

Are the Deterrence Effects of Anti-DUI Policies Short-lived?

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- Driving under influence(DUI) of alcohol remains one of the most notable public security threats to almost all societies around the globe.
- A variety of measures have been used:
 - Blood alcohol content(BAC) limit for driving
 - Sobriety checkpoint
 - Minimum legal drinking age(MLDA)
 - Publicity campaign
 - Graduated drivers license
 - School-base instructional programs

- Two aspects still remain as focal points and looking for solutions:
 - ① How effective are anti-DUI policies?(through what channels?)
 - ② What is the driver mentality?(how do we think about recidivism rate?)

- Economists have been working with criminologists in finding the most efficient ways, as it benefits public policy evaluation.
- potential mechanism:
 - ① deterrence effect
 - ② incapacitation effect
 - ③ rehabilitation effect
- Henson (2015) found out that deterrence effect turns out to be the most efficient channel.

- Legislative punishment:
 - 1 analysis on BAC limit(Hansen, 2014, AER)
- Police enforcement:
 - 1 violent and property crime offenders(Levitt 1997; McCrary 2002; Evans and Owens 2007...)
 - 2 exceeding speed limit(DeAngelo and Hansen 2015)

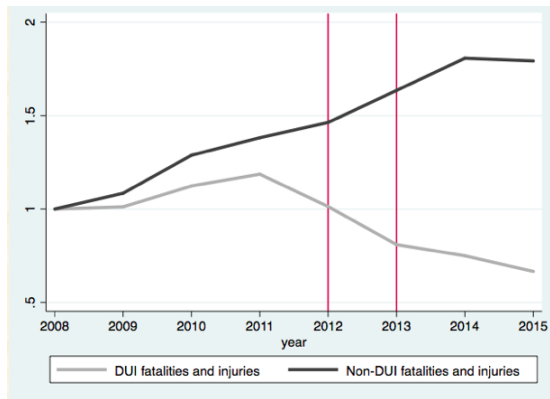
Concerning the effects of Blood Alcohol Concentration(BAC) limit

- Most early studies did not employ proper research designs or rigorous econometric tools
- Hansen (2015) found that stricter rules on BAC significantly reduces recidivism by 30 percent over the first two years after the law change, but the effect weakens dramatically after that time window.
- Lacking evidence from developing world
 - 1 Predominantly in the US
 - 2 Vollrath et al. (2005) and Albalade (2008) are two European studies

As of duration of policy effects:

- In most of the researches, duration is a relative term rather than an absolute term, which is not conclusive and persuasive.
- Abouk and Adams (2013) found that banning text messaging reduced traffic accidents, but the effect appears to be only evident immediately after the ban was implemented and then quickly faded away in one or two months.

- Compare the effects of sobriety checkpoint and punishment on DUI fatalities and injuries in Taiwan
- Track the effects over time and compares the effects in the short term and a relative long term.
- Estimate heterogeneity on first-time and repeat DUI offenders, males and female offenders, and offenders of different age groups, severity of binge drinker.



DUI and non-DUI fatalities and injuries

Multiple Interventions

To address upon the issue, we take advantage of two major incidents

- ① 2012: An intensive sobriety checkpoint operation running from June 1 to July 31
- ② 2013: Law reform implemented on June 13
 - Introduced criminal charge
 - Increased fine
 - More stringent DUI limits
 - Combined with a short period of intensified sobriety checkpoints

Sobriety Checkpoint Campaign 2012

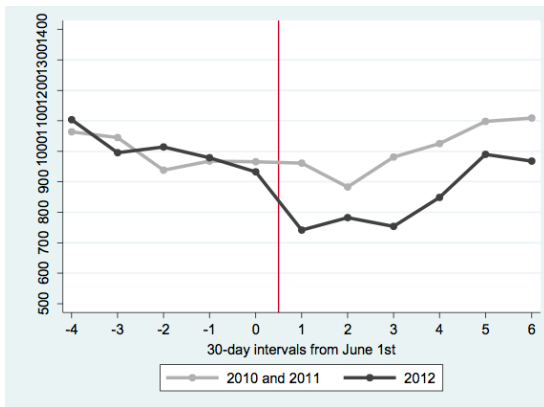
- Operating from June 1st to July 31st
- 8 extra times of sobriety checkpoints are assigned at national level, on top of regular checkpoints
- Total deployment of checkpoints in June 2012 was 11.6 times as much as in June 2011
- There was no change in law in June or July 2012

- Without causing any traffic accident, offenders could still be imprisoned up to two years.(with standard of two cans of beer only)
- Penalty was enhanced to a maximum of ten years
- Implemented on June 13 with intensified checkpoints

The sobriety checkpoints worked tremendously well in 2012

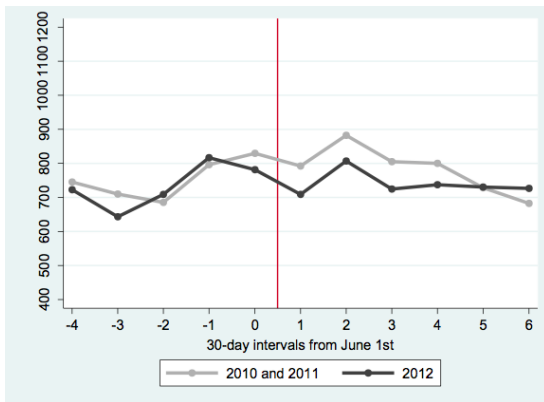
- The 2012 operation decreased nighttime DUI fatalities and injuries by 26 percent in the first month
- Effect persisted, yet weakened as enforcement went back normal
- Almost none daytime effect

DUI in 2012



DUI deaths and injuries caused by first-time offenders in nighttime 2012

DUI in 2012

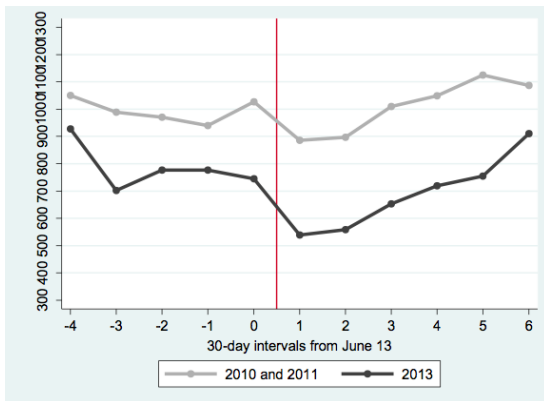


DUI deaths and injuries caused by first-time offenders in the daytime 2012

In 2013,

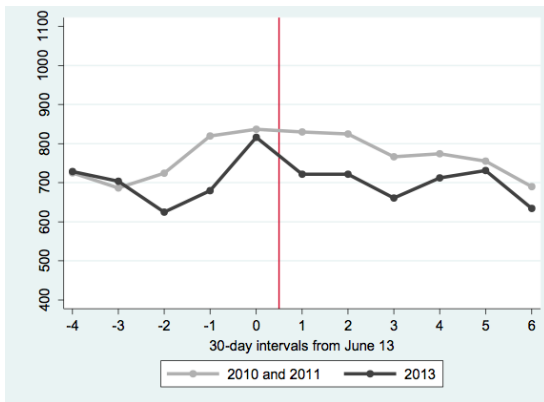
- The 2013 law reform decreased nighttime DUI fatalities and injuries by 18 percent in the first month.
- Effect persisted, fluctuated with a margin of roughly 10 percent
- Very limited daytime effect

DUI in 2013



DUI deaths and injuries caused by first-time offenders in the nighttime
2013

DUI in 2013



DUI deaths and injuries caused by first-time offenders in the daytime 2013

We use the mean of DUI-related fatalities and injuries in 2010 and 2011 as the control group and conduct a difference-in-difference estimation

- No major anti-DUI operation or amendment of anti-DUI laws in 2010 or 2011, which provides ideal control group
- Seasonal pattern in DUI would be perfectly partial out under DID
- Results are robust to using only 2010 or 2011 as control group, however less significant

$$DUI_{ist} = \alpha + \beta T_i + \sum_{m=1}^6 \gamma_m I_m + \sum_{m=1}^6 \rho_m (I_m T_i) + \lambda trend_t + \tau trend_t^2 + \sum_{s=1}^{19} \phi_s county_s + \theta_t Y_{2010} + \pi X_{ist} + \eta_{ist}$$

- DUI_{ist} : an outcome in county s , date i , year t
- T_i : treatment dummy
- I_m : dummy variable indicating the m th 30-day period after the policy intervention
- $county_s$: county fixed-effects
- $trend_t$: time trend measured by day
- $trend_t^2$: time trend squared measured by day

$$DUI_{ist} = \alpha + \beta T_i + \sum_{m=1}^6 \gamma_m I_m + \sum_{m=1}^6 \rho_m (I_m T_i) + \lambda trend_t + \tau trend_t^2 + \sum_{s=1}^{19} \phi_s county_s + \theta_t Y_{2010} + \pi X_{ist} + \eta_{ist}$$

- Parameter ρ_m captures the mean difference in number of deaths and injuries between period m and the pre-intervention period for the treatment year, relative to the same difference for the control (2010-11).
- The period of 150 days before the intervention as the benchmark
- We remove observation at top 0.1 percent of the distribution of the dependent variable

Traffic Accident Files (TAF) 2003-2013

- Comprehensive records of traffic accidents that involved fatality or injury
- Selection issue accidents causing no fatality or injury are excluded
- Rich dataset that has two modules – accident module and individual module
 - Date and location (township), weather and road conditions at the time of the accident
 - The primary cause and secondary causes
 - Number of consequent injuries and deaths, degree of each injury
 - Characteristics of all involved individuals
 - Types of the vehicles involved, the purpose of travel for each vehicle
 - Usage of protections (seatbelt and helmet)
 - BAC and BrAC test results on the drivers

Limitation:

- ① Selection issue accidents causing no fatality or injury are excluded
Lengths of daytime and nighttime are seasonal
- ② We do not have data on checkpoints yet
- ③ We identify repeat DUI offenders as drivers who caused at least two traffic accidents from 2003 to 2013

National Health Insurance (NHI) database: complete medical records of all Taiwanese from 2010 to 2013 (4 years)

- 1 Registry of beneficiaries (ID files): date of birth, gender, insurance type at the start of each year
- 2 Inpatient admissions (DD files): admission and discharge dates, diagnoses, expenses of each admission (copayment, drugs, bed, examinations (itemized), surgeries (itemized), etc.

Hourly weather data 2010-2013

- temperature
- rainfall

Summary Statistics

Table 1: Fatalities and injuries Caused by DUI and Non-DUI Accidents

	2010	2011	2012	2013
First-time DUI drivers				
Night-time	12,459	13,402	11,756	8,664
Day-time	8,525	8,995	8,398	8,002
Repeat DUI driver				
Night-time	1,106	1,424	1,337	1,177
Day-time	939	1,011	1,300	1,200
Non-DUI drivers				
Night-time	74,405	81,041	83,666	91,735
Day-time	176,028	188,147	202,279	239,222

Results for first-time DUI offenders

**Table 2: The Effects of 2012 Enforcement and 2013 Reform on DUI Deaths and Injuries
(First-time offenders)**

	2010-11 vs 2012		2010-11 vs 2013	
	(1)	(2)	(3)	(4)
	Nighttime	Daytime	Nighttime	Daytime
Mean Y of the treatment group in the first 30-day period before intervention	1.74	1.3	1.29	1.31
(Post 1-30 days) x Treatment	-0.461*** (0.085)	-0.124* (0.075)	-0.234*** (0.076)	-0.111 (0.073)
(Post 31-60 days) x Treatment	-0.256*** (0.085)	-0.106 (0.076)	-0.141* (0.079)	-0.125* (0.072)
(Post 61-90 days) x Treatment	-0.379*** (0.087)	-0.098 (0.074)	-0.262*** (0.080)	-0.044 (0.073)
(Post 91-120 days) x Treatment	-0.257*** (0.093)	-0.023 (0.073)	-0.204** (0.081)	-0.027 (0.074)
(Post 121-150 days) x Treatment	-0.219** (0.099)	-0.016 (0.073)	-0.372*** (0.086)	0.083 (0.075)
(Post 151-180 days) x Treatment	-0.349*** (0.094)	0.032 (0.074)	0.065 (0.087)	0.082 (0.073)
Observations	18,597	18,578	18,366	18,589

Summary of the results

- Significant and persistent nighttime effect in 2012 and 2013
- Limited daytime effect in 2012, 2013
- In our setting, we tend to attribute the effect to deterrence effect, rather than rehab or incapacitation.

Interpretations

- Beckers (1968) hypothesis of rational crimes based on benefit and cost of crimes at work.
- Drivers avoided drunk driving in the nighttime time because the expected cost was raised by the operation of sobriety checkpoints.
- Drivers in the daytime did not respond to the operation because the expected cost remained unchanged.
- Policies effect last surprisingly long even without heavy checkpoints, especially enforcement effect

Explanation:

- 1 The intensified checkpoints changed drivers expectation of risk, which is hard to identify
- 2 There is entry cost to strategies for preventing drunk driving, such as arranging a designated non-drinking driver, arranging alternate transportation, etc.

Results for Repeat DUI offenders

**Table 2: The Effects of 2012 Enforcement and 2013 Reform on DUI Deaths and Injuries
(Repeat offenders)**

	2010-11 vs 2012		2010-11 vs 2013	
	(1)	(2)	(3)	(4)
	Nighttime	Daytime	Nighttime	Daytime
Mean Y of the treatment group in the first 30-day period before intervention	0.13	0.03	0.146	0.185
(Post 1-30 days) x Treatment	-0.014 (0.022)	0.005 (0.010)	-0.037* (0.022)	-0.060*** (0.022)
(Post 31-60 days) x Treatment	-0.062*** (0.020)	-0.005 (0.010)	-0.024 (0.022)	-0.013 (0.024)
(Post 61-90 days) x Treatment	-0.038* (0.023)	-0.020** (0.009)	-0.036 (0.023)	-0.016 (0.023)
(Post 91-120 days) x Treatment	-0.031 (0.026)	-0.003 (0.010)	-0.046** (0.023)	0.014 (0.024)
(Post 121-150 days) x Treatment	-0.014 (0.025)	0.007 (0.010)	-0.029 (0.025)	-0.025 (0.023)
(Post 151-180 days) x Treatment	-0.072*** (0.024)	-0.003 (0.009)	-0.046* (0.024)	0.004 (0.022)
Observations	18,520	18,323	18,564	18,563

Explanation:

- 1 Repeat offenders might be less responsive to raised cost (enforcement or punishment).
- 2 Policy implication: need to address alcohol addiction, not DUI
- 3 USA is recently deciding on whether to make BAC limit 0.05, just like Taiwan.

Results for Non-DUI fatalities and injuries

Table 3. The Effect of 2012 Enforcement and 2013 Reform on **Non-DUI** Deaths and Injuries

	2010-11 vs 2012		2010-11 vs 2013	
	(1)	(2)	(3)	(4)
	Nighttime	Daytime	Nighttime	Daytime
Mean Y of the treatment group in the first 30-day period before intervention	11.08	31.88	12.48	34.57
(Post 1-30 days) x Treatment	-1.446*** (0.289)	-2.714*** (0.561)	-0.573* (0.293)	0.450 (0.619)
(Post 31-60 days) x Treatment	-1.057*** (0.286)	-0.631 (0.540)	-0.372 (0.279)	0.543 (0.646)
(Post 61-90 days) x Treatment	-1.718*** (0.287)	-2.399*** (0.572)	-0.180 (0.317)	0.924 (0.675)
(Post 91-120 days) x Treatment	-0.892*** (0.305)	-0.376 (0.532)	0.424 (0.360)	0.622 (0.670)
(Post 121-150 days) x Treatment	-0.277 (0.344)	2.952*** (0.557)	0.974** (0.395)	3.706*** (0.675)
(Post 151-180 days) x Treatment	-0.914** (0.364)	0.491 (0.518)	0.261 (0.397)	4.296*** (0.638)
Observations	18,661	18,660	18,675	18,662

Explanation:

- 1 Spillover effects are significant on non-DUI fatalities and injuries, in 2012 mainly
- 2 This was likely due to the deterrence effects on speeding, careless driving, usage of handheld device, etc.

Alternative explanation: awareness?

Explanation:

- Is it possible that media exposure of the anti-DUI policies raised drivers awareness of risk or morality?
- This explanation is unlikely unless the awareness effect was limited to nighttime drivers
- To further examine the potential awareness effect, we estimate the effect of the heinous car accident by Guan-Heng Yeh on April 25, 2012

$$DUI_{ist} = \alpha + \beta T_i + \sum_{m=0}^6 \gamma_m I_m + \sum_{m=1}^6 \rho_m (I_m T_i) + \lambda trend_t + \tau trend_t^2 + \sum_{s=1}^{19} \phi_s county_s + \theta_t Y_{2010} + \pi X_{ist} + \eta_{ist}$$

- m starts from 0 instead of 1, meaning 1 month prior
- a dummy I_0 is added to regression to indicate the time period from April 25 to May 31, 2012
- If the event had no effect, ρ_0 should be zero

Results for first-time DUI offenders

**Table 2: The Effects of 2012 Enforcement and 2013 Reform on DUI Deaths and Injuries
(First-time offenders)**

	2010-11 vs 2012	
	(1) Nighttime	(2) Daytime
Mean Y of the treatment group in the first 30-day period before intervention	0.97	0.72
(Pre 37-1 days) x Treatment	-0.103 (0.097)	-0.090 (0.080)
(Post 1-30 days) x Treatment	-0.549*** (0.100)	-0.147* (0.086)
(Post 31-60 days) x Treatment	-0.333*** (0.101)	-0.115 (0.088)
(Post 61-90 days) x Treatment	-0.452*** (0.103)	-0.112 (0.086)
(Post 91-120 days) x Treatment	-0.304*** (0.109)	-0.046 (0.085)
(Post 121-150 days) x Treatment	-0.277** (0.115)	-0.044 (0.085)
(Post 151-180 days) x Treatment	-0.405***	-0.014

- Awareness appears unimportant
- This implies that publicity campaigns against DUI may have a limited effect

- Results are robust when using number of accidents as the outcome variable
- Heterogeneous effect on subgroups of age and of different vehicles, severity of DUI in both 2012 and 2013

Conclusions

- Enforcement effect was significant and persistent
- Punishment effect was significant but less long lasting
- Spillover effect was significant but short-lived, 2012 mainly
- The 2012 and 2013 interventions combined accounted for at least 67 percent of the decline in DUI fatalities and injuries from 2011 to 2014