as drinking and driving, tail gaiting, or speeding for pleasure. Teen passengers increase crash risk by 100 percent or more per passenger by increasing the number of in vehicle distractions and passengers inciting risky behavior. Driving at night is a more difficult task for which teens have very little experience. Moreover, contexts that increase propensity for risk-taking by teens such as carrying young passengers and recreational driving are more common at night, leading to a higher rate of serious injury and fatal crashes at this time of day.

1.3 Graduated Driver License Laws

In response to high teen driver crash rates, almost every state has implemented a graduated driver license (GDL) law in the past decade. GDL laws aim to strike a compromise between lowering driving risk and allowing teens to gain the experience needed to become safe drivers. GDL systems require teens to progress through three stages in which they must successfully meet certain requirements to progress to the next stage. In the learner stage, teens may drive only under the supervision a licensed adult (usually over 21 years old) for the first 3 to 6 months, and are often required to complete drivers education while logging a minimum amount of supervised practice driving hours (from 10 to 60 hours). During the intermediate stage, which usually lasts from 6 months to a year, teen drivers may drive on their own but with passenger and nighttime driving restrictions. Passenger restrictions limit the number of young passengers (under 20-21 years of age) that teen drivers may carry. Restrictions usually range from 0 to 3 passengers under 20 years of age. The most common restriction is 1 young passenger. Nighttime restrictions prohibit teen drivers from driving after certain times at night. Ten pm is recommended by the IIHS, but most states laws begin at 12 am. In most states, if teens successfully pass through the first two stages without any violations or accidents they are given a full privilege driver license[6]. This occurs at a minimum age of 16 and 1/2 to 17 years of age in most states.

GDL components and enforcement rules vary by state. Some states have also increased the age requirement for either the learners or intermediate stage or both (Baker, Susan, Chen, Li-Hui, and

5 This ratio depends on the age group and the denominator used, e.g., vehicle miles traveled, population, or licensed driver.
6 Sanctions for traffic violations and crashes vary among states.

Li, Guohua 2007). Holding periods during which teens can only drive with a parent or a guardian vary from 1 to 12 months. The required number of hours of supervised practice can vary from 10 to 100 hours, without driver education, however the average amount is 30. Very few states have set early nighttime curfews. Most occur at 12am or after and passenger restrictions are most often one or more passengers as opposed to none, and some states make exceptions for nighttime restrictions for travel to work. Nighttime driving is generally more hazardous across all age groups due to reduced visibility and higher numbers of drivers under the influence of alcohol. Some have argued that teen safety may be adversely affected by nighttime curfews given that most skill acquisition occurs through practice and teens will gain less experience driving at night in the first few months of driving (Mayhew, 2007). In response, some states have passed requirements for some portion of supervised practice hours to occur at night.

1.3.1 Evolution of GDL Programs

The first GDL program was adopted in New Zealand in 1987 followed by two Canadian provinces in 1994. Key elements of what are now known as graduated drivers license laws were passed in several states many years before graduated driving laws became more common, including Maryland (1979), California (1983) and Oregon (1989). New York has had nighttime driving curfew since before 1970. The first states to adopt a formalized three stage GDL law with both passenger and night restrictions include Florida (1996), Georgia (1997), California (1998), and Massachusetts (1999). By the year 2000, just under a quarter of all states had some type of GDL law, and by 2009, nearly three-quarters had adopted such laws (Figure 1). Currently, all but one state has some type of GDL program. However, the strength of these programs varies widely. For example, Georgia had the first passenger and night restrictions but initially they were so weak as to barely pass as a GDL system, with passenger limits of 3 young passengers and a nighttime driving curfew of 1am beginning in 1996 (Table 3), although in more recent years their requirements have been increased substantially.

GDL programs grew in the late 1990's and early 2000's in part in response to a public campaign to encourage states to enact GDL programs, *Licensed to Learn*, launched by the Automobile Association of America (AAA) in 1997, as well as federal incentives in the form of matching grants under the Transportation Efficiency Act of the 21st Century (TEA 21)[7] (CPCU, 2002). In addition, due to a wide variation among states in the specifications of GDL systems, the National Transportation Safety Board (NTSB), National Highway Traffic Safety Administration (NHTSA), and the Insurance Institute for Highway Safety (IIHS) came together to develop program standards. These standards were influenced in part by a set of criteria for evaluating GDL programs developed by the National Committee on Uniform Traffic and Safety Laws and Ordinances (NCUTLO). Although the criteria did not include all aspects recommended by safety experts, the National Traffic Safety Board, the National Highway Traffic Safety Administration, and the Insurance Institute for Highway safety used this as a benchmark to evaluate laws. Additionally, these standards served as the basis for the criteria used by the National Highway Safety Administration (NHTSA) to determine grant eligibility through Section 410 of the Transportation Efficiency Act of the 21st Century (TEA 21).

7 Passed in 1998.

In 1998, the NHTSA began providing matching safety grants, under TEA 21, to states that passed three stage graduated drivers license laws for drivers under the age of 18. Funding was conditional on standards for minimum length and thresholds for each stage including a learner and intermediate phase of at least six months each. The programs must have had some type of passenger restrictions, nighttime curfews, as well as requirements for driver education and certified supervised practice hours. Additionally, states were required to condition full licensure upon teens remaining free of accidents and convictions, particularly alcohol and seatbelt violations, during the beginner and intermediate phases. The focus of this section of TEA 21 was reducing alcohol related fatalities, and GDL programs were one of many ways that states could win grants.

Table 1-2. Institute for Highway Safety Rating System

Component	Point Criteria
Learner's entry age	1 point for learner's entry age of 16
Learner's holding period	2 points for ≥6 months; 1 point for 3-5 months; none for <3 months
Practice driving certification	1 point for ≥30 hours; none for <30 hours
Night driving restriction	2 points for 9 or 10 pm; 1 point for after 10 pm
Passenger restriction	2 points for ≤1 underage passenger; 1 for 2 passengers; none for 3; where supervising driver may be <21, point values were determined including the supervising driver as a passenger
Driver education	Where completion of driver education changed a requirement, point values were determined for the driver education track
Duration of restrictions	1 point if difference between minimum unrestricted license age and minimum intermediate license age is 12 or more months; night driving and passenger restrictions were valued independently

Rating	Points
Good	> 6
Fair	4 to 5
Marginal	2 to 3
Poor	< 2

Source: Insurance Institute for Highway Safety http://www.iihs.org/laws/graduatedLicenseIntro.aspx

More recently, the Institute for Highway Safety rating system (Table 1-2)[8] has developed multiple criteria to rate programs in which various points are assigned for levels of strictness of the program provisions. They rate state GDL systems from poor to good (less than 2 points =poor. Good = 6+ points). Points are given for the strength of the each GDL component. For example, 2 points are given for states with nighttime driving curfews of 10pm or earlier, and 1 point for after 10pm. Currently, 37 states are rated as good, none as poor, 7 as marginal, and remainder as fair.

8 Also see: http://www.iihs.org/laws/graduatedLicenseIntro.aspx

Nevada and Virginia have the most stringent passenger and nighttime restrictions (0 passengers and curfew before 10pm). The most lenient according to this rating system are Idaho, Arizona, and Alabama.

1.3.2 Theorized Impact of GDL Systems on Teen Traffic Safety

GDL systems are theorized to reduce teen driver and teen driver related fatalities by allowing teens to gain more supervised driving instruction and by limiting their exposure to known high risk driving factors such as carrying young passengers and driving at night. As well, in some cases, they delay driving until teens are slightly older and more mature. Mediating factors leading to reduced crash and fatality rates include 1) reduced exposure, 2) a gradual transition between learners phase and full privilege phase that includes increased supervision and driver education requirements, and 3) limiting contexts known to substantially increase crash risk among youth.

In cases where states raise the minimum age to get a license, as well as impose a substantial wait time between the learner and intermediate license stage, crash rates among young teens would be expected to decline due to a reduction in total driving exposure among teens, assuming a general level of compliance with the law, both as drivers and passengers of teen drivers. Moreover, a gradual transition allows teens to gain more experience, while at the same time maturing, under lower risk and supervised conditions.

Driver education requirements or incentives to complete courses (through the reduction in supervised practice hours) may decrease risk through increased knowledge and skills, although this effect would be subject to the content of individual driver education programs. Moreover, some studies have shown that practice is often much more salient to acquiring good driving skills than classroom learning (Mayhew, 2007). Since teens drive more cautiously in the presence of parents or older adults than with either peers or alone, extended periods that teens must practice with their parents may act to both temper risk taking behavior in the immediate term, instill good long-term driving habits, while allowing them to gain needed experience. Some studies have found that in fact teens learn more driving skills through parents than through driver education programs (Mayhew, 2007).

Passenger restrictions are theorized to reduce risk through the attenuation of peer effects that lead to risky driving behaviors among newly licensed teens. The strength of these effects would be expected to be proportionate the severity of the restriction.[9] Passenger restrictions would also reduce teen driver related fatalities by limiting total teen passenger exposure to teen drivers. However, a possible unintended effect of passenger restrictions is the possibility that more teens will get their license and begin driving sooner than they would otherwise, due to reduced carpooling opportunities, increasing the total number of teens driving and risk exposure for both teens and drivers in general. This effect would also be determined in part upon other transportation options such as, rides from parents, public transit access, availability, price, and quality. Given that the risk of accidents has been shown to be substantially higher with each teen passenger, this may not increase accident risk per teen driver-mile, but may increase exposure by inducing additional car trips that would not have been otherwise taken by teen drivers. Therefore, the net effect of passenger restrictions could theoretically be ambiguous if they were to increase licensing and induce trips relative to no law.

9 Although given that teens may be more likely to text if alone, it may be safer to have a one passenger restriction compared to a zero passenger one.

Nighttime driving curfews may affect crash risk through the reduction of driving during times when teens are more likely to engage in high risk behaviors due to the increase in likelihood of several cofactors that may contribute to risky driving such as drinking, riding with friends, and driving for recreational purposes. Crashes are more likely to occur among teens during 3pm to 6pm but the most serious crashes occur at night (Williams, 2003). So while, some trips that would have been taken at night may be shifted to daytime hours, net crash risk may not decline in proportion to prior nighttime shifts. However, the number of serious and fatal crashes would be expected to drop.

Finally, the degree of effectiveness of GDL programs will be dependent in large extent upon enforcement levels by police and parents. Passenger and nighttime GDL components are likely to be less readily enforced compared to age and extended supervised practice (holding periods) requirements. In many states, teens may only be cited for these violations if pulled over for another traffic violation, known as secondary enforcement. Additionally, enforcement would likely depend upon police resources and priorities. As well, it may be difficult for officers to decipher what age or stage young drivers are at in the three stage process. Nevertheless, this may induce teens drive more conservatively to avoid being pulled over even if violating the restrictions. Enforcement of supervised practice hours would be subject to parental time constraints and may be less strictly enforced by busy working parents or parents who lean upon teens to help make household trips such as shopping or other errands. In contrast, minimum age requirements and holding periods are most likely to be strictly enforced through state departments of motor vehicles.

1.3.3 Trends in Graduated Drivers License Laws over the Study Period

Table 1-3 displays trends in GDL provisions among states from 1996-2009 for all 51 states. The average length of holding time during the learner stage was just half a month beginning in 1996 and 6.5 months by 2009, with longest period extending up to one year in 2009. The number of required hours of supervised driving averages 18 to 20 hours, depending on whether driver education is taken, a maximum of 60 (or 100 without drivers education) in some states. The entry age for the intermediate stage ranges from 14 to 17 years old, with a mean of 15.9 years. The mean passenger restriction is 3, where a value of 4 equates to no passenger restriction, and the mean of the nighttime restriction variable is 13.8 (or a little after 1am). Passenger and nighttime restrictions lasted on average 4, to 8 months respectively, with the longest duration observed at 2 years.

Both the number of states with GDL systems and the strength of the laws have increased dramatically since 1996 (Figure 1). The first GDL programs were adopted in the late 90's and by 2009, more three-quarters of states had some type of program. Several states have amended their laws to strengthen their existing programs as well as more states have adopted laws. The average holding period has increased from only half a month in 1996 to 6.5 months in 2009, the average amount of required supervised driving has increased from less than one hour to 31.4 hours, the number of passengers allowed went from no restrictions to 1.5, and the nighttime curfew is on average midnight.

Table 1-3. National Annual Averages of GDL Components: 1996-2009

Year	Holding Period (months)	Required Supervised Practice w/Drivers Education (hours)	License Entry Age (yrs)	Number of Young Passengers Allowed (0-4)	Hour of Nighttime Driving Curfew (0-17)	Duration of Passenger Restriction (months)	Duration Of Night Restriction (months)	GDL Points (IIHS rating system)
1996	0.5	0.0	15.8	4.0	16.0	0.0	2.9	0.3
1997	1.2	0.7	15.8	4.0	15.8	0.2	3.7	0.6
1998	1.8	2.6	15.9	4.0	15.4	0.8	4.5	0.8
1999	2.9	9.2	15.9	3.9	14.9	1.1	5.7	1.4
2000	3.7	14.7	15.9	3.7	14.4	1.9	6.5	1.9
2001	4.8	19.4	15.9	3.3	13.8	3.2	8.4	2.6
2002	5.2	22.3	15.9	3.1	13.5	3.9	8.9	3.0
2003	5.4	23.0	15.9	2.9	13.4	4.4	9.2	3.3
2004	5.6	23.7	15.9	2.9	13.4	4.6	9.4	3.4
2005	5.8	25.2	15.9	2.6	13.2	5.1	9.8	3.7
2006	6.0	28.6	16.0	2.3	12.7	6.4	10.9	4.2
2007	6.2	30.7	16.0	2.0	12.5	7.2	11.5	4.5
2008	6.5	30.7	16.0	1.7	12.3	7.9	12.1	4.9
2009	6.5	31.4	16.0	1.5	12.0	8.6	12.6	5.2
Total	4.4	18.7	15.9	3.0	13.8	4.0	8.3	2.8

Note: N=204 in each year (4 quarters per year and 51 states). Hour of nighttime restriction coded as: 6 to 12=6pm to 12am, 13=1am 17=5am or no restriction. Passenger restriction values: 0-3 = #passengers allowed and 4=no passenger restriction)

The strength of GDL restrictions in the intermediate stage varies widely among states. Applying the rating system used by the IIHS as a measure of program strength the average strength of GDL programs among states has grown from 0.3 to 5.2 in 2009 (Table 1-3).[10] The most common passenger restriction allows only one young passenger (by 2009, 42 percent of states had such a restriction, whereas only a quarter allowed no young passengers). A restriction of 3 passengers is considered very weak by the IIHS and almost equates to having no restriction. The percentage of states with this type of requirement is small, with only 6 percent adopting this policy in 2009.

[10] Statistic includes zeros for states that had no program.

Figure 1-1. Rate of GDL Adoption: 1996 to 2009

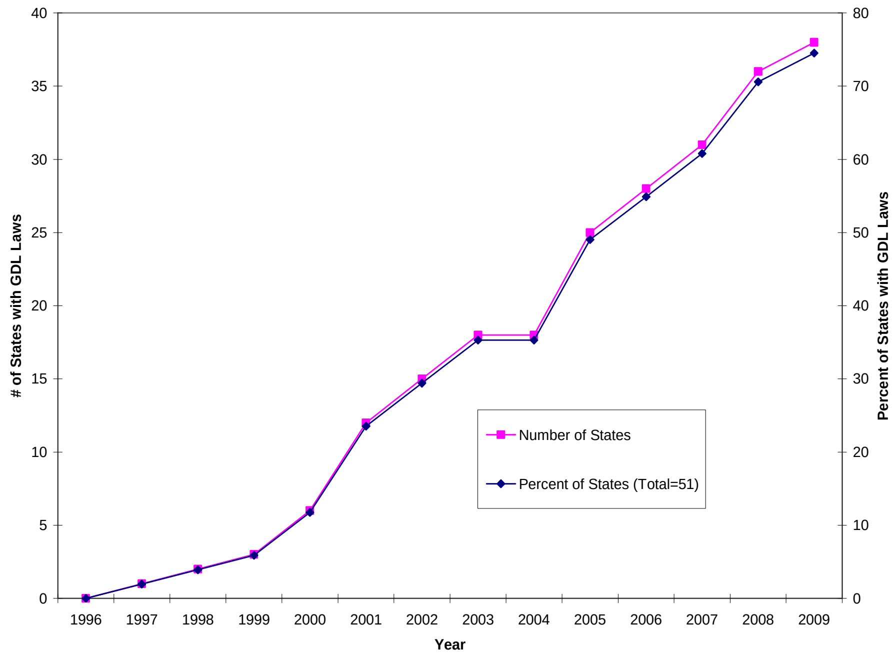
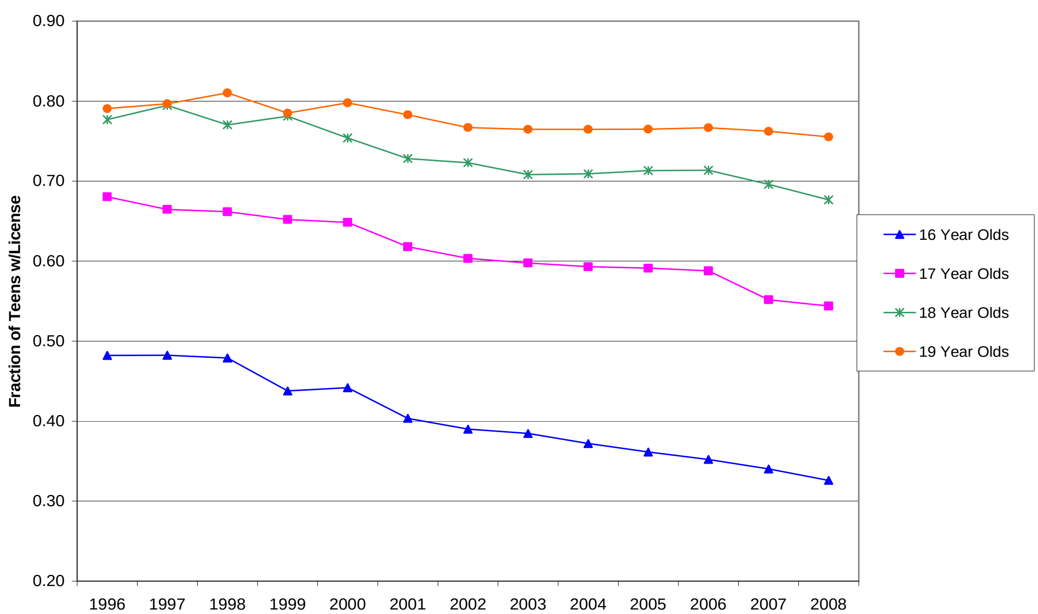


Figure 1-2. Trends in U.S. Teen Licensure Rates: Average Fraction of Teens by Age



Source: Author's calculations using FHWA State Drivers License and US Census Population Estimates Data
Note: Only includes states (35) for which reliable driver license data was attainable (see Appendix for a list of states).

1.3.4 Trends in Fatality and Crash rates

The state-level average quarterly rate of crashes involving teens (16-17 yrs) and adults (25-64 yrs) has been declining from 1996 to 2008. The rate of 16 and 17 year old driver involved fatal crashes have declined by 44 percent (from 10.11 to 5.54 per 100,000 population) while that for adults (age 25-64) have declined by 21 percent, (from 6.94 to 5.62 per 100,000 population). However, per licensed driver, the teen rate has declined by only 14% (18.09 to 14.82), more slowly than the rate for adults (21%). Concomitant with the implementation of GDL programs teen licensure rates have also been declining (Figure 1), suggesting that some portion of the decreased fatalities may be due to reduced exposure rates through increasing age requirements and durations of learner periods for licensure. The relative risk ratios (compared to adult drivers 25 to 64 years of age), per *licensed driver*, have remained nearly the same (Figure 1). In 1996 approximately 48 percent of 16 year olds and 68 percent of 17 year olds were licensed to drive but this rate has been declining steadily, particularly since 2000. In 2009, roughly 32 percent of 16 year olds and 54 percent of 17 year olds possessed a driver license. Therefore, some of the reduction in overall fatalities, may be due to reduced licensure rates.

Table 1-4. Trends in Quarterly Fatal Crash Rates per 100,000: Per Population versus Licensed Drivers among Teens and Adults

Year	All Teen Drivers (Ages 16-17)		Adult Drivers (Ages 25-64)		IRRs (Ratio of Teen to Adult Crash Rates)	
per 100,000	Population	Licensed Drivers	Population	Licensed Drivers	Population	Licensed Drivers
1996	10.11	18.09	6.94	7.31	1.52	2.70
1997	9.88	18.44	7.07	7.38	1.46	2.83
1998	9.49	17.15	6.93	7.16	1.45	2.65
1999	9.49	17.79	6.90	7.12	1.38	2.64
2000	8.91	16.83	6.64	6.09	1.40	3.39
2001	8.45	17.48	6.68	7.06	1.32	2.70
2002	9.03	19.93	6.67	7.08	1.43	3.20
2003	8.21	17.93	6.73	7.10	1.28	2.79
2004	8.48	19.13	6.72	7.05	1.35	3.05
2005	7.44	16.22	6.67	7.00	1.13	2.48
2006	7.41	16.21	6.58	6.92	1.18	2.55
2007	6.83	17.80	6.14	6.49	1.19	3.24
2008	5.54	14.82	5.62	5.93	1.02	2.67
Total	8.41	17.52	6.64	6.90	1.19	2.70
% Change	-44%	-14%	-21%	-21%	-30%	9%

Source: Calculations use FARS, Census, and Driver License data.

Note: Teen Driver Crash Rates are calculated as the number of fatal accidents per quarter where a teen ages 16 to 17 was driving (each vehicle with a teen driver is counted even if in the same crash) divided by the total population or total drivers and multiplied by 100,000).

Notably, the rate of crashes due to teen driver error has fallen much more rapidly per unit population and licensed driver, a 52 and 22 percent decline, respectively (Table 1-5). The ratio of crashes involving young teen drivers who made an error fell from 0.73, in 1996 to 0.55, in 2009. So while overall traffic fatalities have fallen for both groups, those where teens are at fault have declined even more, suggesting that teens may have become better drivers over these years compared to their earlier cohorts. Additionally, drinking and driving, a factor known to increase driver errors has also decreased, indicating that drunk driving laws may have also influenced the decline in teen driving error related crash rates.

Table 1-5. Trends in Fraction of Teen (Age 16-17) Driver Fatal Crash Involvement by Crash Characteristic

Year	Fraction Teen Driving Error	Fraction Multiple Teen Passengers	Fraction Night (9pm to 6am)
1996	0.73	0.44	0.20
1997	0.76	0.45	0.19
1998	0.74	0.43	0.18
1999	0.74	0.42	0.18
2000	0.75	0.41	0.20
2001	0.77	0.45	0.20
2002	0.78	0.42	0.20
2003	0.72	0.37	0.18
2004	0.70	0.37	0.19
2005	0.70	0.36	0.17
2006	0.67	0.35	0.19
2007	0.66	0.34	0.18
2008	0.64	0.33	0.17
2009	0.55	0.28	0.18
Total	0.71	0.39	0.19

Source: This study using FARS data 1996 to 2009.

1.4 Literature Review

Several studies evaluating the effectiveness of GDL in the United States have been conducted at both the national and individual state level, finding reductions in crash rates, fatalities, and hospitalization rates, associated with teen drivers ranging from 9 to 30%. The wide variation in results has been attributed to the wide variation between program strength and the types of provisions included in each states' law. As well, study results vary due to differences in the types of methods, outcome measures and age groups analyzed.

1.4.1 State-level studies

State level studies find reductions in teen crash and fatal crash rates ranging from 39-49 percent. A study of Michigan found 44 percent per capita reduction in 16 year old driver fatalities, in Pennsylvania, 16 year old driver fatalities decreased 49 percent per capita, North Carolina's fatal and injury crashes fell 39 percent after implementation of their GDL program, in Texas, which is rated as *marginal* by IIHS, a 22 percent decline (16 year old drivers fatalities was found among 16-19 year old drivers, and a 72 percent decrease in Ontario, Canada, in 16 year old per capita fatal crashes. Most of these studies employ time series analyses, autoregressive moving average model (ARIMA), while two use pre-post time period comparisons with chi-squared tests.

California is an early adopter state, first passing its GDL law in 1998, and has one of the most stringent GDL systems in the United States (Swicker et al, 2006). Five studies of California covering period ranging from 2004 to 2007 have been conducted, with conflicting results (Masten & Hagge, 2004; Rice et al., 2004; Cooper, 2005; Swicker, et al, 2006; Males 2007). Most find large declines in fatal and injury crashes, from 11 to 38%. Masten & Hagge, 2004 find no generalized effects, although some effects for increased passenger and nighttime restrictions, and attribute the weak findings for overall effects to a pre-existing downward trend in crashes. A latter study (Zwicker et al, 2006) finds a 38 percent decrease in injury and fatal crashes among 16 year old drivers. They cite using a less restrictive modeling processes and controls for seasonality and nonlinear periodic trends in injury and fatal crashes that were lacking in the Masten and Hagge study. Their study also used more years of post data then the previous ones. Males (2007), using ARIMA, found a 19 percent decrease in 16 year old fatal crashes but increases among older cohorts, suggesting that crash risk was shifted toward older teens once they were fully licensed.

Single state studies are very informative but carry several limitations. Since the strength of GDL systems and types of components vary widely among states, any one state evaluation may not be directly applicable to other states with differing program components. Moreover, GDL programs are multi-faceted and usually passed as a package, making it difficult identify the relative effectiveness of each component. While all use controls for time trends and the rates of crash rates among older cohorts within the study state, findings may in some cases be vulnerable to spurious time trends. By necessity, most studies use older teens as a comparison group, however, given the rapid developmental changes in the teen years, older teens may not be ideal comparison groups compared to similarly aged teens. In contrast, national state-level time series studies allow for identification of the effects of the variations in GDL programs components included and use crash rates among similarly aged drivers in state-periods without GDL laws as a control group.

1.4.2 National Studies

Several national studies using multistate panel data have found reductions in fatal crash rates among teen drivers from 9 to 19 percent. Eisenberg (2003) studied the effect of drunk driving laws as well as GDL systems, and found a 9 percent decrease in under 21 driver fatalities from GDL using weighted least squares and state and year fixed effects. Chen (2006) finds reductions of 16 to 21 percent in statewide 16 year old fatal crash involvement rates associated with the presence of state GDL laws. They used negative binomial regression models based on general estimating equations and FARS data from 1994 to 2004, where the dependent variable measured the natural log of the number of fatal crashes involving target age and controls included population, state and quarter fixed effects. Policy variables included a dummy variable for whether the state had a GDL program (defined as any state with an intermediate stage) and in subsequent models, the number of GDL components. Greater reductions fatal crash involvements were found in states with more comprehensive programs- 18 to 21 percent in state quarters with 5 or more of the 7 GDL components examined.

Studies that test for effects by the relative quality or strength of GDL programs have found increased effectiveness with increasing number of program components or with programs more highly rated by the IIHS. Baker et al (2007) examined quarterly state level fatal and injury crash involvements of 16 year old drivers using FARS census and the NHTSA injury crash data in states with and without GDL systems using a negative binomial regression, with rate ratios as a dependent outcome variable. They find that the fatal and injury crash rates among 16 year olds decline more as the number of GDL components increase (night and passenger restrictions, minimum age requirements, holding period 6 months or greater, etc). On average, fatality rates declined by 11 percent in the presence of a state GDL, however, states legislating 5 or more components decreased fatal crashes of 16 year old drivers by 38 percent. Injury crashes declined similarly by 19 versus 40 percent, respectively.

Dee et al (2005) investigate the relationships between the strength of GDL programs as rated by the IIHS (marginal, fair, good) on annual state level teen driver fatality rates among 15-17 year old drivers controlling for primary and secondary seatbelt laws. They use a generalized difference-in-difference estimation with state and year fixed effects using state-by-year panel data of fatalities from 1992 to 2002, analyzing the effects of GDL on night versus day time fatal crashes involving teens as well as the number 15-19 year old passenger fatalities where a teen 15-17 was driving. They find average effects of at least 5.6 percent decline in for 15-17 year old traffic fatalities, 19 percent among states with GDL programs rated as "good." However, their measure doesn't distinguish among those fatalities actually caused by or associated with teen drivers. For example, a teen that is killed in a two car accident, each with adults driving, would be included in this measure.

Few studies examine the impacts of GDL on crash rates per licensed teen. Williams (2003) notes that different measures (population versus driver licenses as the denominator) of teen driver related traffic fatalities have important policy implications in examining the impact of GDL or other safety programs; the per population ratio measures the effect on the general population while the per license ratio is an indicator of risk per teen exposure. Some of the reduction in teen traffic fatalities may be attributable to reduced exposure through increased age requirements and waiting periods. Foss et al, 2007, find a 7 percent decline in rates per licensed driver, versus 39 percent per population. In Texas, Willis, (2006) found 22 percent decrease in fatal crashes 3 years post implementation, but only a slight increase in per licensed driver crashes. One draw back of studies including driver license data, is the unreliability of data for some states.

1.4.3 Studies on Individual GDL Components

Some research has examined the relative effectiveness of specific GDL components. Masten and Hagge (2004) examine the effects of improvements to California's GDL law in 1998, which included tougher passenger restrictions and a nighttime curfew. They find no change in per capita fatal and injury crashes among 15-17 year olds or 16 year olds separately associated with longer permit period and practice requirements implemented in 1998, however passenger and nighttime restrictions resulted in an annual reduction of 55 fatal and injury crashes associated with the passenger restriction (2% decline) and 815 nighttime crashes (9% decrease) after the curfew implementation, saved annually. However, their measure indicates compliance rather than effectiveness of the law since passenger restrictions should decrease the overall likeliness of crashes among teen drivers and nighttime restrictions could result in teens shifting their driving time to earlier times of the night. They in fact did not find overall effects to be statistically significant, but as mentioned previously attribute this to pre-existing downward trends from initial prior, although slightly weaker version, of the GDL law in California. Cooper, et al 2005, examined crash rates for 16 year olds up to four years post GDL implementation and found no significant effect on share of fatal crashes after the night curfew.

Research by Vanlaar et al, (2009) estimate relative fatality risks of 16-, 17-, 18- and 19-year-old drivers compared to 25–54-year-old drivers for all jurisdictions were summarized using the random effects DerSimonian and Laird meta regression model using (FARS) 1992 through 2006. Their study allows for random variation of effects at the state level. GDL laws had a positive and significant impact on the relative fatality risk of 16-year-old drivers (reduction of 19.1%). No effects were found among 17-, 18- and 19-year-old drivers. They found that passenger restrictions in the intermediate stage decreased the relative fatality risk of 16 year old drivers by 88.5 percent.

In summary, single-state studies find larger decreases in teen injury and fatal crash rates ranging from 39 to 49 percent. The national level studies tend to use better controls, such as seat belt and drunk driving laws, find smaller declines in teen injury and fatal crash rates, ranging from 5 to 20 percent (Dee et al, 2005). However, in some studies the outcome measures used are too coarse to measure the policy objectives of the programs. For example, while measuring all teen traffic fatalities provides a general indicator of teen public health, it includes deaths related to *all* drivers and not necessarily *teen* drivers. Similarly, the studies that do use teen driver related fatalities to date do not identify effects on crashes that GDL programs are designed to address, caused by teen driver errors. Finally, both single-study and national studies to date, have not examined variations in effects by local geographic areas such as rural versus urban areas. This dissertation chapter will address these issues through the use of a national state and cross-state border commuting zone panel data set, which also allows for the comparison of effects by rural versus urban areas and controls for pre-existing time trends.

1.5 Methodology

The research approach employed in this study takes advantage of policy discontinuities at state borders to estimate the effect of GDL polices on teen driver fatal crash rates, within cross-state commuting zones, with varying GDL policies.[11] Prior national studies aggregate total fatal crashes up to the state level, loosing important information on how impacts vary among regional commuting areas and by rural versus urban regions and may possible introduce omitted variable biases. The unit of observation for this study is county-level fatal crash rates, with groups of counties within commuting zones that cross state boundaries serving to form in effect a series of regional-level control and treatment groups. The advantage of this unit of analysis over state-level studies is that through the inclusion of commuting zone-time and county fixed effects, it controls for within state variation and heterogeneity in trends among commuting zones that may differentially affect vehicle crash rates. Such factors include variations over time and space in local road design and maintenance, city and regional land use, travel patterns supply of emergency response services, intensity of law enforcement, vehicle stock composition and age, and demographic composition. Regional economic conditions including economic activity, and travel prices such as gas, parking, tolls, etc that affect traffic levels and patterns are especially likely to vary within states by commuting areas. Importantly, these may change over time at different rates within the states. If unobserved in the regression analysis, such variables may introduce biased estimates, particularly if accident rates were spuriously correlated with the policy changes. Moreover, because commuting zones are not defined by population thresholds, as is the case with metropolitan statistical area definitions, this unit of analysis allows for the differentiation of policy impacts at both the rural and urban areas, which have important varying determinants of crash rates.

A panel data set of GDL systems and their components along with fatal crash rates by age and characteristic, licensure rates, and economic and demographic control variables from 1996 to 2009 for 48 states[12] is constructed. Dummy variables for the quarter of implementation of seatbelt, drunk-

11 This method follows the work of Dube, Lester, and Reich, 2010
12 The data set excludes the states of Hawaii and Alaska.

driving, and zero-tolerance alcohol laws are included to control for other policy variables likely to affect teen driver involved fatal crash rates. As a measure of overall fatal accident risk in each county, all regressions control for the rate of non-teen-involved-adult crash rates. To avoid double counting of crashes and endogeneity between the control and outcome measures, this rate is calculated by counting quarterly county-level fatal crashes among drivers age 25 to 64 that did not involve a teen driver age 16 to 17.

Also unlike prior studies, this research assesses the effect of GDL programs on the number of fatal crashes where a teen was behind the wheel and made a driving error, thus focusing on the GDL systems' effect on teen driving skills. Outcome measures are quarterly teen driver involved fatal crash rates, per 100,000 population, among teens age 16 to 17, by the following categories:

1. All[13]
2. Driver error related
3. Day 6am to < 9pm
4. Nighttime crashes 9pm to < 6am
5. One or more young passengers present (less than 20 years of age)
6. Driver tested BAC>=0.08
7. Number of crash related fatalities per teen driver involved fatal crash

Measures of GDL programs include 1) a composite measure of GDL strength (using IIHS rating system), 2) length, in months, of the learner period ("holding period"), 3) age to get a license, 4) number of hours of required supervised practice, 5) passenger and nighttime driving restrictions, and, 6) duration of passenger and nighttime restrictions (Table 1-6). Additionally, controls for the effect of declining rates of teen licensure are included.

Table 1-6. Coding of GDL System Components

GDL Component	Units/Coding
Learners Stage	
Holding Period during which teens must only drive with a parent or licensed adult	0 to 24 months
Minimum hours of required supervised driving	0-60 hours with drivers education
Intermediate Stage	
Minimum Age	14 to 17 years
0 to 1 Young Passenger Limit	Indicator variable (0/1)
3 or More Passengers	Indicator variable (0/1)
Duration of Passenger Restrictions	Time period restrictions apply (0-24 months)
Nighttime Restrictions	
10pm or earlier	Indicator variable (0/1)
After 10pm before 1am	Indicator variable (0/1)
Duration of nighttime driving restriction	Time period of restriction apply (0-24 months)

13 Teen driver involved ages 16-17.

Dummy variables that account for policies such as seatbelt and drunk-driving laws are included in all regressions. Primary enforcement laws are those in which police may pull over drivers for violation of the law whereas secondary enforcement laws are citable only if the driver is pulled over for another violation. Additionally, I add a set of controls related to drunk-driving laws that would be expected to have an effect on fatal accident rates among teens including, zero tolerance alcohol laws, state beer taxes, and blood alcohol concentration limits (Carpenter, 2004).

In rare cases, a teen fatal accident occurred in a bordering state from the teen's home state, but within the same commuting zone. These cases were reallocated to the teen's home county since the teen would still be subject to the GDL system in their home state.[14] A tabulation of the fraction of such accidents reveals that this represents less than a third of one percent (0.3 percent) of total fatal teen crashes in county-quarters (Table 1-7).

Next, I conduct a set of regressions estimating the effect of GDL programs on teen driving fatal crashes controlling for the state-level share of licensed teens age 16 and 17. Driver license data provided by the Federal Highway Administration is fraught with errors and anomalies for some states. I carefully examined data for each state series and requested the original data sources from each state DOT where needed. State driver license data where reliable data was not available or where data points were could not confidently interpolate points are excluded, leaving a subset of 33 states for this section of the analysis. Finally, tests for heterogeneous impacts at the rural versus urban levels are presented.

Table 1-7. Within Commute Zone Cross-Border Fatal Teen Crashes (Quarterly Data)

Fraction of Cases	Obs	Mean	SD
Teen driver	41,552	0.003	0.058
Adult Driver	41,552	0.122	0.462

1.5.1 Estimation Strategy

Several sets of regressions at the state and at the cross-state commuting-zone county level are presented. The first estimate includes a set of state-level fixed effects regression, for comparison to prior studies. The next set of regressions present the main analysis for this chapter and use a sample of counties straddling cross-state commuting zones to estimate the effect of GDL systems on crash rates per 100,000 population among teens age 16 and 17. The effect of GDL programs, controlling for teen licensure rates, is estimated using subset of this sample in states with reliable driver license data. The final sets of estimates test for heterogeneous effects in rural versus urban areas using separate regressions for counties in rural and urban areas.[15]

The state-level fixed effects ordinary least squares estimate is specified as follows:

$$y_{st} = \beta_0 + G_{st}\beta_1 + X_{st}\,\beta_2 + \alpha_s + \tau_t + \varepsilon_{it} \qquad (1)$$

where y_{st} is the state-level rate of teen driver (16-17) involved fatal accidents per 100,000 population for all young teen fatal crashes and young teen driver error related fatal crashes in state, s,

14 Although, police may not actively enforce laws applying to teens in bordering states, legally teens are still bounded by them even when driving cross state. Moreover, since the teen presumably begins and ends trips within their own home state, they would still be vulnerable to citations for nighttime and passenger restrictions if violated.

15 Using definitions from the Office of Budget and Management http://www.ers.usda.gov/Briefing/Rurality/RuralUrbCon/

and period (year-quarter), t; G_{it} is a matrix of GDL policy measures; X_{st} are observable factors affecting crash rates including non-teen adult driver fatal crashes, BAC laws, seatbelt laws, speed limits, drunk driving laws, and unemployment rates; α_s are state-level fixed effects, which control for unobservable local factors such as road conditions, economic activity-traffic volumes, access to medical treatment, vehicle stock, weather; T_t denotes time trend, which controls for unobserved changes within the state over time and ε_{it} is an idiosyncratic error term.

The county-level cross-border analysis is specified as follows:

$$y_{icst} = \beta_0 + G_{st}\beta_1 + X_{ict}\,\beta_2 + X_{ist}\,\beta_3 + \alpha_i + \tau_{ct} + \varepsilon_{it} \qquad (2)$$

where y_{icst} is the *county*-level rate of teen driver, ages 16 to 17, involved fatal accidents per 100,000 population, in period t and i, t, c, s, and t, represent, county, commuting zone, state, and period (year-quarter), respectively. X_{ict} is a matrix of county-level observable factors affecting crash rates (Non-teen adult driver fatal crashes), and X_{ist} is a matrix of state-level BAC laws, seatbelt laws, speed limits, drunk driving laws. α_i are county level fixed effects, to control for unobservable local factors such as road conditions, economic activity-traffic volumes, access to medical treatment, vehicle stock, weather, mentioned above, τ_{ct} represents the commuting zone-period trend, which controls for changes within the state commuting zone over time and ε_{it} is an idiosyncratic error term. Including a commuting zone-level time trend, takes out between commuting zone variation over time, allowing for a cross-state comparison of within commute zone time trends in crash rates, controlling for possible spurious trends in crash rates. That is, if states with higher accident rates are more likely to adopt GDL or GDL programs, then we may see an upward trend in fatal accident rates before the laws in each state were implemented, which would bias results upward, conversely, for any prior downward trends in fatal accident involvement rates. Including time trends will account for such correlations.

Both the state and county level regressions include various measures of GDL policies. The first regression includes uses an overall measure of GDL strength defined by the IIHS rating (from 0, no law, to 8 points). In the second third regressions, the GDL points are divided into those applying to the learner stage and those in the intermediate stage. Learner stage IIHS points include those assigned for the number months of holding period and the required supervised hours of practice, while the intermediate stage IIHS points reflects those for the passenger and night restrictions, in addition to the length of the intermediate stage. In other specifications, I enter passenger and nighttime restriction categories enter as dummy variables, including continuous variables for age to get a license and holding period in months. For example:

$$y_{icst} = \beta_0 + \beta_1 A_{st} + \beta_2 H_{st} + \mathbf{P}_{st}\beta_3 + \mathbf{N}_{st}\beta_4 + + X_{ict}\,\beta_5 + X_{ist}\,\beta_6 + \alpha_i + \tau_{ct} + \varepsilon_{it} \qquad (3)$$

where A_{st} is age to get a license, H_{st} is the mandatory holding period, both entered as a continuous variable, $\mathbf{P}_{st}$ is a set of passenger limits dummy variables (0-1, 2, and no limit omitted) and $\mathbf{N}_{st}$ is a set of nighttime hour restrictions (before 10pm, after 10pm, with no restriction omitted). Some states in the north western have GDL programs with entry ages ranging from 14 to 15. In these states any night and passenger restrictions would expire at age 16, assuming most teens started their permitting process at the earliest possible age. For example, in South Dakota a teen may get their intermediate or restricted driver permit at age 14 and 6 months. After driving 6 months without any violations, they may obtain a full privilege driver permit. Since the outcome variable includes teen crashes among teens ages 16 to 17, the night and passenger restrictions are coded as zero for those county or state-periods where a 16 or 17 year old would not likely be subject to the restriction, even if they may have been in their 14th or 15th year.

In addition to all teen and teen driver error outcomes included in the state-level analysis, the county-level sets of regressions test the effects on crash outcomes targeted by GDL systems and most associated with teen driving errors, including nighttime (past 10pm and before 5am), multiple young occupants (less than 20 years of age), and those where the teen driver tested as above the legal driving limit for adults (BAC >=0.08).

The next set of regressions analyze the degree to which GDL programs have contributed to reduced licensure rates among teens. Minimum age to get an intermediate stage license enters the equation in two forms, as a set of categorical variables for each age 16, 17, with 15 and under as the omitted and a continuous variable, in separate regressions:

$$D_{ist} = \beta_0 + \beta_1 I_{16st} + \beta_2\, I_{16st} + \beta_3\, H_{st} + \beta_4 D_{st} + \alpha_s + \tau_t + \varepsilon_{it} \qquad (4)$$

$$D_{ist} = \beta_0 + \beta_1 A_{st} + \beta_2\, H_{st} + \beta_3 D_{st} + \alpha_s + \tau_t + \varepsilon_{it} \qquad (5)$$

where $D_{ist,}$ is the share of licensed drivers for age i, I_{ist} is a set of dummy variables for minimum entry age categories, in years, 16 and 17, with 15 and under as the omitted age category, and D_{st} is the share of licensed adults age 25-65, as a control for general licensure rate trends in the state, in state, s, in year, t. GDL policy measures appear in the regression equations as a continuous GDL points measure in the first specification and another specification as nighttime and passenger restriction categorical variables in the subsequent regressions.

$$D_{ist} = \beta_0 + \beta_1 G_{st} + \beta_2\, H_{st} + \beta_3 D_{st} + \alpha_s + \tau_t + \varepsilon_{it} \qquad (6)$$

where G_{st} represents the IIHS rating from 0-8. Subsequent specifications include night and passenger restrictions entered in the same categorical variables used in the county level commuting zone estimates.

The next specification adds in the proportion of licensed teens for ages 16 and 17, D_{st}, in state-period, t, with the following equation:

$$y_{icst} = \beta_0 + G_{st}\beta_1 + X_{ict}\,\beta_2 + X_{st}\,\beta_3 + \beta_3 D_{st} + \alpha_i + \tau_{ct} + \varepsilon_{it} \qquad (7)$$

Finally, heterogeneous impacts in commuting zones types are measured, by breaking the sample into two subsets: those counties defined as rural and those defined as urban, and using the same regression equation in equation 2. This final estimation tests for differences in rural and urban traffic risks that may also lead to important differences in the effectiveness of GDL programs.

1.5.2 Data

The Fatality Analysis Reporting System (FARS) provides a complete census of motor vehicle crashes on public roadways that result in a fatality to driver, passenger, or pedestrian within 30 days of the accident in all 50 states. It includes information on the demographics of drivers and passengers, time, date, type of the accident, number of vehicles involved, location, and factors that caused the crash such as driver errors, roadway conditions or alcohol use as well as the type of vehicles involved.[16] Crash data is based upon state police reports, vehicle registration files, driver licensing files, vital statistics, death certificates, coroner/medical examiner reports, hospital medical, records, and emergency medical service reports.[17]

Quarterly counts of teen driver fatal crashes at the county as well as state level were calculated from 1996 to 2009. Total teen driver involved counts include any accident where a teen driver was involved and at least one fatality occurred. These also include cases were non-motorists were involved, such as a pedestrian or a bicyclist. In cases of multiple teen drivers involved in a single crash, each teen driver was counted separately. So for example, a two car fatal crash involving two teen drivers between the ages of 16 and 17 would be counted as two teen driver fatal crashes. The total number of fatal crashes where a driver made an error was calculated using driver error related codes provided in the FARS crash characteristics variable[18]. Factors included as driver error include overcorrecting, operating vehicle improperly (talking on cell phone, distracted etc), driving on the wrong side of road, speeding, racing, road raging, being pursued by an officer.

16 http://www.nhtsa.gov/people/ncsa/fars.html

17 Collected and provided by the National Center for Statistics and Analysis (NCSA) through state contracts

18 Vehicle crash factors codes 17, 26–48, 50, 54, and 58 following work by Williams et al 2005, but includes additional codes.

Teen driver involved fatal crash rates are calculated per population of 16 and 17 year olds by three characteristics including alcohol involvement, time of day, and presence of young passengers. Blood alcohol content of driver (where test is given) is coded as less than 0.02, 0.02 to less than 0.8, and above 0.08, where the latter would be considered drunk or significantly impaired driving in most states. Time of day fatal teen crashes calculations are grouped by those teen driver crashes occurring during the day, from 6 am to 8:59pm and at night, from 9pm until 5:59am. Teen driver crashes with young passengers are calculated for one, and two more passengers, and a summary measure of one or more young passengers.

Data on population at the state and county level is from the US Census Bureau population estimates.[19] For the years 2000 to 2009 population by age at the county level was only available for specific age groups 14 to 17 years of age. The ratio of state-level population for ages 16 and 17 to the total population, age 14 to 17 years, is used to estimate the number of 16 to 17 year olds at the county level. The county crash rate for adults ages 25 to 64 serves as a comparison group. Adult drivers aged 25 to 64 were used since young adults younger than 25 may still have less maturity and experience. Commuting zones, defined as labor market areas with close commuting ties, also come from the U.S. Census Bureau.

The Federal Highway Administration (FHWA) collects data from each state on the number of licensed drivers. All available years, 1996 to 2008, are included here. Changes in reporting definitions of licensed teen driver make latter years somewhat unreliable for some states since there has been some confusion among states about whether to include teens with learner permits. Learner permits have been *excluded* and the total number of drivers in the intermediate stage *included* from the totals of licensed drivers, however some states have begun to include learners when the guidelines were changed in 2006. Moreover, some data reported by states have inexplicable anomalies from year to year. After several discussions with federal and state officials at the FHWA and at several state DOT's who manage this data I was able to correct some errors. I kept license data for states where either the data series looked reliable and consistent upon visual inspection of trends, where data was directly obtainable from the state DOT, or where I could easily and interpolate data points (35 states, See Appendix for a list of states.).

Details of each state GDL systems, their components and effective dates, come from the Insurance Institute of Highway Safety. Components of each state law are entered and coded for analysis as follows (Table 1-6). The mandatory waiting or holding period is defined as the number of months during which teens may drive only with a parent. The minimum number of hours of required supervised driving, which varies with whether a teen completes a driver education course, was entered as two variables, one with driver education and without. The analysis assumes teens would take drivers education and uses the number of hours with driver education.

Small numbers of state-periods with some levels of strength among various components limited the ability to estimate each discrete policy case. For example, since very few state-periods had zero passenger laws, zero and one passenger limits were grouped into one category. Nighttime restrictions were coded as the hour the curfew begins. Indicator variables were created for nighttime restrictions 10pm and earlier and after 10pm to 1am. In the two cases (Indiana and Mississippi) where states had varying nighttime driving curfews for weekdays versus weekend nights (Friday and Saturday), the Friday and Saturday night curfews were used. Passenger restrictions were coded as

19 http://www.census.gov/popest/overview.html

indicator variables for zero or one passenger allowed, and two passengers allowed (with the omitted category being 3 passengers allowed or no restriction).[20] Finally, variables indicating the duration, in months, of the night and passenger restrictions were created.

1.6 Summary Statistics

Table 1-8 presents a comparison of summary statistics of the state and cross-state commuting zone county samples. The states of Alaska and Hawaii are excluded in both samples. Both samples contain quarterly data for 56 periods over the years 1996-2009. The state level sample contains 2,744 observations, while the cross-state commuting zone county sample contains 41,522 observations, including 137 commuting zones and 742 counties. The mean county-level population for teens age 16 to 17 is 3,265, with a standard deviation almost four times as large (11,970). That for the state sample is 166,506 with a much smaller *relative* standard deviation (180,846). Mean per population quarterly crash rates tend to be slightly higher in the cross-state commuting zone (CSCZ)-county sample due to a greater variation in crash rates, due to wider variation in population sizes.[21] The mean teen driver fatal crash rates at the CSCZ county level are 12.2 per 100,000 population, with a standard deviation of 60.9, while those at the state level are only 8.2, with a much smaller standard deviation of 5.0. Most of the GDL components are of comparable average strength between the two samples. The average IIHS rating is 4.1 at the county-level and 3.9 at the state (out of a maximum of 8 points) over the sample period. With the exception of the duration of the passenger restrictions, individual GDL components are similar between the state and cross-border commuting zone county samples. The mean passenger restriction period is between 4 and 5 months, one month longer in the county than the state sample (5.17 versus 3.99 months). The duration of the night restriction is around 9 months in both samples. The 10pm or earlier driving curfew is more frequent in the state sample (at 11 percent versus 8 percent of the samples, respectively). Only a small fraction of the samples had nighttime curfews 10pm or earlier, 7 of the county-periods sample and 8 percent of the state-periods. Twenty-seven percent of both samples had passenger restrictions of 0 to 1 young passenger, with only one percent allowing 2 and the remainder allowing 3 or having no restriction.

Most states had enacted either a primary or secondary mandatory seat belt law over the sample period, with the majority having primary enforcement (62 to 63 percent). Zero-tolerance alcohol laws, which make it illegal for anyone under the drinking age to drive after to consuming any amount of alcohol (BAC >=0.02), were present in most states during the entire sample period (95-96 percent). BAC 08 laws, which would affect general accident rates, were present in 72 and 73 percent of the county and state samples, respectively. The annual state unemployment rate, a factor found to be positively associated with traffic fatalities, was around 5 percent in both samples.

Teen crash rates by GDL components: More detailed breakdowns of descriptive statistics for teen driver and teen driver error crash rates, ages 16 to 17, by GDL components are presented in Table 1-9.[22] Fatal young teen driver involved crash rates general decrease with increasing GDL law strength. The mean young teen driver involved quarterly fatal crash rate per 100,000 in the cross-state commuting zone (CSCZ) county sample in periods with no GDL program is 22.8. This rate declines by more than half, to 9.0, in periods with the most stringent programs (7-8 points). A

20 Not enough observations were available to decompose passenger limits into smaller categories.

21 For example, teen driver fatalities would be rarer events at the county level but when they occur in small population counties, the rate in that quarter would be much higher than the median, strongly skewing the average.

22 Here on out teen driver involved crashes and teen driver error related crashes among teens ages 16 to 17 are referred to interchangeably as young teen driver and driver error crash rates.

similar pattern occurs in the state-level sample. Fatal young teen crash rates also decline with increasing holding periods among both the county and state samples for both types of driver crashes (all teen and teen driver error). Counties-periods with stricter passenger limits (0-1 passenger) had substantially lower mean young teen driver involved fatal crash rates of 9.1, or 69 percent of those with no passenger limits (13.3). As well, means rates are lower in each sample in periods with nighttime restrictions compared to those without, however, declines in rates between the 10pm curfew compared the later curfews, are only observed for driver error related crash rates. The driver error crash rates show larger declines in means with increasing GDL stringency overall. At the state level, driver error crash rates among states with the strongest GDL programs (rated 7-8), are nearly half those in periods with no program elements (7.5 versus 3.9 per 100,000). In the CSCZ sample they are close to a third (16.7 versus 6.4 per 100,000).

Table 1-8. Summary Statistics of Samples: 1996-2009

Variable	Cross-State Commuting Zone Counties Mean	Cross-State Commuting Zone Counties Std. Dev.	State Mean	State Std. Dev.
Population				
Population Age 16-17	3,265	11,970	166,506	180,846
Population Age 25-64	59,672	218,243	3,053,953	3,315,280
Total Population	113,150	413,169	5,632,617	6,269,668
Crash Rates (per Population)				
Teen Driver	12.2	60.9	8.2	5.0
Teen Driver Error	9.3	54.7	5.9	4.1
Adult Driver (age 25-64)	10.2	21.9	6.4	2.7
Teen Driver Error with Young Passengers	5.10	41.33	3.1	2.8
Drunk Teen Driver Error (BAC >= 0.08)	0.78	14.67	0.7	1.4
Day Time Teen Driver Error (5am to 9:59am)	7.25	49.28	6.5	4.4
Night Time Teen Driver Error (10pm to 4:49am)	1.98	23.29	1.5	1.8
Teen Driver Crash Associated Total Fatality Count	0.23	0.69	13.5	13.0
Teen Driver Error Associated Fatalities	0.17	0.54	0.00	11.00
Graduated Driver License Laws				
GDL IIHS Points	4.1	2.5	3.9	2.5
Age to get a License	16.0	0.5	15.9	0.5
Supervised Driving Req (hours)	18.97	21.76	19.54	21.84
Holding Period (months)	4.94	3.53	4.45	3.36
0 or 1 Passenger	0.27	0.44	0.27	0.45
Two Passengers	0.01	0.08	0.02	0.13
Duration of Passenger Restriction (months)	5.17	7.62	3.99	6.07
10 pm or earlier Curfew	0.07	0.25	0.08	0.27
After 10pm Curfew	0.46	0.50	0.46	0.50
Duration of Night Restriction	9.15	8.63	8.91	8.07
Traffic Policy and Economic				
Secondary Seatbelt Law	0.36	0.48	0.35	0.48
Primary Seatbelt Law	0.62	0.48	0.63	0.48
Zero Tolerance Law	0.96	0.18	0.95	0.20
BAC 08 Law	0.72	0.44	0.73	0.43
Annual State Unemployment	4.99	1.57	5.00	1.57
Number of Commuting Zones/States	137		48	
Number of Counties	742		na	
n	41,552		2,744	

Data Sources: US Census (population), FARS (Fatal Accidents), IIHS (GDL & Seatbelt Laws), BLS (unemployment).

Note: Teen Driver Crash Rates are calculated as the number of fatal accidents where a teen ages 16 to 17 was driving (each vehicle with a teen driver is counted even if in the same crash) divided by the total population and multiplied by 100,000).

Table 1-9. Summary Statistics of Teen Driver Involved Crash Rates by Graduated Drivers License System Components

GDL Component	Cross-State Commuting Zone Counties: Teen Driver Crash Rate Mean	Std. Dev.	Teen Driver Error Crash Rate Mean	Std. Dev.	Obs N	States: Teen Driver Crash Rate Mean	Std. Dev.	Teen Driver Error Crash Rate Mean	Std. Dev.	Obs N
GDL IIHS Points										
0	22.8	158.5	16.7	139.8	641	10.0	6.4	7.5	5.8	95
1-2	14.0	61.6	11.3	57.1	13,00	9.5	5.2	7.2	4.4	941
3-4	13.6	68.4	10.2	59.6	9,232	8.7	4.7	6.2	3.9	577
5-6	10.6	54.1	8.1	50.7	9,044	7.1	4.6	5.0	3.6	633
7-8	9.0	44.3	6.4	36.9	9,629	5.8	4.2	3.9	3.1	610
Holding Period										
No Holding Period	14.8	77.1	11.8	67.1	8,549	9.3	5.4	6.9	4.5	649
Less than 6 months	12.9	53.5	10.0	48.3	6,277	9.4	5.0	7.0	4.4	471
6 to less than 12	10.9	56.1	8.1	50.9	22,63	7.3	4.7	5.1	3.8	1,42
One year	12.6	58.9	9.7	55.2	4,092	8.1	4.1	5.8	3.5	198
Passenger Restriction										
No Restriction	13.3	65.8	10.4	59.6	30,05	8.80	4.97	6.48	4.17	2,03
Two Passengers	7.9	21.1	6.0	19.8	284	10.0	6.77	6.88	5.32	48
0 or 1 Passenger	9.1	46.3	6.4	39.3	11,21	5.96	4.44	3.95	3.39	778
Duration of Passenger Limit										
No Restriction	13.9	70.0	11.0	63.5	23,77	9.1	5.0	6.7	4.2	1,71
< 6 months	10.7	36.5	7.7	31.4	1,622	7.1	3.4	5.0	2.8	105
6-12	9.4	46.2	6.5	38.9	11,21	6.4	4.8	4.3	3.7	855
> 12	10.4	48.2	8.1	44.3	4,934	6.5	4.4	4.9	3.6	186
Night Restriction										
No Restriction	14.0	66.7	11.0	60.6	18,32	9.4	5.3	7.0	4.5	1,22
After 10pm Curfew	10.6	53.4	7.80	45.9	19,34	6.6	4.2	4.6	3.3	1,31
10 pm or earlier	9.1	32.8	6.7	28.0	2,876	7.6	5.1	5.4	4.0	225
Duration of Night Curfew Stage										
No Intermediate stage	14.1	68.4	11.2	62.3	15,49	9.5	5.4	7.2	4.6	1,07
< 6 months	12.7	16.6	9.4	14.6	84	11.5	8.0	8.1	6.3	28
6-12	10.7	55.4	7.9	47.4	16,63	7.1	4.5	5.0	3.6	1,16
> 12	11.5	57.1	8.8	53.5	9,335	7.1	4.4	4.9	3.5	588

Data Sources: US Census (population), FARS (Fatal Accidents), IIHS (GDL Laws)

Note: Teen Driver Crash Rates are calculated as the number of fatal accidents where a teen ages 16 to 17 was driving (each vehicle with a teen driver is counted even if in the same crash) divided by the total population and multiplied by 100,000).

1.7 Results

This section discusses results of the estimates GDL systems effects on young teen driver and teen driver error related fatal crash rates. The first section presents the basic state-level estimate including state and year effects. The subsequent sections discuss results from the cross-state commuting zone level analysis including those involving all young teen driver fatalities, young teen driver error related, number of fatalities per crash, and crash characteristics such as presence of young passengers, drunk driving, night time and day time. The regressions in section 1.7.5 include controls for the share of licensed teens for a subset of states with reliable license data. Finally, section 1.7.6 includes robustness checks or tests for heterogeneity of effects in rural versus urban areas.

1.7.1 State Fixed-Effects of GDL Components by Stage

Table 1-11 presents the results of a basic *state*-level fixed effects analysis of the effect of GDL systems on young teen driver fatal crashes. GDL systems seem to be more effective at reducing young teen driving errors than all crashes. None of the learner stage components is statistically significant. However, the intermediate stage components, particularly early night time curfews, had a significant downward effect on teen fatal crashes. The point estimate for the effect of overall GDL system strength is -0.113 on all young teen driver fatal crashes and -0.129 on teen driving error related. This would equate to a 9.0 and 13.3 percent decrease in teen driver and teen driving error fatal crashes among states with the highest IIHS rating (8 points), respectively. However, only the coefficient for all teen crashes it is statistically significant, and only at the 10 percent level for teen driving error related crashes. These estimates are slightly lower than what previous state-level studies have found and have much less statistically significance. This may be due to the greater number of controls used compared to other studies including seatbelt laws and drunk driving laws or differences in methodology. For example, Dee et al (2005) control for seatbelt laws and drunk driving laws and obtain results within similar ranges, although their outcome measure is slightly different. They use counts of all young teen traffic fatalities regardless of whether the teen was driving or not, and a negative binomial regression model, with log of population on the right hand side.

Columns 2-4, and 6-8 display estimates of the effects of each individual GDL component. The intermediate stage, particularly 10pm and earlier nighttime restriction, is the most effective GDL component. Columns 2-3 and 6-7 use the composite measure for GDL strength decomposed by licensing stage. Regressions 3 and 6 estimate the individual effect of each learner stage component (holding period and hours of supervised practice) while controlling for the composite measure of the intermediate stage. Similarly, the specifications in columns 3 and 7 are of the effect of individual components in the intermediate stage (including passenger and night time restrictions and their respective durations), while controlling for the overall strength of the learner phase.

The coefficient on the intermediate stage composite measure is -0.196 (column 2) for all young teen drivers and -0.265 for those involving driving errors (statistically significant at the 1 percent level). The composite intermediate stage measure is only significant for the driver error outcome measure. In these estimates the coefficients on the earlier night time restrictions (10pm and earlier) (-2.310 to -2.492, columns 3 and 4) are significant and negative for all teen drivers, and represent a 25 to 27 percent reduction from county periods with no curfews. The coefficients on teen driver errors are -2.049 to -2.117, columns 7 and 8, and represent a 29 to 31 percent reduction compared to no curfews.[23] The effect is slightly stronger in reducing teen driving error related fatal crashes.

While the estimates of the effects of passenger limits were not statistically significant, the duration of limits was, with a reduction of -0.062 and -0.057 among all teen driver fatal crashes (columns 3 and 4, respectively) and -0.056 to -0.058 among teen driver error fatal Crashes for each additional month of passenger restriction. This estimate implies that a six month period of passenger limits would decrease teen driver crash rates by approximately 4 percent for all and 5 percent for teen driver errors.

In summary, the overall estimates at the state-level aggregation are similar in magnitude to what prior national level studies of GDL have found, although results of previous studies have found smaller but more statistically statistic effects for passenger restrictions. For example, Masten and Hagge (2004) found a two percent decline in teen fatal and injury crash rates with passenger restrictions.

Table 1-10. Comparison of Crash Rate Statistics in All Versus Reliable Driver License Data States

	All Cross-State Commuting Zone Counties Sample					Good Drivers License Cross-State Commuting Zone Sample				
	Teen Driver Crash Rate		Teen Driver Error Crash Rate		Obs	Teen Driver Crash Rate		Teen Driver Error Crash Rate		Obs
Geographic Divisions	Mean	Std. Dev.	Mean	Std. Dev.	N	Mean	Std. Dev.	Mean	Std. Dev.	N
Urban	9.4	33.7	6.9	28.7	18,648	9.7	34.0	7.2	29.7	12,208
Rural	14.4	76.2	11.3	68.9	22,904	11.5	76.0	14.5	81.7	14,616
All	12.2	60.9	9.3	54.7	41,552	12.3	64.6	9.6	59.6	26,824

23 The mean young teen driver involved and driver error fatal crash rate for observations in the sample in states and periods without a night time curfew is 9.5 and 7.0 per 100 thousand young teens, respectively (Table 1-9)(Young teen from here on out refers to ages 16-17).

Table 1-11. Effect of GDL on Teen Driver Involved Fatal Crash Rates: State-Level Fixed Effects Regression

	All Teen Driver Involved Fatal Crash Rate (per 10^5 pop)				Teen Driver Error Fatal Crash Rate (per 10^5 pop)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
GDL IIHS Points (0-9)	-0.111				-0.122*			
	(0.085)				(0.067)			
Age to get a License		-0.499	0.047	0.030		0.174	0.588	0.688
		(0.834)	(0.620)	(0.689)		(0.858)	(0.749)	(0.722)
Holding Period (Months)		-0.052		-0.024		0.022		0.048
		(0.081)		(0.078)		(0.061)		(0.051)
Hours Supervised Driving		0.010		0.004	0.003		-0.001	
		(0.010)		(0.009)	(0.006)		(0.006)	
Intermediate Stage IIHS		-0.196				-0.265***		
		(0.132)				(0.093)		
Learner Period IIHS Points			0.046				0.143	
			(0.188)				(0.150)	
Zero or One Passengers			0.193	0.146			-0.041	0.008
			(0.368)	(0.317)			(0.287)	(0.270)
Two Passengers Allowed			0.639	0.652			0.406	0.427
			(1.029)	(1.060)			(1.316)	(1.259)
Duration of Passenger			-0.062**	-0.057**			-0.056***	-0.058***
			(0.028)	(0.028)			(0.020)	(0.020)
6 to 10pm Curfews			-2.492***	-2.310**			-2.049**	-2.117**
			(0.911)	(1.038)			(0.843)	(0.927)
Later than 10 Curfew			-0.066	-0.022			-0.464	-0.396
			(0.781)	(0.719)			(0.451)	(0.432)
Duration of Night			-0.007	-0.009			0.003	0.002
			(0.034)	(0.033)			(0.026)	(0.027)
BAC 08 Law	0.155	0.138	0.199	0.190	-0.034	-0.063	-0.047	-0.018
	(0.350)	(0.353)	(0.360)	(0.351)	(0.306)	(0.309)	(0.316)	(0.309)
Zero Tolerance Alcohol Law	-0.241	-0.155	-0.392	-0.335	-0.213	-0.280	-0.411	-0.452
	(0.554)	(0.547)	(0.516)	(0.519)	(0.555)	(0.558)	(0.522)	(0.534)
Observations	2744	2744	2744	2744	2744	2744	2744	2744

Notes: OLS regression use state level quarterly data using state and period fixed effects 1996 to 2009 (49 States, 56 periods (year-quarters)). All regressions control for state level population (with base, squared, and cubed terms), presence or absence of primary and secondary seat belt laws, zero tolerance alcohol laws, and BAC 08 limits, annual unemployment rate, and the county level non-teen involved accident rate. Standard errors are reported in parenthesis.

1.7.2 Cross-State Commuting Zones Analysis

The effects estimated in the CSCZ analysis are larger and more statistically significant than the state level analysis. As in the state-level analysis, the 10pm and earlier nighttime curfews and duration of passenger restriction were negative and statistically significant. However, the estimated magnitudes of the effects are much larger. Differing from the previous results, the overall GDL strength measure had a substantially larger and statistically significant effect for both types of crashes. In addition the duration of night time restriction had a very small positive, but strongly statistically significant effect on all teen driver crashes, but not teen driver error crash rates.

Table 1-12 displays estimates for the effects of GDL system strength on the young teen driver fatal crash rates (columns 1-4) and the driver error related crash rates (columns 5-8). The effect of each additional GDL point (columns 1 & 4) is quite large and statistically significant for both types of young teen driver crashes (all and driver error related). Young teen driver crash rates are reduced by -0.972 (column 1) and driver error related are reduced by -0.943 (Column 5), representing an average decrease *per GDL point* of 4.2 and 5.6 percent.[24] This implies that states with GDL programs rated as good (6-8 points), on average, reduce young teen driver and driver error crash rates, by 25-34 percent and 34-45 percent, compared to those with no program. These estimates are three to four times larger than what was estimated in the state-level fixed effect analysis above.

Columns 2 through 4 and 6 through 8 decompose effects by each GDL system component. In the learner stage, the period of supervised driving (holding period), was also effective in reducing all young teen driver crashes. On driver errors, the coefficient was only statistically significant at the 10 percent level. This implies, that each additional month teens are restricted to driving only while supervised, reduced young teen driver quarterly crash rates by approximately -0.683 (column 2) to -0.783 (Column 4, including all components individually). Young teen driver error related crash rates declined by -0.499 to -0.519 for each additional month of holding period, and were statistically significant, representing a mean percent decrease of 25 to 26 percent, for a 6 month waiting period[25]. While the length of learner period was important, the number of supervised driving hours and the minimum entry age to get an intermediate stage license were not significant.

Among the intermediate stage components, the estimated effect of the early nighttime curfew was also statistically significant and a highly effective in reducing teen driver fatal crashes for teen driver error crash rates only. Relative to no curfew, young teen driver error fatal crash rates were reduced by -9.381 to -9.326. This represents an 86 percent decline for all and teen error crashes, respectively.

24 Relative to a mean of 22.8 and 16.7, all and driver errors, respectively for state-periods without GDL programs.

25 Average young teen crash quarterly rates are 11.8 in periods with no holding period

Table 1-12. Effect of GDL Systems on Teen Fatal Crash Rates in Cross-State Commuting Zone Counties

	All Teen Driver Involved Fatal Crash Rate (per 10^5 pop)				Teen Driver Error Fatal Crash Rate (per 10^5 pop)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDL IIHS Points (0-8)	-0.972**				-0.943***			
	(0.426)				(0.342)			
Age to get a License		4.429	5.778	6.285		5.861	7.073*	7.656*
		(4.321)	(4.859)	(4.912)		(4.080)	(4.143)	(4.481)
Holding Period (Months)		-0.683**		-0.783**		-0.499*		-0.519*
		(0.337)		(0.353)		(0.291)		(0.267)
Supervised Driving Req (hours)		-0.007		-0.058		-0.003		-0.054
		(0.036)		(0.048)		(0.031)		(0.042)
Intermediate Stage IIHS Points		-0.562				-0.814		
		(0.592)				(0.501)		
Learner IIHS Points			-2.563**				-2.021***	
			(1.008)				(0.739)	
Zero or One Passengers Allowed			-0.821	-0.852			-0.657	-0.481
			(1.323)	(1.488)			(1.101)	(1.268)
Two Passengers Allowed			1.598	0.732			1.018	0.427
			(1.413)	(1.494)			(1.388)	(1.454)
Duration of Passenger Restriction			-0.159	-0.180			-0.137	-0.168
			(0.115)	(0.122)			(0.110)	(0.119)
6 to 10pm Curfews			-6.672*	-5.624			-9.381***	-9.326***
			(3.444)	(3.576)			(2.506)	(2.756)
Later than 10 Curfew			5.337**	5.260**			3.224*	3.047
			(2.346)	(2.523)			(1.617)	(1.819)
Duration of Night Restriction			-0.130	-0.091			-0.079	-0.048
			(0.084)	(0.079)			(0.062)	(0.064)
BAC 08 Law	-0.037	-0.104	0.498	0.137	0.752	0.740	1.245	1.021
	(1.981)	(1.936)	(1.950)	(1.914)	(1.958)	(1.931)	(1.935)	(1.899)
Zero Tolerance Alcohol Law	-12.595**	-12.036**	-12.019**	-11.740**	-10.853**	-10.627**	-10.844**	-10.868**
	(4.764)	(4.767)	(4.699)	(4.662)	(4.474)	(4.422)	(4.423)	(4.400)
Observations	41552	41552	41552	41552	41552	41552	41552	41552

Notes: OLS regressions of fatal crash rates involving Teen Drivers (Ages 16-17) (per 100,000 population) using county level quarterly data in cross state commuting zones for 1996 to 2009 (742 counties and 137 commuting zones). All regressions include commuting zone-period and county fixed effects and controls for county level population (base, squared, and cubed terms), presence or absence of primary and secondary seat belt laws, zero tolerance alcohol laws, and BAC 08 limits, annual state unemployment rate, and the county level adult driver involved accident rate. Standard errors are reported in parenthesis

The magnitudes of the county-level estimates are again much higher than that of the state-level fixed effects estimates for nighttime driving restrictions. Relative to no curfew, later curfews (starting between 11pm to 1am) were not effective in reducing serious teen crashes. The coefficients on the later curfew variable are positive but not significant at the 5 percent level. Given that the range of curfews within this group was wide, the positive coefficient may be attributable to some of the counties in states with later curfews which may not be very different than having no curfew. The strong negative finding for earlier curfews is consistent with the literature that has found a sharp increase in accidents after 10pm (Williams, 1992). Passenger restrictions have been found to be effective in other studies however although the magnitudes were large and negative, they were not statistically significant in this set of estimates.

To summarize, both the state and county level estimates find that nighttime curfews of 10pm or earlier are strongly effective and while coefficients for passenger restrictions are negative but not significant. The state and CSCZ county estimates differ in that only the duration of passenger restrictions are significant in the state estimates. Also, the CSCZ county estimates are in general much larger and more statistically significant than the state estimates. The CSCZ estimates show that strongest programs, rated as good by the IIHS, reduce total teen fatal crashes by 25-34 percent for all teens and by 34-45 percent for teen driver error related.

The CSCZ county level estimates may be higher for several reasons. This border pair method introduces better controls for local factors affecting crash rates not accounted for by state-level regressions. That is, using groups of counties on either side of a state border within the same commuting zone with *only* GDL system components differing - with and without a GDL policy or with variations in GDL component designs-provides a better comparison than comparing entire states. For example, many factors affecting crash risk such as levels of economic activity, transportation prices, labor markets, land-use, traffic patterns, and road design are more likely to be similar among counties within the same commute zone than within entire states. In particular, state level fixed effects estimates may be biased due to varying compositions between states of rural versus urban areas. Since rural areas have higher risk factors for fatal crashes, this would tend to underestimate the effect of GDL on teen driver crash reduction.

1.7.3 Fatalities per Teen Driver Involved Crash

Table 1-13 presents regressions of cross-state commuting zone county quarterly counts of total fatalities associated with young teen driver involved vehicle accidents. Mean young teen driver involved fatality counts are 0.23 (sd. = 0.69 and teen driving error associated are 0.17 (s.d. =0.54), per quarter per county. Since the measure is the count of total fatalities, these regressions include the total county population of teens age 16 and 17 along with the same controls variables included in the previous estimates above.[26] Since the total population of young teens is included as a control, this set of regressions serves as a measure the overall intensity of young teen driver fatal crashes. Passenger restrictions would be expected to reduce deaths associated with teen driver crashes. At the same time, if fewer teen driver crashes are single vehicle, due to improvements in driving skills, given a fatal crash, it would be more likely to involve other drivers. Therefore, this measure would be expected to decline most for teen driver error related crash rates.

The overall impact of GDL points is only statistically significant for all young teen driver involved crash related fatalities (-0.008, 5 percent level). For GDL systems that meet all of the IIHS recommendations (IIHS rating 8 points), this equates to a 0.06 point decline or 28 percent reduction in young teen driver involved crash rates. Older license entry ages are negatively associated with total fatalities per crash due to teen driver errors. That is, as the age to get a license is raised, it reduces the severity of young driver fatal crashes. The coefficients are -0.059 to -0.065 for all and -0.324 to -0.356 for driver error related. However, it is only statistically significant at the 10 percent level for error related crash rates and only in one specification (Column 6). This indicates that requiring teens to wait until they are more mature may reduce the severity of crashes, or the number of fatalities associated with driver error related crashes.

The holding period is also significant and reduces all young teen driver associated fatalities per crash by -0.005 to -0.007 per month, a 13 percent decrease for a 6 month holding period. However, the estimate is not significant for driver error related fatalities. During the holding period, teens may only drive with their parents. So this finding is likely a reflection of teens driving more conservatively while with parents and also a lasting effect of instilling better driving habits.

As in previous estimates, the earlier curfew range (10pm and before) is highly effective. The average number of fatalities per crash declines by -0.134 to -0.137 for all crashes involving teens 16 to 17; however, the results were not statistically significant for crashes related to driving mistakes. Relative to no curfew, the 10pm or earlier nighttime curfews decrease fatalities associated with young teen driver crashes by 60 percent. Although the specific passenger restrictions were not significant, the duration of the restriction, in months, is and has a negative impact for both types of crash rates. The magnitude is much larger for driver errors than all young teens, reducing fatalities by -0.004 associated with all young teen crashes (columns 3 and 4) and -0.013 and -0.012 for teen driver error related ones (columns 7 and 8). This represents an average 8 percent decrease in error related fatalities per crash for each month of learner period and a 2 percent decrease among all teen associated fatalities. A one year intermediate phase with passenger restrictions therefore, on average, reduces fatalities associated with crashes related to teen driver mistakes by 48 percent.

[26] These controls include: total county population, adult driver accident rates, BAC 08 alcohol, zero tolerance, and seat belt laws.

Table 1-13. Effect of GDL Systems on Fatalities Associated with Teen Driver Involved Crashes

	Teen Driver Fatalities				Teen Driver Error Related Fatalities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDL IIHS Points (0-9)	-0.008**				0.008			
	(0.003)				(0.018)			
Age to get a License		-0.065	-0.069	-0.059		-0.356*	-0.390	-0.324
		(0.055)	(0.058)	(0.055)		(0.204)	(0.238)	(0.281)
Holding Period (Months)		-0.007**		-0.005*		-0.009		-0.006
		(0.003)		(0.003)		(0.015)		(0.022)
Supervised Driving Req (hours)		-0.000		-0.001		0.001		0.000
		(0.000)		(0.000)		(0.002)		(0.003)
Intermediate Stage IIHS Points		0.001				0.027		
		(0.007)				(0.030)		
Learner IIHS Points			-0.017**				0.030	
			(0.008)				(0.041)	
Two Passengers Allowed			0.075	0.070			0.087	0.072
			(0.046)	(0.045)			(0.188)	(0.197)
Zero or One Passengers			0.023	0.025			0.153	0.136
			(0.022)	(0.022)			(0.104)	(0.136)
Duration of Passenger			-0.004***	-0.004***			-0.013**	-0.012**
			(0.001)	(0.001)			(0.006)	(0.006)
6 to 10pm Curfews			-0.137***	-0.134***			-0.000	0.049
			(0.031)	(0.030)			(0.288)	(0.310)
Later than 10 Curfews			-0.033	-0.031			-0.056	-0.005
			(0.021)	(0.021)			(0.170)	(0.181)
Duration of Night Restriction			0.004***	0.004***			0.007	0.006
			(0.001)	(0.001)			(0.008)	(0.008)
BAC 0.08 Law	-0.009	-0.012	-0.010	-0.011	-0.096	-0.101	-0.107	-0.095
	(0.021)	(0.020)	(0.018)	(0.018)	(0.127)	(0.131)	(0.127)	(0.122)
Zero Tolerance Alcohol Law	-0.035	-0.023	-0.032	-0.032	-0.008	0.037	0.066	0.068
	(0.036)	(0.037)	(0.038)	(0.037)	(0.110)	(0.116)	(0.128)	(0.136)
Observations	41552	41552	41552	41552	4870	4870	4870	4870

Notes: OLS regression using county level quarterly data in cross state commuting zones using commuting zone-period and county fixed effects 1996 to 2009 (742 counties and 137 commuting zones). All regressions control for county level population (with base, squared, and cubed terms), presence or absence of primary and secondary seat belt laws, unemployment, and the county level non-teen involved accident rate. Fatal crash rates involving Teen Drivers (Ages 16-17) (per 100,000 population).

To review, the number of fatalities per teen driver crash is on average 0.23 per quarter in CSCZ counties. The very strongest GDL programs, rated as 8, by IIHS, reduce fatalities associated with young teen driver involved crashes, by 28 percent. This represents a significant public health benefit for both teens and others on the road affected by their driving. A driving curfew 10pm or earlier has a particularly dramatic effect on young teen crash associated fatalities, reducing rates by 60 percent, on average. The fatalities-per-crash outcome variable measures the overall deadliness of teen driver involved crashes. The reduction in intensity is most likely an indication that fewer teen accidents are occurring with multiple young occupants. Since serious teen crashes are most likely to occur after 10pm and to involve multiple young passengers, it is logical that the earlier curfews had the most dramatic effect on crash deadliness. A holding period of 6 months results in a reduction in fatalities counts of 13 percent. This is most likely the effect of reduced exposure and the fact that teens drive more cautiously while with parents. While the specific type of passenger restriction that was most effective was not discernable from the estimates, the duration of such restrictions reduces fatalities caused by poor teen driving (errors) by 8 percent per month and 48 percent for one year. This is a strong indicator that with fewer passengers in the vehicle, teen driver crashes that do occur will result in fewer fatalities among youth.

1.7.4 GDL Effects by Crash Characteristics

This section evaluates how GDL systems have affected young teen driver fatal vehicle accidents where driving error was a factor by specific crash types including day versus nighttime (after 9 pm), drunk driving and those involving young occupants (Table 1-14). The day versus nighttime coefficients are a decomposition of the main effects found in the earlier CSCZ regressions on teen driver error crashes, summing approximately to the main effect on all times of day. For example, the GDL composite measure is -0.917 for day, and -0.037 for night, while the estimate for all times of day is -0.943 (Table 1-9). In general, the GDL system rating (IIHS points) had the greatest overall impact on daytime time accidents. However, since the nighttime category includes fewer hours (9 versus 15), resulting in smaller sample sizes, the point estimates may be less precise.

Among individual components, the holding period was significant at reducing young teen driver error crashes (-0.195) at night, but was weakly significant for day crashes (before 9pm). Thus, increased holding periods in the learner stage may be more salient to reducing night than day time driver error crashes. Counter-intuitively, increasing the age to get an intermediate stage license appears to increase the rate of teen error accidents for those involving one or more passengers and occurring during the day. The coefficient on age for is 4.442 young occupant crashes and 9.196 for day crashes. Both are highly significant (at 1 percent significance level). However, this may be the result of the range of license age (14-17 years) including teens younger than 16 and 17, outcome age of interest in this study. Some states, including North Dakota, South Dakota, Idaho, allow teens to begin the intermediate stage before well before turning 16. These states also have very early nighttime curfew, beginning at 6pm in one case. Since the outcome measure includes accidents involving teens age 16 and 17, the age variable may show an increase in accidents for these teen drivers only because the accidents among very young ones (age 14 and 15) are not included in the measure. It may also likely reflect an effect of increased driving experience. That is 16 and 17 year old drivers in states with younger entry ages of 14 and 15 would have a full year or two of driving experience compared to their cohorts in other states, which would be expected to improve their driving skills and reduce crashes, irrespective of maturity levels. However, more analysis is needed to distinguish the effect of age versus experience. Including lag terms and more age groups in the outcome measures in future work could help disentangle these effects.

Table 1-14. Teen Driver Error Related Fatal Accident Rates by Characteristic

	One or More Young Passengers		BAC >=0.08		Day 6:00am to < 9:00pm		Night 9:00pm to < 6:00am	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	b/se	b/se	b/se	b/se	b/se	b/se	b/se	b/se
GDL IIHS Points (0-8)	-0.369		0.042		-0.917***		-0.037	
	(0.221)		(0.067)		(0.313)		(0.116)	
Age to get a License		4.442**		-0.825		9.196**		-1.536
		(2.131)		(0.810)		(4.367)		(1.223)
Holding Period (Months)		-0.261		-0.003		-0.340		-0.195**
		(0.209)		(0.061)		(0.256)		(0.097)
Supervised Driving Req. (hours)		-0.023		0.004		-0.074*		0.021
		(0.026)		(0.009)		(0.039)		(0.013)
Two Passengers Allowed		1.096		-0.686		0.230		0.066
		(1.822)		(0.583)		(1.706)		(1.136)
Zero or One Passengers Allowed		-0.003		0.074		-0.752		0.160
		(1.191)		(0.371)		(1.182)		(0.588)
Duration of Passenger Restriction		-0.142*		-0.010		-0.113		-0.051
		(0.081)		(0.022)		(0.104)		(0.036)
6 to 10pm Curfews		-7.971***		-0.636		-7.667***		-1.533*
		(2.605)		(0.583)		(2.739)		(0.854)
Later than 10 Curfews		2.730*		0.396		3.999**		-0.929
		(1.555)		(0.526)		(1.817)		(0.785)
Duration of Night Restriction		-0.069		-0.012		-0.158**		0.110***
		(0.074)		(0.023)		(0.062)		(0.035)
BAC 0.08 Law	0.197	0.318	0.634	0.606	-0.409	0.012	1.432**	1.272**
	(1.588)	(1.597)	(0.515)	(0.556)	(1.736)	(1.696)	(0.639)	(0.555)
Zero Tolerance Alcohol Law	-8.198**	-8.277**	-0.885	-0.757	-10.683**	-11.197**	-0.480	0.055
	(3.491)	(3.484)	(0.560)	(0.562)	(4.390)	(4.199)	(0.848)	(0.896)
Observations	41,552	41,552	41,552	41,552	41,552	41,552	41,552	41,552

Notes: OLS regression using county level quarterly data in cross state commuting zones using commuting zone-period and county fixed effects 1996 to 2009 (742 counties and 137 commuting zones). All regressions control for county level population (with base, squared, and cubed terms), presence or absence of primary and secondary seat belt laws, unemployment, and the county level non-teen involved accident rate. Fatal crash rates involving Teen Drivers (Ages 16-17) (per 100,000 population).

Unlike previous regressions, the hours of required supervised driving practice was nearly significant for *daytime* crashes, with a -0.074 point reduction per hour of supervision, but not for the other categories. Among the states that require a supervised practice period, the average requirement is 40 hours. Therefore, this an approximate average effect of -2.96 or a 27 percent decline in the teen driver error fatal crash rate for states with 40-hour practice periods. The fact that this component was not at all significant in other regressions, may indicate that parents supervising teens improves daytime crash outcomes only and not nighttime ones because teens would tend to drive more in the day with their parents. It also may indicate that the effect is for times when teens are actually in the car with parents, rather than a more generalized effect, where teens learn from their supervision and replicate the manner of driving while with parents when they are alone or with friends. That is, it is not clear that crash rates are being reduced for teens when they are driving without their parents, as result of the supervised driving practice. In future work, it may be helpful to include lagged terms to determine if there are more lasting effects from supervision.

The 10pm and earlier nighttime curfews reduced both day and night crash rates as well as crashes with multiple young passengers (-7.971). The magnitude of the daytime coefficient (-7.667) was much larger than nighttime crashes (-1.533).[27] However, since the daytime young teen driver error crash rates include more hours than the nighttime period, 15 versus 9, the mean quarterly crash rate is higher in the day than at night, 7.2 (s.d.= 49) for daytime crashes and 1.9 (s.d. = 23) for nighttime. Moreover, the rate of daytime crashes in periods with no curfew is 8.69 per 100,000, or and the nighttime rate is 2.32 per 100,000 teens age 16-17. Adjusting for the larger number of hours included in the daytime category, teen driver error daytime crashes are predicted to decline by approximately 5.9 percent per daytime hour,[28] and 7.3 percent per nighttime hour.[29] Some states have night curfews much earlier than 10pm that may have affected early evening crashes (which would be included in the daytime crash category). A puzzling result, however, is that the duration of the nighttime curfew *reduced* daytime crash rates but *increased* nighttime ones. This may reflect declines in rates for crashes occurring during the early evening, from 6pm to 9pm, hours which are included in both the daytime crash definition and the nighttime curfews before 10pm variable.

None of the GDL system measures were significant for drunk-driving related crashes.

In summary, nighttime driving restrictions beginning before 10pm were again extremely effective in reducing the rate of teen driving error related fatal crashes, including those involving young passengers at both times of day. The effect was slightly larger for nighttime crashes, which is in line with previous findings in the literature, that teen driving errors tend to happen at night. As well one would expect the night curfew to affect crashes more often during times of day that are effected by the curfew-past 9pm. Supervised practice may be effective in reducing day time crashes suggesting that teens may have fewer crashes while driving under parental supervision. The finding for the extended wait period before teens are allowed to drive unsupervised (holding period) is in line with the finding for supervised practice period. That is, the holding period has a strong and negative effect for nighttime teen error fatal crash rates, implying that while practicing with adults is effective it is also effective through reducing night driving exposure by increasing the holding period where they are not permitted to drive without adult supervision.

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27 Day includes crashes from 6am to before 9pm and night includes crashes between after 9pm to before 6am.

28 From a base crash rate of 1.9 (s.d = 23).

29 From a base of μ =2.32, s.d.=25 in county-periods with no nighttime restriction.

1.7.5 Robustness Checks: Rural versus Urban Effects

Rural driving is a more hazardous task for all age groups but particularly so for young novice drivers. The mean young teen driver involved fatal crash rate for the sample period is more than 50 percent higher in rural than in urban counties, with the mean fatal teen driver involved crash rate of 14.4 in rural versus 9.4 in urban counties in the sample period. Rural and urban traffic risks differ substantially along a number of dimensions, including road design and emergency response times, access to medical care, travel speeds and traffic law enforcement (Baker, Whitfield, and O'Neill 1987; Ossenbruggen, Pendharkar, and Ivan 2001; Zwerling et al. 2005). While crashes, per mile driven, are more frequent in urban areas, *fatal* accident rates tend to be higher in rural areas. Fatality vehicle accident rates are higher in rural areas for a number of reasons. Rural traffic tends to flow at higher speeds due to higher speed limits, different road design, and lower traffic enforcement. Additionally, rural roads tend to be more poorly designed and maintained. They are more likely to traverse mountainous terrain, to be unpaved, or two lane roads without center dividers or guard rails, and to convey high speed traffic through non-signalized cross roads. Additionally, high risk utility vehicles and carrying passengers in open pick-up trucks are more popular in rural areas (Baker et. al, 1987). Once there is a crash, response times are generally longer due to greater distances between destinations, lower density of medical treatment centers, and less availability of wireless telecommunications. Moreover, incidents are more likely to be head-on crashes, single-vehicle crashes into stationary objects such as trees, or high speed crashes. In contrast, urban crashes are more likely to be at lower speeds and at angles less likely to cause serious injuries, such as rear end collisions. These factors combined, tend to increase seriousness of crash injuries and to lower likelihood that crash victims receive timely and proper medical treatment. Given the plethora of differences in factors affecting the severity of crashes and their outcomes, it is important to test for differences in the effectiveness of GDL systems as well as control for the variation in risk factors affecting teen driving among rural versus urban areas.

The coefficients for the GDL provisions are in general more statistically significant for the urban subsample rather than the rural. There is wider variation in the rural sample (standard deviation of 76 among rural observations versus 33 among urban). Higher variation in the rural sample may have made a precise estimate less feasible; yet, the magnitudes and the signs of the coefficients for the overall GDL rating are similar indicating that the effects may not differ widely overall.

In urban areas, both the holding period and the nighttime curfew have statistically significant effects, consistent with the previous results. The holding period was significant for all teen crash rates and teen error related crash rates, with point estimates of -0.764 and -0.433, respectively. As in the previous estimates, the nighttime curfew was strongly effective in urban areas. The estimate of the coefficient for the 10pm or earlier night curfew is significant and strongly negative (-4.968 all and -6.436 teen error) in urban areas.

In rural areas, the duration of passenger restriction reduced all teen driver involved fatal crashes and nighttime restrictions had negative impacts on fatal crashes related to teen driving errors. Compared to the urban effects, the rural coefficients for the earlier curfews are larger in absolute magnitude (-4785 all teen crashes and -9.668 teen error crashes), however only the teen error coefficient is statistically significant for rural areas. Passenger restrictions were not significant for either rural or urban, however, the duration of the passenger restriction period in months was for all young teen fatal crashes in rural areas (-0.520).

In sum, GDL programs have more clear effects in urban than rural areas. However, in both environments, the nighttime driving curfew remains important, particularly for reducing teen driving error related fatal crashes. The holding period also remains effective (statistically significant) in urban areas but the impact is less apparent for rural ones. Although passenger restrictions did not have a statistically significant effect, as in prior regressions, the coefficients are negative and the *duration* of the passenger restriction is highly significant and large in rural areas. This indicates that although it was not possible to decipher the effects of each restriction individually, that the restriction did reduce crashes the longer it applied to intermediate teen drivers. Since there is a wider variability in factors contributing to teen crashes in rural areas compared to urban, this may indicate a need for further research into the unique factors contributing to teen vehicle accidents in rural regions and how GDL provisions may be tailored to address them.

1.7.6 GDL Systems and Teen Licensure Rates

The share of young teen drivers on the road has declined substantially with the growth of GDL systems. This has occurred primarily by increasing the age when teens can get a learner permit, increasing periods of supervised practice ,and driver education before being teens are allowed to drive independently. Some teens may have also been dissuaded by the increased costs of driver education requirements and or possibly, but not likely, the passengers and nighttime driving limits.

Table 1-15 presents state-level regressions of GDL laws and licensure rates of teens aged 16 and 17. The proportion of licensed teens in each state were regressed on various GDL components including the length of holding period in the learner stage, the intermediate stage entry age, the number of young passengers teens may carry, the hour of nighttime curfew, and the strength of the GDL system using only data for states reliable driver license statistics were attainable (35 states). All regressions include fixed effects for state and year and standard errors clustered at the state level. Relative to an intermediate stage entry age of 15, an entry age of 16 and 17 decreased the average proportion of licensed 16 year olds, by 0.11 and 0.41, respectively. The length of holding period is also a statistically significant predictor of the share of 16 and 17 year olds with a license, although the magnitude of its effect is quite small, only reducing the proportion of 16 year olds with a license by 0.009 or less than one percentage point per month. Nevertheless, a six month holding period would add up to approximately 6 percentage point decline in the share of licensed teens.

The intermediate stage passenger and night time restrictions did not have an impact on licensure rates, indicating that most teens do not to delay getting a license until age 18 in order to skip this phase and also that more teens did not get their license earlier because of passenger limits. Some of the observed reduction in young teen driver fatal crashes may be attributable to reduced exposure resulting from the decline in the share of teen drivers on the road, through increased minimum age and holding period requirements. The consistently significant and negative coefficient on holding period in the previous regressions is also consistent with this theory. Since driver license data for teens was not available for all 48 states, it was not included in the main regressions, however, the regressions presented in Table 1-16 control for the effect of reduced licensure rates on the previous outcomes analyzed above, using a subset of the data with reliable drivers license data (35 states). Of the 35 states, 33 had cross-border commuting zones. As expected, the young teen driver fatal crash rates increased with the share of licensed teens aged 16 and 17, however, this measure is only significant for fatality counts and day time crashes.

Table 1-15. Effect of GDL Systems on Teen Licensure Rates

All regressions include state and year fixed effects	**Proportion 16 year olds**				**Proportion 16 to 17 years old**			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intermediate entry age=16 (relative to age 15)	-0.105***				-0.083***			
	(0.019)				(0.013)			
Intermediate entry age=17 (relative to age 15)	-0.411***				-0.208***			
	(0.019)				(0.013)			
Holding period in Months	-0.009***	-0.009***	-0.007**	-0.007**	-0.008***	-0.008***	-0.007**	-0.008***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)
Proportion of total population with a license	0.503*	0.559*	0.528*	0.565*	0.587**	0.634**	0.596**	0.635**
	(0.277)	(0.299)	(0.264)	(0.297)	(0.226)	(0.251)	(0.227)	(0.252)
Intermediate entry age (continuous variable)		-0.089	-0.067	-0.083		-0.052	-0.036	-0.050
		(0.065)	(0.062)	(0.065)		(0.048)	(0.053)	(0.050)
Nighttime Before 10pm			-0.063				-0.060	
			(0.063)				(0.050)	
Nighttime Before 1am			-0.003				0.002	
			(0.028)				(0.021)	
Zero Young Passengers Allowed			-0.026				-0.017	
			(0.028)				(0.020)	
One Passenger Allowed			-0.017				-0.007	
			(0.030)				(0.028)	
2-3 Passengers Allowed			0.042				0.021	
			(0.032)				(0.016)	
GDL Points				-0.003				-0.001
				(0.005)				(0.004)
Observations	1,784	1,784	1,784	1,784	1,784	1,784	1,784	1,784

Notes Quarterly GDL law and annual drivers license and population data from 35 states from 1996-2008. Standard errors in parenthesis. Omitted state: Alabama. Omitted year: 1996

1.7.6.1 Effects on Young Teen Driver Crash Rates Controlling for Teen License Rates

Accounting for the share of licensed teen drivers, the zero to one passenger restriction reduced teen driver errors (-6.338) and day time fatal crashes (-5.909). This component was not statistically significant in the previous estimates that did not control for license rates. As well, the length of time, in months, that these restrictions applied appears to also be important for these two outcomes. Finally, the effect of nighttime curfew before 10 pm, is again highly significant and large for several of the outcomes including teen driver errors, fatality counts, presence of young passengers, and daytime crashes. Increasing age to get a license increased young teen driver crash rates for 16 and 17 year olds, possibly due to a comparison with teens with substantially more driving experience (from states with license ages of 14 and 15).

1.7.6.2 Effects on Crash Characteristics Controlling for Teen License Rates

Fatality counts also decreased with increasing GDL strength, with a reduction of fatalities of -0.014 per GDL point, double the effect that was found not controlling for licensed teens. Increasing age to get a license an important component, with a decline of -0.260 (5% sig. level) per year in age requirement.

The nighttime curfew had statistically significant and large downward effects on almost all crash types. Crashes involving young passengers fell substantially in commuting zones with early nighttime curfews, or by -11.814 (1% sig. level). This estimate is nearly 50 percent more than was found in the previous estimates.[30] Moreover, the duration of these restrictions also had a strong and significant downward effect on multiple occupant crashes (-0.533 per month, 1% sig. level). Unlike prior estimates, drunk-driving involved fatal teen crashes were reduced by the early nighttime curfews by -2.535 (1% sig. level). Almost all of the downward effect on teen driver errors was attributable to accidents occurring before 9pm. This implies that curfews before 10pm (which range from 6 to 10pm) had strong effects on early evening crashes.[31] The standard errors on nighttime crashes after 9pm were too large to determine the effect of nighttime curfews controlling for license rates. As in previous regressions, the holding period was important for nighttime crashes, reducing rates by -0.373 per month of holding period, almost double the effect found without controls for license rates.

30 Recall that the estimate without controlling for license rate was -7.971 (Table 1-14)
31 The "day time" crashes group includes crashes up to 9pm.

Table 1-16. Effect of Graduated Driver License Systems on Teen Driver Involved Fatal Crash Rates, Controlling for Share of Teens with a License: Cross-State Commuting Zone Counties in 33 States

	Teen Driver Involved Fatal Crash Rate (per 10^5 pop)	Teen Driver Error Fatal Crash Rate (per 10^5 pop)	Teen Driver Age 15-19 Fatalities	One or More Young Passengers	Teen Driver BAC >=0.08	Teen Driver Day 6:00am to < 9:00pm	Teen Driver Night 9:00pm to < 6:00am
GDL IIHS Points (0-8)	-1.705**	-1.574**	-0.014**	-0.173	-0.313	-1.653***	-0.337
	(0.749)	(0.620)	(0.006)	(0.364)	(0.185)	(0.471)	(0.387)
Primary Seatbelt Law	-15.655	-18.975	0.437**	-19.701	0.617	-325.485***	-1.882
	(14.628)	(14.366)	(0.203)	(12.293)	(0.885)	(40.982)	(1.188)
Secondary Seatbelt Law	70.295**	73.055**	-0.944**	59.847**	3.391***	-1.393	3.089*
	(27.462)	(27.856)	(0.374)	(26.716)	(1.124)	(4.110)	(1.564)
State UE Rate	4.079*	3.380	0.010	0.495	0.548	2.696	1.192
	(2.247)	(2.076)	(0.013)	(1.048)	(0.357)	(2.385)	(1.269)
Zero Tolerance Law	-20.977***	-19.042***	-0.056	-14.349***	-5.928*	-31.567***	-3.078
	(6.656)	(6.159)	(0.061)	(5.058)	(3.339)	(10.411)	(2.754)
BAC 0.08 Law	-3.266	-1.457	0.018	-2.525	2.377**	-2.781	2.209
	(3.942)	(2.934)	(0.047)	(2.247)	(1.112)	(3.715)	(1.478)
Proportion Lic. Teens 16-17 with License	27.887*	26.711*	0.271***	8.218	-0.306	19.931*	4.070
	(15.248)	(13.373)	(0.098)	(7.968)	(1.910)	(10.547)	(11.722)
Observations	14744	14744	14744	14744	11045	11045	11045

Notes: OLS regression using county level quarterly data in cross state commuting zones using commuting zone-period and county fixed effects 1996 to 2009 (742 counties and 137 commuting zones). All regressions control for county level population (with base, squared, and cubed terms), presence or absence of primary and secondary seat belt laws, unemployment, and the county level non-teen involved accident rate. Fatal crash rates involving Teen Drivers (Ages 16-17) (per 100,000 population).

Table 1-17. Effect of Graduated Driver License Law Components on Teen Driver Involved Fatal Crash Rates, Controlling for Share of Teens with a License: Cross-State Commuting Zone Counties in 33 States

	Teen Drivers	Teen Driver Error Crashes	Fatalities	Young Passengers	BAC >=0.08	Day 6:00am to < 9:00pm	Night 9:00pm to < 6:00am
Age to get a License	21.893*	31.713**	-0.260**	9.298	-4.167	39.902**	-9.858
	(12.521)	(14.776)	(0.110)	(6.454)	(3.878)	(18.089)	(8.448)
Holding Period (Months)	-0.558	-0.099	-0.006	0.219	0.065	0.243	-0.373**
	(0.689)	(0.583)	(0.004)	(0.413)	(0.104)	(0.519)	(0.161)
Supervised Driving Req (hours)	-0.218	-0.231	0.000	-0.055	0.001	-0.222	-0.008
	(0.143)	(0.136)	(0.001)	(0.080)	(0.019)	(0.149)	(0.035)
Zero or One Passengers Allowed	-1.678	-4.719**	0.092*	-2.030	0.432	-4.516*	0.225
	(2.460)	(2.281)	(0.051)	(1.884)	(0.469)	(2.246)	(0.856)
Two Passengers Allowed	-4.901	-6.231	0.319***	3.087	1.963*	-10.761	5.020**
	(6.913)	(6.198)	(0.075)	(3.405)	(0.993)	(6.529)	(1.950)
Duration of Passenger Restriction	-0.244*	-0.118	-0.008***	-0.076	-0.037	-0.079	-0.062
	(0.120)	(0.108)	(0.003)	(0.067)	(0.023)	(0.079)	(0.051)
6 to 10pm Curfews	-9.378	-12.541**	-0.251***	-11.814***	-2.535***	-10.856*	-1.888
	(7.236)	(5.545)	(0.065)	(3.374)	(0.869)	(5.667)	(1.521)
Later than 10 Curfews	8.941	11.633*	-0.251***	10.470*	-0.905	12.207*	-1.278
	(7.825)	(6.655)	(0.069)	(5.533)	(1.088)	(6.617)	(1.708)
Duration of Night Restriction	-0.255	-0.473	0.014***	-0.533**	0.057	-0.635**	0.202**
	(0.314)	(0.286)	(0.003)	(0.260)	(0.052)	(0.294)	(0.093)
Zero Tolerance Law	-18.035**	-16.776**	-0.075	-13.850**	-2.682***	-14.446*	-2.371*
	(7.457)	(6.703)	(0.053)	(5.551)	(0.946)	(7.111)	(1.392)
Proportion Teens 16-17 with	-2.659	-0.530	0.008	-2.347	1.159	-0.486	0.156
	(3.906)	(2.976)	(0.035)	(2.655)	(0.765)	(2.879)	(0.850)
Observations	22.873	22.191	0.278**	2.301	0.288	21.865**	1.201

Notes: OLS regression using county level quarterly county-level data in cross-state commuting zones using commuting zone-period and county fixed effects 1996 to 2009 in states with reliable drivers license data (287 counties and 57 commuting zones). Regressions include additional controls (aside from those shown) for county level population (with base, squared, and cubed terms), state unemployment rates, and the county level adult driver accident rate.

Table 1-18. Estimates of Graduated Driver License Systems in Rural Versus Urban Commuting Zones on Teen Driver Crash Rates

	Teen Driver Involved Fatal Crash Rate				Teen Driver Error Fatal Crash Rate			
	Rural		*Urban*		*Rural*		*Urban*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDL IIHS Points (0-8)	-0.818		-0.880***		-0.741		-0.775***	
	(0.767)		(0.305)		(0.615)		(0.282)	
Age to get a License		1.203		5.566		5.949		3.428
		(7.357)		(3.489)		(7.340)		(2.627)
Holding Period (Months)		-0.686		-0.764***		-0.377		-0.433**
		(0.604)		(0.248)		(0.466)		(0.201)
Supervised Driving Req (hours)		-0.092		0.004		-0.104		0.008
		(0.086)		(0.036)		(0.076)		(0.029)
Zero or One Passengers Allowed		-2.471		-0.317		-1.198		-0.244
		(2.927)		(2.111)		(2.376)		(1.877)
Two Passengers Allowed		3.380		0.349		3.499		1.010
		(3.601)		(1.875)		(3.359)		(1.521)
Duration of Passenger Restriction		-0.520**		-0.128		-0.404		-0.087
		(0.211)		(0.128)		(0.243)		(0.124)
6 to 10pm Curfews		-4.785		-4.968*		-9.668**		-6.436**
		(5.528)		(2.850)		(4.501)		(2.435)
Later than 10 Curfews		14.114**		-1.835		8.340**		-2.679*
		(5.496)		(1.847)		(4.052)		(1.443)
Duration of Night Restriction		-0.155		0.137		0.048		0.099
		(0.172)		(0.097)		(0.165)		(0.093)
Zero Tolerance Law	-16.229*	-13.607*	-9.924***	-9.323***	-14.916*	-14.148*	-7.449**	-7.424**
	(8.258)	(7.985)	(3.670)	(3.403)	(7.638)	(7.462)	(2.945)	(3.120)
BAC 08 Law	-1.916	-2.532	2.157	2.498***	0.937	0.959	0.856	0.923
	(3.987)	(4.111)	(1.372)	(0.895)	(3.969)	(4.070)	(1.336)	(1.066)
Observations	22,904	22,904	18,648	18,648	22,904	22,904	18,648	18,648

1.8 Summary and Conclusions

GDL systems, when well designed, are highly effective in reducing teen driver involved fatal crashes. The IIHS rating system is a consistent indicator of efficacy of overall programs, with higher rated programs leading to large declines in teen fatal crash rates. Among the most highly rated programs (rated 6 to 8 by the IIHS), young teen driver involved fatal crash rates are reduced by 25 to 34 percent. This is a substantially larger finding than Dee et al (2005), which used a state-level fixed effect and similar controls for drunk driving and zero tolerance laws and found a 19 percent decline in teen traffic fatalities among ages 15-17 for the strongest GDL programs (those rated as 6-8).

A major contribution of this study is the identification of the specific effects intended by GDL systems-that of reducing poor teen driving, including speeding, swerving off the road, distracted driving, among others driving errors. GDL programs target exactly these types of crashes, reducing fatalities caused by teen driving errors, by 34-45 percent among GDL programs rated as "good" by the IIHS. The cross-state commuting zone county level regressions in this study adds further controls than many previous studies, including alcohol and seat belt laws, as well as controls for unobserved local level heterogeneity that may have introduced potential omitted variable biases in state level studies. In fact, the estimates in the CSCZ are substantially higher than the state-fixed effects studies, indicating that higher rural fatal crash rates, combined with variations in the share of rural and urban land compositions of states, and other omitted factors, may have biased state-level national studies upward.

Since GDL programs are passed as a package and vary considerably by state, both in composition and strength, it is important to understand the efficacy of the specific program components in the learner and intermediate stages. In the learner phase, the number of required hours of supervised practice was not statistically significant in most regressions, but was weakly so for daytime fatal teen driver accidents (at the 10 percent level). The months of holding period, in which teens were prohibited from driving without adult supervision, was a consistently statistically significant and important measure, reducing crash rates, by up to a percentage point for each month of holding period. These two findings together, indicate that the supervised practice may not be as effective as delaying when teens may drive unsupervised. However, since it is more difficult to verify and enforce the supervised driving requirements relative to others, this variable may not provide an accurate reflection of actual supervised practice time. Yet, for daytime crashes, the results suggest it may in fact be an effective measure.

Age to get a license was not statistically significant in most cases, but was positively associated with teen driver error daytime and young occupant fatal crashes, particularly when controlling for the number of licensed teens. Since the range of ages to get a license extends beyond the define outcome age range, this finding may reflect that role of experience. That is, more 16 and 17 year olds are likely to be involved in fatal crashes if they are newly licensed rather than have their license since age 14 or 15, indicating that experience is helpful here. Importantly, the severity of fatal crashes, defined as the number of fatalities per young teen crash, declines as minimum age requirements increase. Given that the holding period is more consistently significant, the effect of having an extended practice period is likely more important than starting licensing process earlier. Moreover, more work would need to be done to understand the effect of experience and supervised practice given various starting ages. Further study of this issue, by including more age groups in the outcomes, interaction, and lagged terms, is needed. When licensure rates among teens were included the estimations, the holding period effect disappears, except in the case of nighttime accidents. This may imply that for *daytime* accidents, the effect of holding period is mostly due to reduced exposure or fewer teens on the road.

Nevertheless, reduced exposure is only part of the story. Even accounting for the number teens on the road, nighttime restrictions beginning before 10pm, dramatically reduce the number of fatal vehicle accidents involving young passengers and those occurring at night, with effects ranging from 48 to 89 percent. This finding was consistent throughout the study, with the 10pm and earlier GDL component being large and statistically significant in almost all specifications including robustness checks for rural and urban areas. Earlier curfews are particularly salient to reducing accidents involving teen driving mistakes and those occurring at night after 9pm. The effect on crashes related to teen driving mistakes was remarkable, falling by 89 percent compared to those rates in commuting-zone-state-periods with no night restrictions. Controlling for the share of licensed teens, these curfews reduced almost all crash types, including young occupant, day as well as the intensity of crashes, the fatalities per crash. Curfews later than 10pm, beginning anytime from 11pm to 1am, were not shown to be effective and in fact the estimates of coefficients on this variable had positive, although insignificant, signs.

Among passenger limits, while only the duration of the restrictions is significant in the analyses without controls for the share of licensed teens, when these controls are included, the zero to one passenger restriction reduced teen driver errors related fatal crash rates substantially, by -6.388 points, relative to a mean rate of 9.5 in state-periods without restrictions. Zero to one passenger limits are also highly effective at reducing nighttime crashes among teens, with an reduction in these crash rates of -5.909.

Finally, GDL effects are more clear in urban than rural areas. However, since the factors that affect rural accidents vary widely, precise estimates are less feasible. Nevertheless, given the additional challenges of learning to drive on rural roads, novice teen drivers may require more specialized training and stronger GDL provisions tailored to rural conditions. Additionally, enforcement of the intermediate phase may be significantly weaker in these areas, given the longer distances, making the enforcement of GDL perhaps more dependent more upon parental involvement than city and state highway patrols. More work is needed to understand the unique traffic safety issues facing teens and driving in rural areas and effective policies to address them.

Given the consistent and large results for earlier nighttime curfews, all states should consider setting curfews at a minimum of 10pm or not even earlier for teen drivers in the first year of driving. Passenger restrictions of one or no passengers are also highly effective in reducing crashes caused by teen driving errors, consistent with research that has found that young passengers are a source of multiple distractions and incite riskier driving behavior. The duration of this phase is also effective, with longer durations leading to more lives saved. States that have not adopted such policies should consider adopting one or no passenger limits for the first year of driving as part of their GDL systems. More research is needed to determine whether zero passenger restrictions would be more effective than allowing one passenger. Some research has suggested that teens driving alone may be more likely to text while driving so it is not clear in this case that no passengers would be better than one. Sample sizes using quarterly-county level data were not large enough to distinguish between these two policy levels. Aggregating data to *annual* counts in future work may allow for more precise estimates of more finely delineated passenger limits. Given that supervised driving hours were effective for reducing daytime fatal teen crashes, this policy should be continued and adopted in states that don not yet require it. Moreover, the holding period seems to remain important for nighttime fatal crash reduction even when accounting for the effect of reduced licensure.

Chapter 2: Lobbying by Transportation Agencies in the San Francisco Bay Area*

2.1 Introduction

Government transportation agencies spend substantial sums of money attempting to influence state and federal legislation ($2.7 million in 2001 in California alone), through their own legislative staff, and the efforts of appointed officials and hired lobbyists. Lobbying as a broad topic has been studied in some detail (Olson, 1965; Banks, 1977, Salisbury, 1988, Hamm, 1988, Richards, 1991, Hayes, 1981, Kingdon, 1995, Walker, 1991) however, almost none of the literature to date has examined how *government* institutions use their funding and political influence in lobbying efforts. This study examines how four San Francisco Bay Area agencies use their legislative staff and resources to lobby on metropolitan surface transportation issues. Why do some issues make it onto the legislative agenda while others do not? To what extent does transportation agency lobbying have influence on legislation and funding allocations? By looking at what topics agencies choose to lobby on (as well as what topics they do *not* lobby) we can get a picture of how transportation agencies help to create the transportation agendas on which they subsequently work, and how biases in these agendas are mobilized.

The agencies selected include the Metropolitan Transportation Commission (MTC), a regional metropolitan transportation planning organization, with responsibilities for the planning and finance of streets and highways as well as transit in the nine county region; the Bay Area Rapid Transit District (BART), the major sub-regional rail transit agency; Alameda-Contra Costa Transit (AC Transit), a large sub-regional bus agency; and the Santa Clara Valley Transit Authority (VTA), and a large sub-regional rail and bus agency, respectively. Collectively, these four agencies account for approximately 80 percent of the total spending on lobbying activities by San Francisco Bay Area transportation agencies (roughly $695,000 in 2001/2002). They are also the four largest transportation agencies of the region, with 2001/02 operating budgets totaling $876 million (or 70 percent of the total regional operating budget).

The methods used for this study draw on draw on government reports filed by the agencies, in-house agency legislative agenda records, and interviews with legislative and agency staff. Descriptive statistics and a probit analysis of lobbying data are presented. The analysis compares the substance of each agency's lobbying activities to the set of pressing transportation issues, opportunities, threats, and needs the agencies themselves have identified in their planning documents, and the set of transportation issues and needs identified by other key stakeholders from the region, including business groups, social justice advocates, and environmentalists. These analyses seek to identify the issues and determinants of agency agenda setting and to explore in greater depth both what is emphasized and what is omitted.

2.2 Background

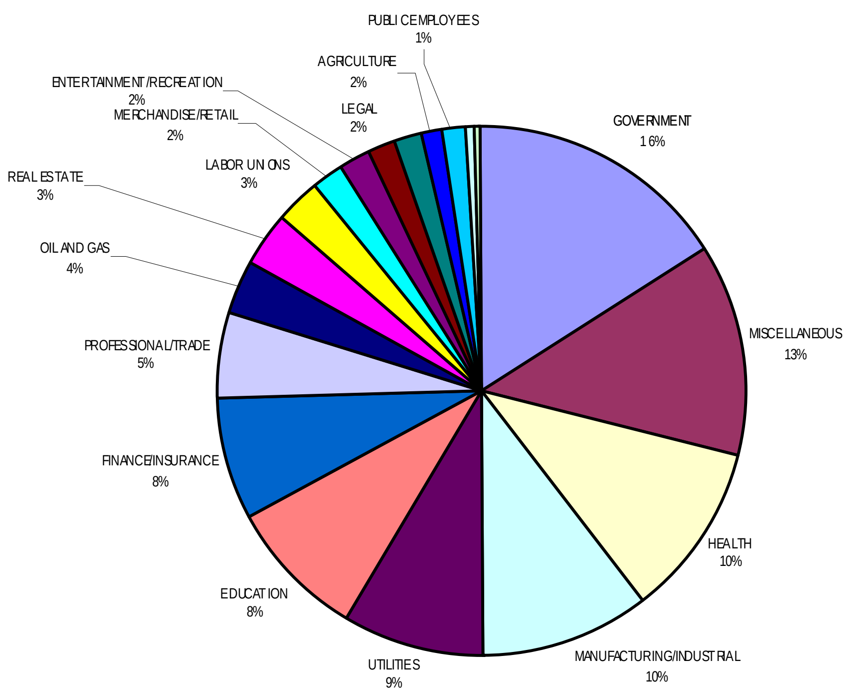
State and local government agencies lobby upper levels of government to protect program funds, to secure additional funding, to gain authority to raise fees or taxes, or to influence legislative outcomes. More than 200 local governments, including counties, cities, and special districts, employ

* This research was conducted and written under the direction of Professor Elizabeth Deakin.

lobbyists, either as full-time employees or under contract (Cal Tax News, 1994) in California. Local governments are required to report lobbying activities if they hire a lobbyist and if more than 10 percent of their expenditures are used to influence legislation or administrative action. California state departments, which are not required to report expenses, also lobby Congress. Among all employers of lobbyists, local government has the largest payroll, with cities counties and special districts, combined, accounting for $16.3 million, or 16 percent of total spending on lobbying at the state level in 1999/2000 and reached $36 million in 2005/06, exceeding expenditures by the oil and gas industry (Figure 2-1) (California Secretary of State)[32].

The transportation sector is a major component of the U.S. economy, receiving approximately $45 billion per year in federal funding. Transportation agencies in the Bay Area engage in a variety of activities to influence legislative processes and outcomes. Agencies have legislative programs developed by staff outline the agencies' legislative goals and objectives guiding the positions they take on bills during each legislative session. According to interviewees, agency staff meets with program heads and the board of directors to develop their legislative positions. Out of these meetings, staff writes recommendations to the board on positions for particular bills, which the board then votes on whether to adopt those positions. In addition, each of the agencies studied regularly hires private lobbyists on retainer and has internal staff that works to promote their agenda.

Figure 2-1. Percent of Total Lobbying Expenditures by Sector in 2001/2002



[32] Total lobbying expenditures were $ $102,994,565.16 in 1999/2000 . Oil and Gas lobbying expenditures were $4,754,566.18 in 1999/2000.

2.2.1 Transportation Agency Lobbying Expenditures

Among transportation planning and transit agencies in the state of California, lobbying expenditures varied widely.[33] Smaller agencies typically reported no expenditures while in contrast, the Los Angeles Metropolitan Transportation Authority (LAMTA), the largest spender, spent $695,000 (25 percent of the state total) in 2001/02.[34]

Transportation agencies in the San Francisco Bay Area spent roughly $1.2 million per year in lobbying state government, representing roughly 42% of the state transportation agency lobbying expenditures (Office of the California Secretary of State, 2001/02). Agencies included in this study are the Metropolitan Transportation Commission (MTC), the Bay Area Rapid Transit District (BART), the Alameda-Contra Costa Transit (AC Transit), and the Santa Clara Valley Transit Authority (VTA). These agencies selected[35] were the four biggest spenders in the region and account for roughly 60 percent of the region's governmental transportation lobbying expenditures in the fiscal year 2001/2002).

2.2.2 Interest Groups and Stakeholders

The San Francisco Bay Area has nine counties, and 102 cites, each of which have traditionally vied with each other for economic development and transportation funds. In addition, the area has more than two dozen transit agencies and congestion management agencies, and numerous transit operators and transportation planning agencies serving the region.

The Metropolitan Transportation Commission (MTC) is a regional transportation planning body created in 1970 as a means to address the many policy and planning dilemmas posed by the fragmentation of funding streams and institutional structures for transportation throughout the Bay Area. The BART district operates commuter rail system in the three central Bay Area counties of the region (Alameda, Contra Costa, and San Francisco) serving more affluent white-collar commuters. The BART board is governed by nine publicly elected members each representing approximately 350,000 residents for four-year terms. VTA is a multi-modal planning and operating agency, operating light-rail, and bus systems, as well as the congestion management agency for the region. They prioritize projects for funding, develop the County-Wide Transportation Plan, and also implement local projects such as building highways. Their scope expands beyond that of MTC's in that they serve as an operating and congestion management agency, build projects, and can put ballot measures and run programs (personal interview, October 26, 2005). AC Transit is a local bus operator in the East Bay of Alameda and Contra Costa County which encompass the cities of Oakland and Berkeley serving many lower income populations. Like BART, it has an elected board. Two major interest groups in S.F. Bay Area transportation poli cy include the Transportation and Land Use Coalition (TALC)36 and the Bay Area Council,37 representing social justice and business interests, respectively.

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[33] Lobbying expenditures include expenditures for the purpose of attempting to influence state administrative actions. Government agencies are required to report in house administrative expenditures related to lobbying if they exceed $5000 per quarter.

[34] Lobbying by public transportation agencies is included within government expenditures, while expenditures by the Transportation sector constitute that by *privat*e transportation companies and associations and are not included in this study.

[35] The Metropolitan Transportation Commission (MTC), the Bay Area Rapid Transit District (BART), the Alameda-Contra Costa Transit (AC Transit), and the Santa Clara Valley Transit Authority (VTA).

[36] " TALC is a partnership of over 90 groups working for a sustainable and socially just Bay Area. We envision a region with healthy, vibrant, walkable communities that provide all residents with transportation choices and affordable housing. TALC analyzes county and regional policies, works with community groups to develop alternatives, and coordinates grassroots campaigns." Quoted directly from website: http://www.transcoalition.org/about.html, March 28, 2005.

Table 2-1. Reported Lobbying Expenditures of California Local and Regional Transportation Planning and Transit Agencies

Agency	2001/2002 ($)	Percent
Los Angeles County Metropolitan Transportation Authority	$695,000	25%
Orange County Transportation Authority	231,000	8%
Bay Area Rapid Transit District (Bart)	207,000	7%
Metropolitan Transportation Commission	177,000	6%
Santa Clara Valley Transportation Authority	167,000	6%
Southern California Association Of Governments	158,000	6%
Alameda-Contra Costa Transit District	144,000	5%
Riverside County Transportation Commission	108,000	4%
Alameda County Transportation Authority	97,000	3%
Sacramento Area Council Of Governments	95,000	3%
Alameda County Congestion Management Agency	77,000	3%
California Association Of Joint Powers Authorities	75,000	3%
Alameda Corridor Transportation Authority	75,000	3%
Transportation Agency For Monterey County	73,000	3%
San Diego Metropolitan Transit Development Board	67,000	2%
San Mateo County Transit District	62,000	2%
Solano Transportation Authority	53,000	2%
North San Diego County Transit Development Board	49,000	2%
Santa Cruz Metropolitan Transit District	48,000	2%
San Francisco County Transportation Authority	41,000	1%
Santa Cruz County Regional Transportation Commission	40,000	1%
Amador County Transportation Commission	29,000	1%
Butte County Association Of Governments	18,000	1%
State Total	$2,780,382	100%
Mean	$120,886	
Standard Deviation	$138,193	

Source: Office of the California Secretary of State (www.ss.ca.gov).

Table 2-2. Transportation Agency Lobbying Expenditures by Region

Region	2001/2002 ($)	Percent of Spending
Central Inland and Central Coast	$161,000	6%
Northern California	$142,000	5%
SF Bay Area	$1,175,000	42%
Southern California	$1,308,000	47%
California Total	$2,786,000	100%

Source: Office of the California Secretary of State (www.ss.ca.gov)

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[37] "The Bay Area Council is a business-sponsored, public-policy advocacy organization for the nine-county Bay Area." Quote from website: http://www.bayareacouncil.org/site/pp.asp?c=dkLRK7MMIqG&b=240320, accessed March 29, 2005.

Table 2-3. San Francisco Bay Area Transportation and Transit Agencies Lobbying Expenditures

TRANSPORTATION PLANNING OR TRANSIT AGENCY	2001/2002 ($)	Lobbying Expenditures % of Regional Total	Operating expenses ($)	Regional Total %	Lobbying Expenditures as Percent of Agency Budget
Bay Area Rapid Transit District	207,000	18%	334,084,000	27%	0.06%
Metropolitan Transportation Commission	177,000	15%	46,334,000	4%	0.38%
Santa Clara Valley Transportation Authority	167,000	14%	282,344,000	23%	0.06%
Alameda-Contra Costa Transit District	144,000	12%	214,122,000	17%	0.07%
Alameda County Transportation Improvement Authority	97,000	8%	12,767,000	1%	0.76%
Alameda County Congestion Management Agency	77,000	7%	11,932,000	1%	0.65%
California Association Of Joint Powers Authorities	75,000	6%	64,946,000	5%	0.12%
Alameda Corridor Transportation Authority	75,000	6%	80,900,000	6%	0.09%
San Mateo County Transit District	62,000	5%	107,156,000	9%	0.06%
Solano Transportation Authority	53,000	5%		0%	
San Francisco County Transportation Authority	41,000	3%	10,552,000	1%	0.39%
Golden Gate Bridge, Highway & Transportation District	$0	0%	74,228,000	6%	-
Vallejo Municipal Transit Services	$0	0%	13,967,000	1%	-
	$1,175,000	100%	$1,253,332,000	100%	0.09%

Source: Office of the California Secretary of State (www.ss.ca.gov).

Since BART came on line in the early seventies political tensions have existed between BART and surrounding transit agencies, in particular AC Transit. For example, when BART began service, they requested that AC Transit provide feeder service, however funds for operating costs were not provided by BART at this time. In addition, since BART provides free parking these feeder services were predicted to be lightly utilized making them cost-inefficient for the bus agency (Zwerling, 1974), exasperating tensions between the agencies.

State and federal law has since significantly expanded the role of Metropolitan Planning Organizations (MPO's) such as MTC, giving MPO's the authority to program some portion of federal funds and leading to more meaningful project lists with dedicated funding and forcing agencies to confront trade-offs between various projects. However, a lack of regional constituency has made regional planning difficult. (Jones, 1976). Commission members are appointed by cities and counties and have more incentive to represent the interests of their local jurisdictions than those of the region. The region is further divided by the presence of three competing downtown centers, San Francisco, Oakland and San Jose, and an urban-suburban political split, making regional transportation coordination even more difficult.

In its plans, MTC addresses a wide, all-encompassing set of issues, identifying both maximizing system efficiency and strategically increasing system capacity as two major goals. Issues identified in its 2030 Plan include 1) reducing highway congestion, 2) expanding transit systems (rail and bus), 3) promoting smart growth development[38] at transit hubs, 4) expanding mobility for elderly, disabled and low-income residents, 5) improving and bicycle and pedestrian facilities, and 6) finding new sources of flexible revenue. However, it has been criticized for advocating most heavily for capital intensive projects that have broad based political clout instead of projects that meet rational criteria such as cost-effectiveness and those that would improve services or increase affordability for transit dependent and lower-income riders. For example, MTC, has vigorously promoted rail projects such as the BART extension to the SFO airport, asking federal legislators for reimbursement for this project along with asking for funding for the BART to San Jose project which will serve primarily upper income riders. Moreover, in their 2004 annual lobbying report, expensive and cost-ineffective rail projects, such as BART extensions and 3rd street rail were listed prominently with requests for large sums of money relative to bus projects. Recently, several social justice groups, including the Transportation and Land Use Coalition, Urban Habitat, and Communities for a Better Environment, have filed a Civil Rights law suit charging discrimination on the basis of both intent and outcome (S.F. Chronicle, April 20, 2005).

TALC and the Bay Area Council represent tend to represent opposite views on issues of transportation resource distribution. TALC has emphasized improving bus services, in particular those for low-income and disabled groups, safety for pedestrians and bicyclists, smart growth, safer transportation for children, and reducing costs for low-income populations. In contrast, the Bay Area Council's agenda is based upon three principles: 1) maintaining and using the current system more efficiently, 2) making strategic investments to new capacity (those with the highest return), and 3) minimizing impacts of transportation improvements on the environment. Specific proposals emphasize highway capacity increases at bottlenecks, increasing and linking HOV lanes, congestion pricing, increasing rail investments at key locations expansion of ferry services, increasing express

[38] Smart Growth development includes increasing mixed use development, multi-family housing, and density around transit corridors and hubs (Transit Oriented Development (TOD)), obtaining a better balance between jobs and housing over geographic areas, and in general finding alternatives sprawling, suburban development that is thought to increase auto-dependency and better coordinate land use and transportation planning.

bus service in commute corridors, finding new sources of funding, and authorizing private-public partnerships.

Many groups have charged that transportation funding mechanisms in the Bay Area tend to favor capital intensive systems that tend to serve primarily upper income commuters. With increasing attention to environmental issues there has been a concomitant increase in the proportion of total funding going to transit in comparison to highways in major urban areas. However, the focus of transit investment has been overwhelmingly on traffic congestion relief and enticing higher-income commuters, who commute long distances from suburbs to downtown centers, out of their cars (TCF, 2000). Consequently, transit investments have tended to favor capital intensive rail projects that serve a greater proportion of upper income commuters. Low-income and minority populations tend to live in the inner cities, have lower rates of car ownership and rely more heavily on transit for their mobility. Moreover, travel patterns of low-income riders, characterized by shorter trips, reverse commuting, and a greater proportion of transit usage for non-work trips such as shopping, daycare and medical purposes, are not well served by rail systems and commuter express buses running in radial suburb-to-urban patterns.

Data from the National Transit Data Base in fact shows that the highest total subsidy in the Bay Area goes to Caltrain, which received a *total* of $19 per unlinked passenger trip in 2003/04,[39] almost four times the average in the region, of which $13 was for capital costs alone (NTD, 2002). Yet Caltrain carries only 2 percent of total annual transit riders in the Bay Area. Conversely, while approximately 79 percent[40] of AC Transit riders are members of minority groups, it received just $3.00 in operating and capital subsidies per passenger in the 2003/04FY. Rail and suburban bus systems tend to be less cost effective relative to inner city buses. For example, the cost per passenger trip for Caltrain and BART were $22 and $10 per passenger trip in 2003/04, respectively, while that for AC Transit was $3.79 in the same fiscal year, and Golden Gate Transit, carrying just 3 percent of all transit trips in the region, cost $6.91 in operating expenses per passenger trip, respectively. This chapter presents an analysis of 1) what issues transportation agencies have in fact lobbied for or against, 2) the differences in lobbying agendas between agencies, 3) where coalitions are formed or conflicts arise around certain issues, and 4) whether agencies seem to be effective in influencing legislation.

2.3 Literature Review

Government agencies lobbying upper levels of government is a controversial issue. Some analysts, and in particular, government officials, view government lobbying as a legitimate method to convey important information about the needs of cities, counties and universities to higher levels of government (Richards, 1991). Proponents argue that the complexity of issues calls for the use of specialists who can gather, synthesize, and convey information about complex issues and serve as necessary liaisons between state and local government. Local governments, in fact, tend to hire lobbyists in greater numbers as the issues they face and messages they need to convey become increasingly complex. Moreover, lobbyists have often been successful in obtaining extra budget line items in a time of uncertainty over budget allocations. Government officials in favor of lobbying contend that if lobbyists weren't hired, staff would need to be assigned to serve as a liaison between local government entity and the state to track of bills and budget interests. They argue that a professional lobbyist is more efficient and effective per dollar spent than in-house staff, since lobbyist spend more time in the capital and are more familiar with current bills and legislators, and

[39] Capital and operating subsidies combined
[40] "Getting on the Bus is Half the Story, SF Chronicle, April 20, 2005.

that since large sums of money are spent on the behalf of private interests, a lobby is needed to counterbalance this influence on the behalf of public needs such as education, parks and the environment.

Richards (1991) notes, however, that others see government lobbying government as presenting an inherent conflict of interest. According to this view, it is strictly the role of the citizenry to convey opinions and preferences on how tax money should be spent. Yet, public agencies are using taxpayer monies to push lobbying agendas that are not subject to public approval or vote. So, while on the one hand government lobbying can be viewed as a means of conveying and gathering key information between different levels of government, it is also seen as posing possible conflicts of interest. In fact, since lobbying is not subject to the usual public review procedures, it is unclear what measures of accountability are in place to ensure that what local governments lobby on accurately represents the interest of the public.

Salisbury (1984) hypothesized that institutions have come to dominate the political processes and interest representation in comparison to membership based interest groups. Institutions can include state, local, governments, universities, think tanks, and most other institutions of the private sector. In comparison to interest groups, institutions have a wider array of policy interests, and have more resources, and are therefore more likely to participate in a given policy area. Interest groups derive much of their political power from representing the interests of their members. However, institutional lobbying agendas are more likely to be based upon the judgments of the institute's leaders as to what policies will foster the needs of the organization. However, unlike private institutions, government institutions might have fewer resources for lobbying and may derive more political influence if they claim to represent their consumers (the populations that they serve) relative to corporate ones. Therefore, while they may be more dominant in the political process than membership based interests groups, they may be less so than private institutions.

Abney (1988) compared private and public sector lobbying through the use of in-depth interviews with officials in 13 major state agencies and a mail survey of legislators in Georgia.[41] Both legislators and agency officials reported that state agencies were important in providing information to legislators.[42] Since public agencies have more staff and are in more contact with constituents they are viewed as more knowledgeable about the potential impacts and views of proposed policies on constituents. Agencies and legislators both perceived this role as giving public agencies a strong influence in the legislative process. In fact, many interactions between legislators and public agency lobbyists are initiated by legislators, as legislators often viewed information from agencies as helpful to their legislative positions. Agency lobbyists reported that the legislature views them as more legitimate because they don't question their motive as much as they would private sector lobbyists. Subsequently, public sector lobbyists court legislators less often than private ones do, reporting that they don't feel a need to take legislators out to expensive lunches or dinners.

Public agencies are viewed by both private and public sector lobbyists and legislators as more influential, on average, than private ones (Abney, 1988). In particular, agencies that are able to offer the most to legislators in terms of resources and discretion are more forceful in their lobbying and have the most influence. For example, the department of transportation is viewed as having most influence because it can earmark funds and legislators can get credit for the allocation. In turn, legislators reported liking to be able to say they were asked to sponsor a bill by a state agency. This in turn, presumably gives agencies more influence in the details of proposed legislation. However,

41 39% of the 236 legislators responded.
42 The legislature is in session only 40 days a year and has less staff than public institutions.

the perception of the agency head, management effectiveness, and the accuracy and trustworthiness of information is important to the degree of agency influence. Agencies tend to have more information on the cost of proposed legislation and can use this to oppose bills. Public lobbyists like private sector lobbyists watch for harmful bills such as those that limit their discretion, reduce their budget, or burden employees of their agency. Agencies reported that their opposition to a bill could be damaging. However, legislators didn't agree as strongly with this perception (with only 30 percent agreeing).

Not surprisingly agencies reported forming alliances and favorable ties with governors and legislators as important to their influence (Abney, 1988). To this end, agencies work to influence committee appointments, appoint legislators to their advisory boards, and seek support of legislators in their districts on issues affecting their joint constituencies. Agency administrators seeking security and budgetary growth have been found to be sensitive to the needs of legislators. That is, some empirical studies have shown that allocation decisions of agency bureaucrats tend to reflect congressmen's preferences (Hamm, 1983). Staff agencies also tend to form alliances with line agencies. Line agencies are clients of staff agencies (Abney, 1988). Both can be mutually dependent, since policies that affect staff agencies also often affect line agencies. Agencies also serve as mediators among various interest groups. In this respect, they work to garner the support and cooperation of interest groups in their legislative agendas through the use of advisory groups.

2.3.1 Exchange Theories of Political Markets

Building upon exchange theory of interest groups developed by Salisbury (1969) and Theodore Lowi, Hayes (1981) develops an exchange theory of political markets in which views legislative actions as goods demanded by interest groups and constituents and supplied by legislators. Within this framework, he argues that legislation rarely resolves policy issues but rather sets the ground rules under which congress members continue to struggle over them. He proposes a typology legislative supply and demand patterns in which interest groups have influence. Under this typology, the demand for legislation action depends upon the stakeholders in a given issue, who is affected and in what ways. Interest groups on all sides will not necessarily be active on an issue at any given time (Hayes, 1981, Wilson, 1973). The extent and nature of organizational activity is a function of perceived incidents and distribution of benefits and costs. When benefits are concentrated, they are more likely to affect small groups that can easily overcome the free rider problem, making action more likely. Conversely, when costs of a proposed policy are widely distributed among a given population, opposition is less likely. Therefore, widely distributed benefits or costs will be less likely to generate organizational activity, or interests from political parties. Groups seeking to block reforms are more likely to take action, than groups seeking to make change. Low income groups are very difficult to organize as well as previously excluded groups because of a lack of sense of political efficacy needed to sustain participation. Usually these organizations are represented by staff in agency organizations.

Hayes (1981) argues that unorganized groups have little impact on legislators while organized groups serve as proxies for the interests of their constituents. The larger the interest group the greater the constituency base and potential influence with congress members but the greater the free rider problem. Small groups have less of a free rider problem,[43] but less persuasiveness in congress because they usually represent fewer constituents. When "groups are active on both sides they tend to cancel each other out, leaving legislators free to vote as they please." In addition, coalitions facing

[43] The free rider problem is a market failure in political markets occurring when each member of a group benefits from the efforts of other group members regardless of whether they participate, therefore creating a disincentive for each member to contribute.

strong opposition may be less effective than a loosely organized one with little or no opposition. "Privileged groups," have the most power in that they have a concentrated core with strong interests enabling them to overcome the free rider problem as well as several loosely associated industries distributed throughout congressional districts that form a wide base of political support.

2.3.2 Supply of Legislation

Hayes (1981) posits an interdependence between legislators and lobbyists in which both survive by appearing to deliver benefits to their constituencies. Both interest group leaders and congress members represent constituents and share the need for credit claiming, the generation of particularized benefits, and visible position taking. Therefore, the reelection seeking congress person will respond interest groups. However, policy makers do not necessarily act to maximize public benefits but also act in self-interest (Hayes, 1981). Congress members may act in ways to minimize conflict between members because they share a common goal of reelection, which to some extent they are working together to achieve. They gain considerable latitude by fostering mutually beneficial exchanges in consensual arenas and taking advantage of imperfect information and complexity to avoid difficult policy choices in highly conflicted policy arenas.

Hayes (1981) categorizes legislative supply patterns into three types of outcomes: 1) passing no bill 2) policy without law (including delegation or passing an ambiguous or discretionary bill), 3) regulatory rule of law (including distributive and redistributive legislation). The result of no regulation passed does not necessarily mean that no change occurs. Inaction may often in fact give more power to private interest groups to make the rules, with the specifics of policy discretion left to the agency that is delegated authority. Accordingly, entrenched elites often work to suppress conflict and limit the agenda to safe issues. Hayes (1981) identifies two distinctive arenas of non-decision, those arising from community values and those within institutional processes. Community values refers to the apparent consensus on an issue among affected parties. Institutional in action occurs when the raising of an issue in the form of proposed legislation is blocked at one of several stages by strong lobbying by opponents. This is referred to as institutional inaction because the structure of the legislative process requires a bill to pass through multiple points of potential veto as it moves through congress.

Regulatory legislation can be either highly structured, with specific laws, or open ended with much discretion left to interest groups and bureaucratic agencies. In the regulatory arena, groups usually face stiff opposition from threatened interests. As a result, these policies are also often delegated to the bureaucratic and administrative spheres. Delegation allows legislators to avoid hard choices under public scrutiny. It can obfuscate the decision- making processes and sometimes gives interest groups more power in the administrative and bureaucratic arenas and makes losers unaware of potential losses. Within regulatory legislation, distributive policies transfer resources, usually through the exclusion of losers from the process, and by logrolling, that creates an atmosphere of consensus. Disadvantaged groups are even more disadvantaged since they lack legitimacy, resources, and ties to key committee chairs. Established groups conversely, have a strong defensive advantage. Policies that aim to redistribute income are typically intensely conflictual. Therefore, legislation often results in the delegation of regulation to the bureaucratic and administrative sphere where policy formulation tends to be ambiguous and indirect and the potential losers will be less aware of the stakes. Thus, redistribution tends towards the upper income levels and the reinforcement of existing inequities.

Finally, Hayes (1981) notes several limits on innovative policies that may redistribute resources more equitably. First, established groups seek to suppress conflict and attention to redistributive issues. Additionally, lower income groups are forced to frame redistributive issues broadly, leading to ambiguous legislation, and policy without law often results in symbolic reassurances, cooptation and regulation of the issue to the regulatory arena indefinitely. However, organized groups may possibly be successful where they are successful in discrediting established groups. These groups may change the demand pattern by exposing sub governments that are co-opted.

2.4 Data and Methodology

The research methods for this study include: 1) coding and augmenting of lobbying data supplied by agencies, 2) descriptive analysis, 3) a probit analyses predicting the determinants of an issue being supported by an agency and efficacy of that support, and 4) interviews with legislative staff.

2.4.1 Coding and Augmenting Data

Most major agencies in the Bay Area keep records of bills they tracked, along with bill summaries, date of introduction, bill author and status, and positions taken on those bills. Using these legislative histories provided by the agencies, bills tracked by the agencies in both the state and federal legislatures (297 bills in total) for the period 2001-2004, were categorized into eleven types based upon legislative issues identified in MTC's Regional Transportation Plan and by Bay Area stakeholders including:

1. Bicycles & Pedestrians
2. Environment
3. Special-User Groups (Elderly, Disabled, Low-income)
4. Freight
5. Hwys & Roads
6. Infrastructure
7. Public Transit (rail and bus)
8. Regional Planning
9. Safety (traffic & anti-terrorism)
10. Smart Growth
11. Finance

Additionally, fifteen bills that addressed access and mobility for either low-income or disabled and elderly, ten of which addressed or were related to low-income populations were identified. Bills were also categorized into six legislative types that describe the type of legislation proposed, irrespective of subject area. These legislative type categories describe the type of method in which a bill would achieve its objectives and include:

1. Delegation/planning/study
2. Funding increase/allocation/distribution
3. Funding redistribution/capture
4. Funding loss
5. Regulatory
6. Market Measures and Other

Delegation/planning/study bills include bills that are those proposing changes in program administration or the governance structure of an agency responsible for transportation policy create new programs or funding, devolve authority to an agency, or require plans or studies. Funding increase/allocation/distribution bills are those that increase or allocate funding by creating a new tax or fee earmarked for transportation purposes. Funding redistribution bills propose to capture funding previously allocated to another purpose or transportation mode. In some cases the funding change represented a funding loss, such as when the elimination or reduction of a tax earmarked for transportation was proposed and these bills were coded as Funding losses. Funding bills often coincided with the transportation finance category discussed above, as many funding type bills were not specific to a single mode but addressed multiple modes and/or taxes used for several transportation purposes. Regulatory bills propose changes in regulation or rules affecting transportation such as new emission standards on automobiles. The market measures/other category includes bills that attempt to achieve transportation policy goals through use of fees and incentives or by increasing competition Finally, the data was augmented with information on the political affiliation and position (e.g. majority leader or transportation committee head) of the bill authors, and whether or not the bill passed.

2.4.2 Descriptive and Probit Analyses

Using this data, descriptive analyses as well as two sets of probit estimates were conducted. The first probit analysis estimates the probability that a bill will pass given the support of an agency and attempts to identify the influence of the agency's lobbying on a bills passage. Issues identified by interests groups and in MTC's RTP were identified in the sample of bills. In addition to issue areas, both sets of estimates include political variables such as such as whether the author was a transportation committee member, committee chair or a majority leader, the authors' political affiliation, the type of bill (Administrative, Funding, Planning, Market Based, Study, with Other as the omitted category),[44] and year dummies to control for differences across time in legislative issues:

(1) Prob (Agency Support) = f(**C,T,P,Y**), for each agency

The second probit analysis estimates the probability that an agency will support a bill conditional on the issue, type of bill, and political factors associated with that bill:

(2) Prob (Bill Passing) = f (S,**C**,**T**,**P**,**Y**),

where S is agency support, **C** is a vector of issue categories, **T**, is a vector of legislative types, **P**, is a set of political variables and **Y** are year dummies (Table 2-4). Dummy variables for key issues in MTC's 2030 RTP and those identified by bay stakeholders were created. Whether the bill seemed to favor or harm an issue was included as a control variable. Dummy variables equal one for issues where the legislation appeared to be essentially pro or at least not on the surface, anti a particular issue it addressed. For example, if a bill proposed to reallocate money previously allocated to bicycle facilities to another use unrelated to bikes it would be coded as zero under bikes/pedestrians.

Since this data set is not a random sample of bills introduced in the legislature (within the research scope), but a set of bills selected by the agencies, a test for possible selection bias was conducted. For example, the probit estimate identifies issues that MTC is more likely to lobby in support of out of the set of bills that they have already selected to track, that is, those that coincide

44 Some bills which were introduced in 2004 are still active and where left out of this analysis since it is not known whether they will pass or not yet.

with their particular agenda. The research scope includes those issues that are relevant to transportation issues in the Bay Area region, including land use and environmental and economic development issues connected to transportation as well as, in the case of MTC, transportation issues affecting inter-regional transportation within the state that would affect the Bay Area**.**

Table 2-4. Variable Definitions

Vectors	Description	Variables (all in binary 0/1 format)
S	Agency Support:	MTC Support, AC Transit Support, BART Support, VTA Support
C	Issue:	Bicycles & Pedestrians, Environment, Equity (Low-income) Freight Hwys & Roads Infrastructure Public Transit (rail and bus) Regional Planning Safety (traffic & anti-terrorism) Smart Growth Finance
T	Legislative Types	Regulatory, Funding
P	Political Power	Transportation Committee Member, Transportation Committee Chair, Majority Leader
Y	Year	2002, 2003, 2004 (2001 omitted)

MTC searches for relevant bills using the Statenet service using the following search terms: "transportation", "gasoline", "diesel fuel", "aviation fuel", "land use", "planning and zoning", "redevelopment and urban renewal". The composition of bills that are introduced at the State level related to the research scope of this study,[45] compared to those tracked by MTC in 2005 (using a random sample of 30 bills related to topics searched under by MTC using a service called Statenet) are closely similar (Table 2-5). In comparison to this sample, the topics most frequently tracked by MTC parallel those in this research scope. That is, MTC's legislative history has a higher representation of 1) smart growth, 2) public transit, 3) transportation finance, 4) highway and road, and 5) freight related bills, and a lower representation of bills related to 1) vehicle consumer affairs, 2) vehicle emissions related bills, 2) miscellaneous traffic violations, and 3) land use planning, redevelopment and housing bills not connected to transportation planning (Table 2-6). Based on

45 Under the topics of land use planning, fuels and transportation, key terms searched under by MTC.

this comparison, the set of bills tracked by MTC should not present any significant biases in the analysis.[46] The remaining sets of agency legislative history analyzed were a subset of MTC´s.

Table 2-5. Random Sample of State Bills from Statenet (n=30)

Bill Category	Freq	Percent
Environment	7	23%
Land Use Planning	6	20%
Hwys & Roads	3	10%
Safety	3	10%
Transportation Finance	3	10%
Housing	2	7%
Architectural/Engineering Services	1	3%
Labor	1	3%
Public Transit	1	3%
Redevelopment	1	3%
Transportation Planning	1	3%
Vehicle Consumer Affairs	1	3%
Total	**30**	**100%**

Table 2-6. MTC Legislative History: State Bills

Bill Category	Freq	Percent
Smart Growth, TOD & Transportation-Land	19	25%
Hwys & Rds	12	16%
Transportation Finance	11	15%
Safety	8	11%
Public Transit	6	8%
Architectural/Engineering	5	7%
Environment	4	5%
Freight	3	4%
Equity-User Groups	2	3%
Statewide Transportation	2	3%
Air Transportation	1	1%
Bikes/Peds	1	1%
Transportation Planning	1	1%
Total	**75**	**100%**

A limitation with the second set of probit analyses (estimates of the probability that a bill will pass given support by any or several agencies) is that support of a bill may be endogenous in that agencies may decide to support bills that they perceive as having a higher chance of passing.

That is, agencies may gauge their political influence on any particular bill and decide to expend their energy on bills that they have a better chance of influencing or those they have sponsored

46 For example, if there were several bills within the research scope presented to the legislature that were not tracked by MTC, the analysis of which bills were supported in relation to the total number of bills in the data set (those tracked by MTC) could be biased upwards.

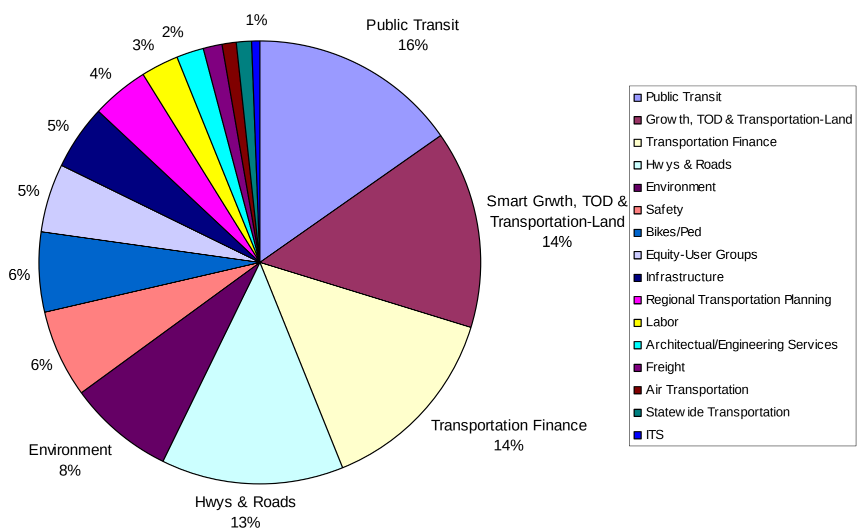
rather than expend their resources on bills with little chance of passing. Therefore, a significant finding of MTC support may indicate that MTC chooses bills that it has greater opportunity to influence within its interest areas, rather than that any bill it lobbies on has a better chance of passing, or a combination of these two effects. The amount agencies spend lobbying on each bill and the relative degree of effort they spend lobbying on each topic is unknown.

Finally, staff and board members at each of the agencies were interviewed to learn more about how they choose the issues they lobby on strategies they use and issues that had been important to them in the past four to five years. Agency staff was asked to discuss issues had been most important to their agendas in the past four to five years and was also asked about issues of operating funds for transit and improvements in transportation aimed at low-income populations, two issues which have been recently particularly controversial in the Bay Area.

2.5 Results

The agencies in this study track bills and send legislative affairs staff or contracted lobbyists to meet with congress members in Sacramento and Washington D.C. to attempt influence legislation outcomes within their agenda. Of the total surface transportation and land use planning related bills introduced each year, the agencies tracked only 5-10%.[47]

Figure 2-2. Legislative Issues Tracked by Major SF Bay Area Transportation Agencies: MTC, VTA, BART, AC Transit



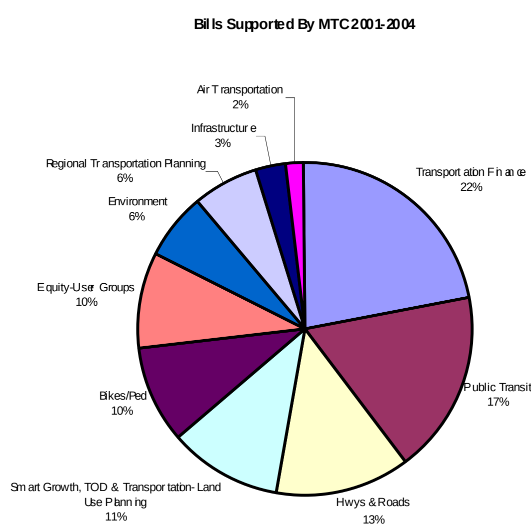
47 MTC is at the upper end and BART at the lower end of this range.

Over half of the bills tracked fell under four subject areas, including:

1. Public transit (15%),
2. Smart growth or transit oriented development (TOD) (14%),
3. Transportation finance[48] (14%), and
4. Highways and roads (13%),

MTC and VTA were significantly more active than the other two agencies in lobbying for bills, supporting 24 percent and 20 percent of the 297 bills tracked by agencies while AC Transit supported only 10 percent of the bills and BART supported just 7 percent over the period (2001-2004).[49] When taking a position on a bill, all of the agencies tended to support rather than oppose bills and were very selective in the bills they opposed, with only a handful of bills opposed by MTC, AC Transit and VTA, and BART having no record of oppositions. With limited resources, the agencies seem to be careful in choosing which bills to support and oppose, limiting support to bills that may have a reasonable chance of passing and opposition to only high stake bills that also have a chance of passing.

Figure 2-3. Bills Supported By MTC 2001-2004



In interviews, agency staff reported that they tend to look at the stakeholders in a given issue, including the local dynamics of the agency boards and the cities and counties, to gauge whether is the bill consistent or at odds with the board's and cities' positions. They tend to engage in full-fledge lobbying only on bills of significant interest that will not bring them in direct conflict with

48 For general transportation or multi-modal bills.
49 For AC Transit we only have two years of data (2003-2004).

stakeholders who are significant political allies. They sometimes also support bills at the request of another agency even if it was of lower interest, to build political capital, however the level of legislative activity may be significantly lower. On bills they opposed, they reported a strategy in which they first quietly discuss concerns with the bill sponsor and see if amendments can be made. They reported openly opposing bills in cases where would be no significant negative political repercussions or where a bill would have considerable negative impact on the agency.

Figure 2-4. Bills Supported AC Transit 2001-2004

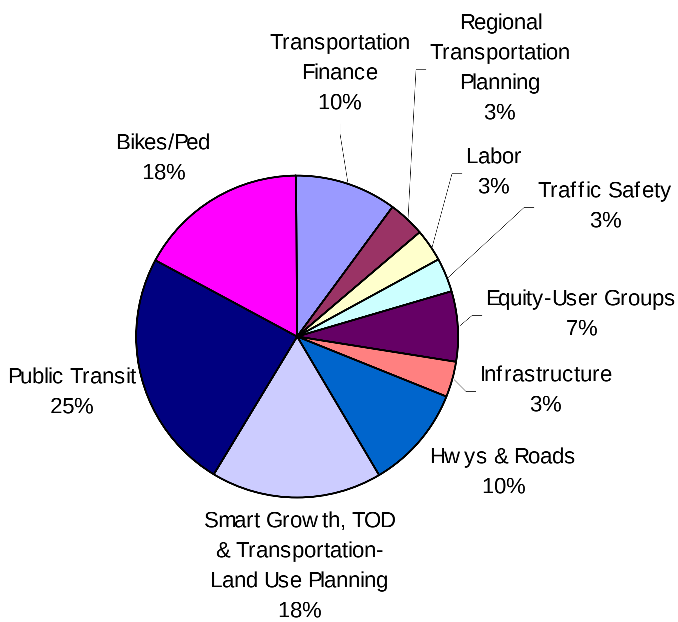


Figure 2-5. Bills Supported by BART 2001-2004

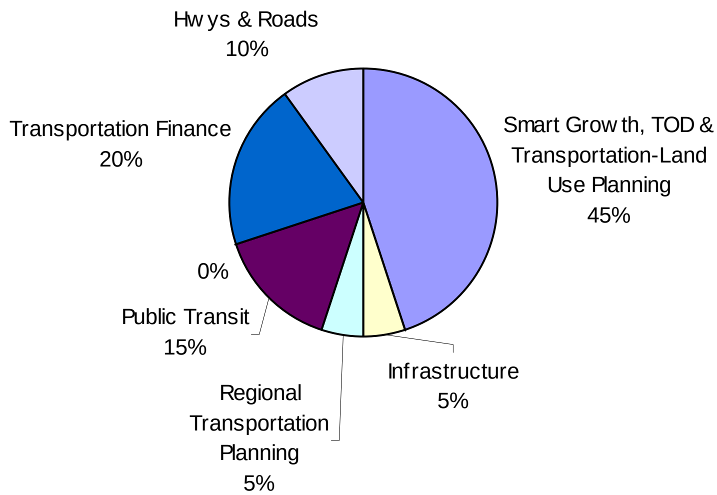


Figure 2-6. Bills Supported by VTA 2001-2004

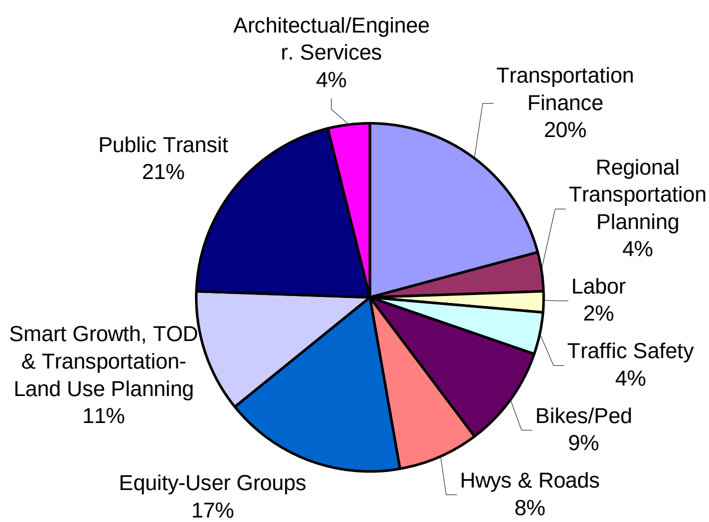


Table 2-7. Agency Bill Positions

	MTC		VTA		AC Transit *		BART	
Bills	#	%	#	%	#	%	#	%
No position	242	81%	232	78	156	89	281	94
Supported	53	18%	58	19	18	10	17	6
Opposed	3	1%	8	3	1	1	0	0
Total	298	100%	298	100	298	100	298	100

*Note: Data for 2003-4 only for AC Transit.

2.5.1 What types of bills were agencies more likely to support?

Of the sixteen categories of bills, the agencies most often supported 1) transportation finance, 2) bicycle and pedestrian transit, 3) public transit, 4) smart growth, and 5) TOD, and 6) special-user-groups (welfare-to-work, disabled and elderly transportation) legislation, representing over seventy percent bills supported. MTC, VTA and BART tended to support bills that increased or protected the funding pot for general transportation (or transportation finance bills)(Table 2-8). These bills were usually proposing to increase funding through either funding allocations or new taxes or to protect existing funds from being reallocated away from transportation uses. In contrast, AC Transit supported bills related to public transit, pedestrian and bicycle issues more often than any other category and in general did not support general transportation finance bills. Public transit was also a high priority for the other three agencies, ranking second only to Transportation Finance in each case.

Bicycle and pedestrian related bills often aimed to increase safety, infrastructure and for bicycles and pedestrians and to allow for bicycle racks to be installed on buses. Seeking exemptions from CEQA for bicycle lanes, increasing safety, and installing racks on buses were all highly supported bills. Bicycle and pedestrian issues seemed to be higher priorities for the two agencies serving as bus operators, (VTA and AC Transit). In particular, AC Transit, supported bicycle and pedestrian bills 22 percent of the time, making it its second most supported bill category after public transit. This category represented only 6 percent of the total bills tracked and 9 percent of those supported by MTC. BART did not take any positions on bills in this subject category. Smart Growth and TOD issues were extremely high priorities for BART, its top most supported issue, comprising 40 percent of the bills they supported. For all the other agencies, fourth these issues ranked fourth. Highway bills were *less* likely and bills authored by transportation committee chairs or majority leaders were *more* likely to receive VTA support, the latter indicating that VTA may be choosing to lobby on bills by authors with more political power. Finally, bills that promote smart growth principles and those authored by a transportation committee member or chair are more likely to be supported by BART. (wonder why equity didn't show up for VTA).

Several subcategories of bills within the four top lobbied issue areas (finance, public transit, bikes/peds, and smart growth/TOD), were identified. Transportation finance bills often addressed fuel taxes, Tea 21 reauthorization, or protecting Proposition 42 funds. Fuel tax bills and those related to protecting proposition 42 were the most often supported bills by the agencies. Among public transit bills, those related to buses, commuter rail, passenger rail (long distance), high speed rail, and increasing financing for transit in general were most often tracked. Eighty percent of both bus (5 total) and commuter rail (5 total) bills were supported by at least one or more agencies. AC transit supported 2 of the five bus bills. MTC supported both types of bills, 2 out 5 bus bills and 3 out of five commuter rail bills. BART and VTA tended to favor commuter rail bills, with BART supporting no bus related bills.

Table 2-8. Issue Areas Most Frequently Supported by Agencies

Percentages	MTC %	AC %	VTA %	BART %
Transportation Finance	19	2	22	18
Bikes/Peds	9	22	9	0
Public Transit	21	28	19	24
Smart Growth/TOD	11	11	14	41
User Groups (disabled, low-income, elderly	11	13	16	0
Percent of Total Bills Supported	72	77	79	82
Total Number of Bills Supported	53	18	58	17

2.5.2 Low-income Populations and Transportation Bills

Ten key bills addressing equity and mobility issues for low-income or disadvantaged users were identified. These types of bills spanned several subject categories, however, most fell under that of equity groups. Some of these bills did not fall under the special user group category directly but had potential indirect effects on equity or mobility for low-income transit users. Seven of the ten fell under the special user groups, two fell under public transit and one fell under smart growth and TOD. MTC supported half of these types of bills, representing approximately 8 percent of the bills they supported between 2001 and 2004. These bills tended to be regulatory or programmatic in nature.

Controlling for the relative frequency of the bills introduced by topic area, the agencies' priorities are highlighted differently. Finance bills tended to represent a higher share of the total supported bills compared to their representation among total tracked bills. For example, while finance related bills comprised 14 percent of the total tracked bills, they represented 22 percent of all bills supported by both MTC and the VTA, 19 percent of those supported by BART and 16 percent supported by AC Transit. VTA supported 50 percent of the six architectural and engineering bills, 30 percent of the forty-three transportation finance bills. VTA supported 60 percent of the fifteen special-user-groups bills, however controlling for other bill factors this issue does not come up as a statistically significant determinant of support. Highway bills were less likely and bills authored by transportation committee chairs or majority leaders were more likely to receive VTA support, the latter indicating that VTA may be choosing to lobby on bills by authors with more political power. Finally, bills that promote smart growth principles and those authored by a transportation committee member or chair are more likely to be supported by BART.

2.5.3 Legislative Action Types

By the legislative action types (type categories which describe the means by which a bill attempts to address an issue), bills addressing issues through funding and regulatory means dominated the set of bills tracked by the four agencies (Table 2-9). "Funding Change" legislation comprised nearly half of the total, or 47 percent, of those tracked. Regulatory bills were the second most frequent type of legislation tracked, representing 21 percent of the bills. Planning or programming, and administrative and governance bills made up much smaller percentages compared to finance and regulation, representing respectively, 11 and 9 percent of the total. Regulatory bills tended to address environmental and safety bills while funding bills tended to address transportation finance, highways and roads, public transit, smart growth and TOD, and infrastructure issues.

Table 2-9. Legislation Tracked by Type

Type	Freq.	Percent
Delegation/planning/study	82	28
Total Funding Change	138	46
Funding I	79	27
Funding redistribution/capture	48	16
Funding loss	11	4
Regulatory	62	21
Market Measures and Other	16	5
Total	298	100

Table 2-10. Positions Taken on Bills (Totals and Percents for all Agencies)

Type of Bill	Supported		Opposed		No Position		Passed	
	Total	%	**Total**	%	**Total**	%	**Total**	%
	33	22%	**5**	26%	289	29%	68	28%
Funding Change (Total)	67		12	63%	459	46%	117	48%
Funding increase/allocation/distribution	48	33%	4	21%	254	25%	75	30%
Funding redistribution/capture	18	12%	5	26%	165	16%	**37**	15%
Funding loss	1	1%	**3**	16%	40	4%	5	2%
Regulatory	34	23%	1	5%	204	20%	47	19%
Market Measures and Other	13	9%	1	5%	50	5%	14	6%
Total	147	100%	19	100%	100%	100%	246	100%

Agencies tended to support bills requesting funding changes more frequently than any other type of bill, often in higher frequency than that of their total shares in the sample (for BART, MTC and AC Transit) (Table 2-10). Most strikingly, BART supported 61 percent of such bills (11 of 18 bills). Given that the implementation of any transportation plan or program requires financing and that agencies representing local and regional areas, usually have more *desired* projects than available funds, the prominence of funding change bills on the agencies' agendas is not surprising. This trend is similar to that of transportation finance observed among subject categories above. In fact, bills in the transportation finance *subject area* often coincided with the funding change legislative action category. This is also explained by the fact, as previously mentioned, that the transportation finance category includes only multi-modal bills, and most bills requesting funding tend to be multi-modal. This may be because these multi-modal bills probably stand a greater chance of gaining broad support than single purpose or single-mode bills.

Regulatory bills were the second most frequently supported bill type ranging from 19-23 percent of bills supported by MTC, VTA and BART. These bills comprise a much larger share (37 percent) of bills supported by AC Transit. In fact, funding change and regulatory bills, together, made up 89 percent of the bills they supported.

Determinants of Agency Support: While the prior descriptive analysis provides a general picture of what bills agencies tend to support or oppose, it does not control for the total number of relevant bills in the legislature, or other attributes of the bill, including the author's political status, and the year of bill introduction. A probit estimation is used to identify the probability that an agency will support or oppose a bill or whether a bill will pass given the set of bills, and their characteristics, relevant to the Bay Area that were being considered during that time.

Table 2-11. Number of Bills Passed by Type

Type of Bill	Supported		Opposed		Passed	
MTC	Total	%	Total	%	Total	%
Delegation/planning/study	13	25%	2	29%	68	28%
Funding Change (Total)	24	45%	3	43%	117	48%
Funding	15	28%	1	14%	75	30%
Funding redistribution/capture	8	15%	2	29%	37	15%
Funding loss	1	2%	0	0%	5	2%
Regulatory	12	23%	1	14%	47	19%
Market Measures and Other	4	8%	1	14%	14	6%
Total	53	100%	7	100%	246	100%
AC Transit	Total	%	Total	%	Total	%
Delegation/planning/study	1	6%	1	33%	68	28%
Funding increase/allocation/distribution	4	22%	1	33%	75	30%
Funding redistribution/capture	2	11%	0	0%	37	15%
Funding loss	0	0%	1	33%	5	2%
Regulatory	8	44%	0	0%	47	19%
Market Measures and Other	3	17%	0	0%	14	6%
Total	18	100%	3	100%	246	100%
VTA	Total	%	Total	%	Total	%
Delegation/planning/study	16	28%	2	22%	68	28%
Funding increase/allocation/distribution	20	34%	2	22%	75	30%
Funding redistribution/capture	6	10%	3	33%	37	15%
Funding loss	0	0%	2	22%	5	2%
Regulatory	12	21%	0	0%	47	19%
Market Measures and Other	4	7%	0	0%	14	6%
	58	100%	9	100%	246	100%
BART	Total	%	Total	%	Total	%
Delegation/planning/study	3	17%	0	0	68	28%
Funding increase/allocation/distribution	9	50%	0	0.	75	30%
Funding redistribution/capture	2	11%	0	0	37	15%
Funding loss	0	0%	0	0.	5	2%
Regulatory	2	11%	0	0.	47	19%
Market Measures and Other	2	11%	0	0	14	6%
		0%				0%
Total	18	100%	0	0.	246	100%

MTC and AC Transit were both more likely to support equity bills that addressed transportation for low-income populations, such as welfare-to-work, with marginal probability of AC Transit support of 0.40 (p=0.01) and MTC support of 0.47 (p=0.02), holding other factors constant (Table 2-12 & Table 2-13). MTC had a high marginal probability of supporting finance bills, with an increase in probability of support of 0.28 (p=0.04) given that the bill addressed transportation finance. Interestingly, AC Transit was not more likely to support public transit bills, however, since only seven of the 45 public transit bills addressed bus services, while the rest addressed rail, this is not surprising (Table 2-13). BART was 18 percent more likely to support bills that aimed to encourage smart growth and transit oriented development (Table 2-14). However they were also strategic in their efforts, with a 10 percent increased chance of supporting a bill authored by a majority leader of the legislature where the bill was introduced and 11 percent increased chance of supporting a bill that was authored by a member of a transportation committee.

The Santa Clara VTA did not seem to favor any subject area among the bills that it supported. Rather, it tended to support bills that were authored by a transportation committee chair, with an increase likelihood of support of 26 percent (p=0.01) (Table 2-15). Many of those bills (12 of 16 bills supported and authored by a committee chair) were authored by then Transportation Committee Chair of the California State Assembly John Dutra whose district was Alameda County which neighbors VTA's district. This assembly member also highly favored the proposed BART extensions to Santa Clara County.

Table 2-12. Probit Estimate of MTC Support Conditional on Bill Characteristics

Number of obs	235		
LR chi2(17)	23.53		
Prob > chi2	0.13		
Pseudo R2	0.099		
Log likelihood =	-107.2		
MTC Support	**dF/dx**	**z**	**P>|z|**
Yr 2001	0.10	1.13	0.26
Yr 2002	-0.02	-0.24	0.81
Yr 2003	-0.05	-0.67	0.51
Regulatory	0.12	1.43	0.15
Bikes/Peds	0.27	1.69	0.09
Finance	0.28	2.06	0.04
Safety			
Environment	-0.02	-0.15	0.88
Equity	**0.47**	**2.78**	0.01
Highways	0.08	0.66	0.51
Transit	0.15	1.17	0.24
Bus	0.17	0.93	0.35
Commuter Rail	0.10	0.69	0.49
Regional	0.24	1.36	0.18
Smart Growth/TOD/Infill	0.09	0.79	0.43
Majority Leader	-0.15	-1.36	0.17
Committee	0.07	1.15	0.25
Chair of Committee	0.14	1.59	0.11
Obs. P	0.20		
pred. P	0.18		

Table 2-13. Probit Estimate of AC Transit Support Conditional on Bill Characteristics

Number of obs	225		
LR chi2(17)	25.02		
Prob > chi2	0.09		
Pseudo R2	0.10		
Log likelihood =	-112.62		
AC Transit	dF/dx	z	P>|z|
Yr 2003	0.03	0.48	0.63
Regulatory	0.13	1.52	0.13
Bikes/Peds	0.34	1.82	0.07
Finance	0.02	0.13	0.90
Safety	0.10	0.53	0.60
Environment			
Equity	**0.40**	**2.05**	**0.04**
Highways	0.04	0.27	0.79
Infrastructure	0.15	0.83	0.41
Transit	0.18	1.27	0.20
Bus	0.03	0.27	0.79
Commuter Rail	0.11	1.58	0.11
Regional			
Smart Growth/TOD/Infill	0.06	0.50	0.62
Majority Leader			
Committee	0.11	1.58	0.11
Chair of Committee	0.15	1.37	0.17

How effective were the agencies? The results of the probit estimates indicate that MTC supporting a bill is a strongly influences it chance of passage (Table 2-16). The estimates show a strong and significant positive affect of MTC support on the chances that a bill tracked by MTC will pass.

The marginal probability that a bill supported by MTC will pass increases by 0.21 given a position of support relative to that of non-support by MTC. This effect was not found for any of the other agencies. Again, this result may indicate either that MTC is skilled at choosing bills that it can influence or that MTC is highly effective in its lobbying or a combination of both. Interestingly, whether the author is a transportation committee member is significant at the 10 percent level. This factor may be also a determinant in which bills MTC decides to lobby in support.

Table 2-14. Probit Estimate of BART Support Conditional on Bill Characteristics

Number of obs	197		
LR chi2(17)	31.23		
Prob > chi2	0.01		
Pseudo R2	0.26		
Log likelihood =	-44.61		
BART Support	**dF/dx**	**Z**	**P>|z|**
yr2001	0.07	1.19	0.233
yr2002	0.01	0.18	0.857
yr2003	0.08	1.43	0.151
Regulatory	0.02	0.5	0.618
Bikes/Peds			
Funding	0.05	1.61	0.106
Safety			
Environment			
Equity			
Highways	0.00	0.05	0.959
Infrastructure	0.05	0.66	0.509
Transit	0.04	0.7	0.486
Bus	-	-	-
Commuter Rail	0.11	1.22	0.222
Regional	0.05	0.6	0.546
Smart Growth/TOD/Infill	**0.18**	**2.6**	0.009
Majority Leader	0.10	1.32	0.016
Committee	**0.11**	**2.41**	0.008
Chair of Committee	**0.23**	**2.65**	0.509
Obs. P	0.09		
pred. P	0.03		

Table 2-15. Probit Estimate of VTA Support Conditional on Bill Characteristics

Number of obs	225		
LR chi2(17)	25.02		
Prob > chi2	0.0942		
Pseudo R2	0.1		
Log likelihood =	-112.622		

VTA Support	dF/dx	Z	P>|z|
yr2001	-0.07	-0.79	0.43
yr2002	-0.13	-1.54	0.12
yr2003	-0.10	-1.28	0.20
Regulatory	-0.04	-0.48	0.63
Bikes/Peds	-0.01	-0.11	0.91
Finance	-0.01	-0.09	0.93
Safety	-0.08	-0.53	0.60
Environment			
Equity	0.05	0.33	0.74
Highways	**-0.18**	**-2.02**	**0.04**
Infrastructure			
Transit	-0.14	-1.36	0.17
Bus	0.25	1.23	0.22
Commuter Rail	0.26	1.45	0.15
Regional	-0.09	-0.71	0.48
Smart Growth/TOD/Infill	-0.15	-1.66	0.10
Majority Leader	-0.21	-1.91	0.06
Committee	0.05	0.80	0.43
Chair of Committee	**0.26**	**2.69**	0.01
Obs. P	0.24		
pred. P	0.22		

Table 2-16. Probit Estimates: Bill Passage

Number of obs	261		
LR chi2(23)	32.26		
Prob > chi2	0.0949		
Pseudo R2	0.0934		
Log likelihood	-156.603		
Passed	**dF/dx**	**Z**	**P>|z|**
MTC Support	**0.21**	**2.32**	0.02
AC Transit Support	0.00	-0.03	0.978
VTA Support	0.07	0.85	0.397
BART Support	0.04	0.29	0.77
yr2001	-0.03	-0.25	0.803
yr2002	-0.02	-0.18	0.86
yr2003	0.06	0.66	0.51
Funding	-0.08	-1.04	0.30
Regulatory	0.13	1.4	0.16
Finance	-0.20	-1.46	0.14
Bikes/Peds	-0.22	-1.48	0.14
Environment	-0.08	-0.54	0.59
Equity	-0.15	-0.95	0.34
Freight	-0.19	-0.74	0.46
Safety	-0.20	-1.18	0.24
Highways	-0.15	-1.18	0.24
Infrastructure	-0.26	-1.67	0.10
Transit	-0.16	-1.25	0.21
Regional	-0.16	-0.97	0.33
Smart Growth/TOD/Infill	-0.25	-2.07	0.04
Majority Leader	0.03	0.16	0.87
Committee	0.15	2.08	0.04
Chair	0.20	1.93	0.054
obs. P	0.38		
Pred. P	0.36		

The same analysis was conducted using the total number of agencies supporting a bill rather than whether each agency supported a bill (Table 2-17). This variable was also significant (at the 0.05 level) but lower in magnitude than MTC supporting a bill. The number of agencies supporting the same bill increased the chances of it passing by 10 percent. This seems to indicate that while agencies work together in support of a bill is a strong strategy, MTC supporting a bill is even more effective. However, the total number of agencies supporting a bill may only be a proxy for MTC's support. To test this theory another probit analysis was conducted with the total number of agencies supporting a bill and whether MTC supported a bill on the right-hand side. With total supporting variable, excluding MTC (i.e. 3 would be the maximum number) and MTC supporting, only the MTC supporting dummy is significant. This suggests that MTC supporting a bill has a stronger effect on a bill passing than if the three of the other agencies align to support a bill (however more than 2 supporting a bill are rare) and that the significance of the total support variable in the previous probit analysis was due mainly to the effect of MTC's support.

Table 2-17. Probit Estimates of Bill Passage on Total Number of Agencies Supporting a Bill with and without MTC

Number of obs	261			Number of obs	261		
LR chi2(20)	30.33			LR chi2(21)	32.07		
Prob > chi2	0.0647			Prob > chi2	0.0576		
Pseudo R2	0.0878			Pseudo R2	0.0928		
Log likelihood =	-157.566			Log likelihood =	-		
Passed	**dF/dx**	**Z**	**P>|z|**	**Passed**	**dF/dx**	**Z**	**P>|z|**
Total # Supporting	**0.10**	**2.52**	**0.012**	# Support (minus MTC)	0.05	0.84	0.398
-	-	-	-	**MTC Support**	**0.21**	**2.35**	**0.019**
yr2001	-0.01	-0.11	0.916	yr2001	-0.02	-0.23	0.821
yr2002	-0.01	-0.09	0.924	yr2002	-0.02	-0.16	0.873
yr2003	0.05	0.58	0.56	yr2003	0.06	0.62	0.534
Funding	-0.08	-1.12	0.263	Funding	-0.08	-1.04	0.298
Regulatory	0.13	1.39	0.164	Regulatory	0.13	1.37	0.17
Finance	-0.18	-1.35	0.177	Finance	-0.19	-1.45	0.147
Bikes/Peds	-0.22	-1.48	0.14	Bikes/Peds	-0.23	-1.53	0.127
Environment	-0.07	-0.49	0.627	Environment	-0.08	-0.57	0.569
Equity	-0.14	-0.94	0.35	Equity	-0.15	-0.94	0.347
Freight	-0.19	-0.71	0.478	Freight	-0.19	-0.74	0.458
Safety	-0.21	-1.27	0.204	Safety	-0.20	-1.2	0.231
Highways	-0.15	-1.13	0.26	Highways	-0.16	-1.2	0.229
Infrastructure	-0.27	-1.74	0.082	Infrastructure	-0.27	-1.72	0.085
Transit	-0.15	-1.23	0.219	Transit	-0.16	-1.29	0.197
Regional	-0.15	-0.91	0.364	Regional	-0.16	-0.98	0.329
Smart	-0.26	-2.13	0.033	Smart	-0.26	-2.13	0.033
Majority Leader	0.01	0.08	0.939	Majority Leader	0.02	0.14	0.89
Committee	0.15	2.04	0.041	Committee	0.15	2.07	0.038
Chair	0.19	1.86	0.063	Chair	0.21	1.95	0.051
Obs. P	0.38			obs. P	0.38		
pred. P	0.36	at x-bar		pred. P	0.36	at x-bar	

2.5.4 Agency Collaboration: Who was aligned or opposed with whom?

The positions of other agencies could not be included on the right-hand side of the second set of probit estimates (the probability of a given agency supporting a bill) since as agencies do collaborate in their efforts, these variables would most likely be jointly determined and it would not be clear which agency was following any other agency's lead. Instead, a simple correlation analysis on a dummy variable for agency support on a bill was conducted to explore which agencies tended to be aligned in support of bills with each other (Table 2-18). MTC and VTA supporting a bill have the highest correlation (0.34 correlation coefficient), followed by AC Transit and VTA (corr coefficient 0.30). BART was most often aligned with VTA and MTC and the least often aligned with AC Transit. In general, BART did not seem to follow other agencies in which bills it supported.

Table 2-18. Correlation Matrix of Agency Support (Support=1)

	Support MTC	Support AC	Support VTA	Support BART
Support MTC	1			
Support AC Transit	0.2133	1		
Support VTA	0.3472	0.302	1	
Support BART	0.1123	-0.0018	0.1346	1

At least one of the four agencies took a position of support on approximately a third of all bills, 103 bills, over the period. Of the bills that were supported by at least one of the agencies, over half of the time, they were the sole supporters (60 bills), and less than half the time, two or more agencies were in support of the same bill (43 bills). In only 2 cases were all four agencies aligned in support of the same bill, and in only four cases, were agencies at odds in their positions.

2.5.5 On what subjects were agencies aligned and opposed?

According to legislative history data, the agencies tended to align most frequently on public transit and finance related bills, with each category representing 23 percent of such bills.50 BART in fact reported collaborating most intensively with other agencies to protect transportation funds from being diverted to other uses. Smart growth/TOD bills were the third most agreed upon bill, comprising 15 percent of such bills, followed by highways and road related bills. For example, transit related bills comprised a third of the nine cases where more than 2 agencies supported or opposed a bill in concert. Three agencies joined in their support for public transit bills AB 1065 and AB 2737. AB 1065, authored by Assembly member Longville in 2003, did not pass, but would have allowed counties to impose an additional sales tax doubling the amount of TDA funds dedicated to transit. AB 2737, which also failed passage, would have reversed the tort liability of transit operators in injuries and fatalities to pedestrian accessing transit stops. Public transit was also the subject of the sole bill, SB 760, were all four agencies aligned in support. Passed in September 2003, this bill extended the sales tax exemption on public transit equipment "leaseback" transactions. Among finance bills, the most popular among the agencies was a bill that would have allowed for increases in the motor vehicle fuel tax in accordance with inflation, with three agencies MTC, VTA, and AC Transit in support.

The agencies aligned on three Special-User Group bills, representing 10 percent of bills where the agencies aligned. AB 903 would have provided non-emergency transportation for medi-cal recipients to access medical services. Introduced in 2001, it was supported by both VTA and MTC however it died in committee. AB 392, which was introduced in 2003, would provide grants for environmental justice and community based transportation planning is supported by AC Transit, MTC and the VTA. As of this writing, the bill is inactive and has not passed. The sole bill in which agencies took differing positions was SB 864, with MTC supporting and VTA opposing. This bill proposed to give regional land use planning responsibilities currently under the jurisdiction of AGAG over to MTC in an effort to better coordinate transportation and land use planning.

2.6 Summary and Conclusions

Although not a large proportion of agency budgets, a substantial share of total governmental lobbying expenditures comes from transportation agencies. Transportation agencies, in particular,

[50] Aligned is defined as cases where two or more agencies supported and none opposed the same bill or visa versa for both categories

MTC, lobby heavily for finance bills that increase revenue and flexibility in fund use as well as funding redistribution. BART, the regional commuter rail operator, lobbies heavily for Smart Growth and transit oriented development, two strategies believed to increase ridership. Both the Santa Clara VTA and BART were strategic in the bills they chose to support, having a greater likelihood of supporting bills authored by transportation committee chairs, perhaps in an effort to both build political capital and to expend resources on bills with a greater chance of passage. In fact, agencies reported that they will sometimes offer support for a bill that is not on their agenda, that they have no opposition to, when it is solicited by a transportation committee member in order to build political capital.

Coalitions seem to be strongest between MTC and VTA who have more similar mandates and weakest between BART and AC Transit, who are both transit operators who in both compete with and depend upon each other for ridership. Contrary to what TALC and social justice groups suggest, MTC is likely to take a supporting position on social equity bills, however, the degree of effort in that support is unknown. However, MTC was not present in public transit bills and they have stated in interviews that they don't sponsor types of bills that benefit particular groups. One former MTC staff member reported in an interview that fare and operational issues that transit operators care about are seen as out of their jurisdiction, partly because they are not issues that staff find exciting or are well versed in, and that labor issues are political hot buttons they try to avoid, which may explain the apparent emphasis on capital over operating issues in their agenda.

MTC seems to have considerable influence in Sacramento; the bills they support have higher chance of passage, but it is unclear whether they are they picking winners or have greater influence. Since MTC has more funds to hire full-time lobbyists, MTC's agenda gets greater lobbying time in Sacramento and DC relative to smaller agencies and transit operators. However, BART was the largest spender on lobbying and did not seem to have great influence. Since MTC is a regional planning organization it may have more political power relative to the other agencies per dollar spent. MTC's considerable influences raises institutional questions of MTC board structure and representation of interest groups, since transit operators are not represented on MTC's board. The MTC board has three representatives from Santa Clara County since third member is on ABAG, which may explain the relative emphasis on projects in this county according to one interviewee. According to some interviewees, MTC commissioners are not necessarily experts or knowledgeable in transportation issues and have strong incentives to represent issues affecting their local districts over those of the region. The length of time the commissioners serve on the board may not be enough to gain adequate knowledge and understanding of the myriad and complex regional transportation issues, acronyms, laws, and procedures.

Bibliography I

Baker, Susan, Chen, Li-Hui, and Li, Guohua. 2007. *Nationwide Review of Graduated Driver Licensing.* Johns Hopkins Bloomberg School of Public Health Center for Injury Research and Policy, February.

Bates, Lyndel, Barry Watson, and Mark King. 2010. Required hours of practice for learner drivers: A comparison between two Australian jurisdictions. *Journal of Safety Research* 41, no. 2 (April): 93-97.

Begg, Dorothy, and Shaun Stephenson. 2003. Graduated driver licensing: the New Zealand experience. *Journal of Safety Research* 34, no. 1 (January 30): 99-105.

Blakemore, S. J, and S. Choudhury. 2006. Development of the adolescent brain: implications for executive function and social cognition. *Journal of Child Psychology and Psychiatry* 47, no. 3-4: 296–312.

Brookland, Rebecca, and Dorothy Begg. Adolescent, and their parents, attitudes towards graduated driver licensing and subsequent risky driving and crashes in young adulthood. *Journal of Safety Research.*

Carpenter, Christopher. 2004. How do Zero Tolerance Drunk Driving Laws work? *Journal of Health Economics* 23, no. 1 (January): 61-83. doi:16/j.jhealeco.2003.08.005.

Casey, B. J., R. M Jones, and T. A Hare. 2008. The adolescent brain. *Annals of the New York Academy of Sciences* 1124, no. 1: 111–126.

Chen, L.-H. 2006. Graduated Driver Licensing Programs and Fatal Crashes of 16-Year-Old Drivers: A National Evaluation. *PEDIATRICS* 118, no. 1 (July): 56-62.

CPCU Society's Central Illinois Chapter. *Rights of Passage- An Analysis of Graduated Driver Licensing in Selected States,* 2002.

Curry, Allison E., Jessica Hafetz, Michael J. Kallan, Flaura K. Winston, and Dennis R. Durbin. 2011. "Prevalence of teen driver errors leading to serious motor vehicle crashes." *Accident Analysis & Prevention* 43 (4) (July): 1285-1290. doi:16/j.aap.2010.10.019.

Dee, Thomas S., David C. Grabowski, and Michael A. Morrisey. 2005. Graduated driver licensing and teen traffic fatalities. *Journal of Health Economics* 24, no. 3 (May): 571-589.

Dube, A., T. W Lester, and M. Reich. 2008. "Minimum wage effects across state borders: Estimates using contiguous counties." *Institute for Research on Labor and Employment Working Paper Series.*

Eisenberg, Daniel. 2003. Evaluating the effectiveness of policies related to drunk driving. *Journal of Policy Analysis and Management* 22, no. 2: 249-274.

Ferguson, S. A, E. R Teoh, and A. T McCartt. 2007. Progress in teenage crash risk during the last decade. *Journal of Safety Research* 38, no. 2: 137–145.

Foss, RobertD., and KellyR. Evenson. 1999. Effectiveness of graduated driver licensing in reducing motor vehicle crashes. *American Journal of Preventive Medicine* 16, no. 1, Supplement 1 (January): 47-56.

Galvan, A., T. A Hare, C. E Parra, J. Penn, H. Voss, G. Glover, and B. J. Casey. 2006. Earlier development of the accumbens relative to orbitofrontal cortex might underlie risk-taking behavior in adolescents. *The Journal of neuroscience* 26, no. 25: 6885.

Galvan, A., T. Hare, H. Voss, G. Glover, and B. J. Casey. 2007. Risk-taking and the adolescent brain: who is at risk? *Developmental Science* 10, no. 2: F8–F14.

Goodwin, Arthur H., and Robert D. Foss. 2004. Graduated driver licensing restrictions: awareness, compliance, and enforcement in North Carolina. *Journal of Safety Research* 35, no. 4: 367-374.

Hallmark, Shauna L., David A. Veneziano, Scott Falb, Michael Pawlovich, and Deborah Witt. 2008. Evaluation of Iowa's graduated driver's licensing program. *Accident Analysis & Prevention* 40, no. 4 (July): 1401-1405.

Hedlund, James, and Richard Compton. 2004. Graduated driver licensing research in 2003 and beyond. *Journal of Safety Research* 35, no. 1: 5-11.

Hedlund, James, Ruth A. Shults, and Richard Compton. 2003. What we know, what we don't know, and what we need to know about graduated driver licensing. *Journal of Safety Research* 34, no. 1 (January 30): 107-115.

———. 2006. Graduated driver licensing and teenage driver research in 2006. *Journal of Safety Research* 37, no. 2: 107-121.

Huang, Rocco R. 2008. Evaluating the real effect of bank branching deregulation: Comparing contiguous counties across US state borders. *Journal of Financial Economics* 87, no. 3 (March): 678-705.

Insurance Institute for Highway Safety. Licensing Systems for Young Drivers Introduction. http://www.iihs.org/laws/graduatedLicenseIntro.aspx.

Jiang, Xinguo, and Richard W. Lyles. 2011. Exposure-based assessment of the effectiveness of Michigan's graduated driver licensing nighttime driving restriction. *Safety Science* 49, no. 3 (March): 484-490

Karaca-Mandic, Pinar, and Greg Ridgeway. 2010. Behavioral impact of graduated driver licensing on teenage driving risk and exposure. *Journal of Health Economics* 29, no. 1 (January): 48-61.

Kmet, L., and C. Macarthur. 2006. "Urban-rural differences in motor vehicle crash fatality and hospitalization rates among children and youth." *Accident Analysis & Prevention* 38 (1): 122–127.

Kirley, Bevan B., Andrea Feller, Elisa Braver, and Patricia Langenberg. 2008. Does the Maryland graduated driver licensing law affect both 16-year-old drivers and those who share the road with them? *Journal of Safety Research* 39, no. 3: 295-301.

Lee, Chris, and Mohamed Abdel-Aty. 2008. Presence of passengers: Does it increase or reduce driver's crash potential? *Accident Analysis & Prevention* 40, no. 5 (September): 1703-1712.

Males, M. 2009. Does the Adolescent Brain Make Risk Taking Inevitable? *Journal of Adolescent Research* 24, no. 1: 3.

Males, Mike. 2007. California's graduated driver license law: Effect on teenage drivers' deaths through 2005. *Journal of Safety Research* 38, no. 6: 651-659.

Margolis, Lewis H., Scott V. Masten, and Robert D. Foss. 2007. The Effects of Graduated Driver Licensing on Hospitalization Rates and Charges for 16-and 17-Year-Olds in North Carolina. *Traffic Injury Prevention* 8, no. 1: 35.

Masten, Scott V., and Robert D. Foss. 2010. Long-term effect of the North Carolina graduated driver licensing system on licensed driver crash incidence: A 5-year survival analysis. *Accident Analysis & Prevention* 42, no. 6 (November): 1647-1652.

Masten, Scott V., and Robert A. Hagge. 2004. Evaluation of California's graduated driver licensing program. *Journal of Safety Research* 35, no. 5: 523-535.

Mayhew, Daniel R., Herbert M. Simpson, and Anita Pak. 2003. Changes in collision rates among novice drivers during the first months of driving. *Accident Analysis & Prevention* 35, no. 5 (September): 683-691.

McCartt, Anne T., William A. Leaf, Charles M. Farmer, Susan A. Ferguson, and Allan F. Williams. 2001. Effects of Florida's graduated licensing program on the behaviors and attitudes of teenagers. *Journal of Safety Research* 32, no. 2: 119-131.

McKnight, A. James, and Raymond C. Peck. 2003. Graduated driver licensing and safer driving. *Journal of Safety Research* 34, no. 1 (January 30): 85-89.

McTaggart, Robin. 1991. Principles for Participatory Action Research. *Adult Education Quarterly* 41, no. 3: 168 -187.

Morrisey, Michael A., David C. Grabowski, Thomas S. Dee, and Christine Campbell. 2006. The strength of graduated drivers license programs and fatalities among teen drivers and passengers. *Accident Analysis & Prevention* 38, no. 1 (January): 135-141.

Morton-Simons, Bruce, Lerner, Neil, and Singer, Jeremiah. The observed effects of teenage passengers on the risky driving behavior of teenage drivers. *Accident Analysis & Prevention* 37, no. 6: 973-982.

Muelleman, R. L, M. C Wadman, T. P Tran, F. Ullrich, and J. R Anderson. 2007. "Rural motor vehicle crash risk of death is higher after controlling for injury severity." *The Journal of Trauma* 62 (1): 221.

Neyens, David M., Birsen Donmez, and Linda Ng Boyle. 2008. The Iowa graduated driver licensing program: Effectiveness in reducing crashes of teenage drivers. *Journal of Safety Research* 39, no. 4: 383-390.

O'Connor, Robert E., Laurie Lin, Glen H. Tinkoff, and Herman Ellis. 2007. Effect of a Graduated Licensing System on Motor Vehicle Crashes andAssociated Injuries Involving Drivers Less Than 18 Years-of-Age. *Prehospital Emergency Care* 11, no. 4 (January): 389-393.

OADC/DNEM. CDC Media Relations - Press Release: October 21, 2010. http://www.cdc.gov/media/pressrel/2010/r101021.html.

Ossenbruggen, P. J, J. Pendharkar, and J. Ivan. 2001. "Roadway safety in rural and small urbanized areas." *Accident Analysis & Prevention* 33 (4): 485–498.

Peck, Raymond C. 2011. Do driver training programs reduce crashes and traffic violations? -- A critical examination of the literature. *IATSS Research* 34, no. 2 (March): 63-71. doi:doi: DOI: 10.1016/j.iatssr.2011.01.001.

Preusser, David F., Susan A. Ferguson, and Allan F. Williams. 1998. The effect of teenage passengers on the fatal crash risk of teenage drivers. *Accident Analysis & Prevention* 30, no. 2 (March): 217-222.

Rice, T. M, C. Peek-Asa, and J. F Kraus. 2004. Effects of the California graduated driver licensing program. *Journal of Safety Research* 35, no. 4: 375–381.

Scott-Parker, Bridie J., Lyndel Bates, Barry C. Watson, Mark J. King, and Melissa K. Hyde. The impact of changes to the graduated driver licensing program in Queensland, Australia on the experiences of Learner drivers. *Accident Analysis & Prevention.*

Shope, Jean T. 2007. Graduated driver licensing: Review of evaluation results since 2002. *Journal of Safety Research* 38, no. 2: 165-175.

Shope, Jean T., and Lisa J. Molnar. 2003. Graduated driver licensing in the United States: evaluation results from the early programs. *Journal of Safety Research* 34, no. 1 (January 30): 63-69.

———. 2004. Michigan's graduated driver licensing program: Evaluation of the first four years. *Journal of Safety Research* 35, no. 3: 337-344.

Simpson, Herb M. 2003. The evolution and effectiveness of graduated licensing. *Journal of Safety Research* 34, no. 1 (January 30): 25-34.

Sisk, C. L, and J. L Zehr. 2005. Pubertal hormones organize the adolescent brain and behavior. *Frontiers in Neuroendocrinology* 26, no. 3-4: 163–174.

Steinberg, L. 2007. Risk taking in adolescence. *Current Directions in Psychological Science* 16, no. 2: 55.

———. 2008. A social neuroscience perspective on adolescent risk-taking. *Developmental Review* 28, no. 1: 78–106.

Triplett, William. 2005. Teen Driving: should states impose tougher restrictions? *The CQ Researcher* 15, no. 1 (January 7): 1-24.

Ulmer, Robert G., David F. Preusser, Allan F. Williams, Susan A. Ferguson, and Charles M. Farmer. 2000. Effect of Florida's graduated licensing program on the crash rate of teenage drivers. *Accident Analysis & Prevention* 32, no. 4 (July): 527-532.

Vanlaar, Ward, Dan Mayhew, Kyla Marcoux, Geert Wets, Tom Brijs, and Jean Shope. 2009. An evaluation of graduated driver licensing programs in North America using a meta-analytic approach. *Accident Analysis & Prevention* 41, no. 5 (September): 1104-1111.

Williams, Allan F. 2003. Teenage drivers: patterns of risk. *Journal of Safety Research* 34, no. 1 (January 30): 5-15.

———. 2007. Contribution of the components of graduated licensing to crash reductions. *Journal of Safety Research* 38, no. 2: 177-184.

Williams, Allan F., and Ruth A. Shults. 2010. Graduated Driver Licensing Research, 2007-Present: A Review and Commentary. *Journal of Safety Research* 41, no. 2 (April): 77-84.

Williams, Allan F., Susan A. Ferguson, and Joann K. Wells. 2005. Sixteen-Year-Old Drivers in Fatal Crashes, United States, 2003. *Traffic Injury Prevention* 6, no. 3: 202.

Zhao, Jinhui, Robert E. Mann, Mary Chipman, Edward Adlaf, Gina Stoduto, and Reginald G. Smart. 2006. The impact of driver education on self-reported collisions among young drivers with a graduated license. *Accident Analysis & Prevention* 38, no. 1 (January): 35-42.

Zhu, Motao, Haitao Chu, and Guohua Li. 2009. Effects of graduated driver licensing on licensure and traffic injury rates in Upstate New York. *Accident Analysis & Prevention* 41, no. 3 (May): 531-535.

Zwerling, C., C. Peek-Asa, P. S. Whitten, S. W. Choi, N. L. Sprince, and M. P. Jones. 2005. "Fatal motor vehicle crashes in rural and urban areas: decomposing rates into contributing factors." *Injury Prevention* 11 (1): 24.

Bibliography II

Banks, 1977. *Political Influence in Transportation Planning: The San Francisco Bay Area Metropolitan Transportation Commission's Regional Transportation Plan,* Dissertation.

California Department of Transportation, 2005, Regional Transportation Guidelines, Accessed March 26, 2005 http://www.dot.ca.gov/hq/tpp/offices/orip/rtp/rtpguidelines/Chap1f.PDF

Hayes, M. *Lobbyists and Legislators: A Theory of Political Markets,* Rutgers University Press, 1981.

Lewis, P. and M. Sprague, 1997. *Federal Transportation Policy and the Role of Metropolitan Planning Organizations in California,* Public Policy Institute of California.

Kingdon, John W. *Agendas, Alternatives, and Public Policies,* University of Michigan, 1995.

Matlack, Carol. 1990. *Too big to move : California lobbying.* National journal. Vol. 22, no. 35 (Sept. 1, 1990).

Office of the Legislative Auditor of the State of Minnesota, 1990. *Local Government Lobbying,* Program Evaluation Division, February 1990.

Richards, Curtis. 1991. *Government lobbyists : California spends millions to influence itself.* California journal. Vol. 22, no. 8 (Aug. 1991).

Stewart, L. "Hard times for transit districts," Bay Area Monitor, June/July 2002.

TCF, 2000, "Widening the Transportation Divide: How Governor Davis' Transportation Plan

Leaves Transit-Dependent People Stranded", Transportation Choices Forum, 2000.

Walker, J. *Mobilizing Interest Groups in America, Patrons, Professions, and Social Movements,* 1991.

Appendix

States with reliable or corrected teen driver license data:

Arizona
Arkansas
Colorado
Connecticut
Delaware
Florida
Georgia
Hawaii
Idaho
Illinois
Kansas
Maine
Maryland
Massachusetts
Michigan
Mississippi
Missouri
Montana
Nevada
New Hampshire
New Jersey
New Mexico
New York
North Carolina
North Dakota
Ohio
South Dakota
Tennessee
Texas
Utah
Vermont
Virginia
Washington
Wisconsin
Wyoming