Effectiveness of Different Policies Aimed to Reduce Traffic Deaths

# Data Exploration:

First, we organized and tried to comprehend the data which is based on 336 observations (N) from 48 States (Entities) through 7 time periods of years 1982-1988 (T).

We wanted to study what policies effectively reduce mraidall (alcohol-involved VFR), which is referenced as Vehicle Fatality Rate X 10,000 (**VFR**) from this point on. The policies we focused on while studying this data were: beertax (tax on case of beer in dollars), jaild (mandatory jail sentence), comserd (mandatory community service) and mlda (minimum legal drinking age).

**Table 1.1** shows variables that we initially thought could be significant in our model with some transformed into logarithmic form for better readability and interpretation.

We began with the following control variables:

* State unemployment rate (%): unrate
* Log per capita personal income ($): lnperinc
* GSP rate of change: gspch
* % of drivers aged 15-24: yngdrv
* % residing in dry counties: dry
* Log Population: lnpop
* Log ave. mile per driver: lnvmiles
* Log population of 15-17 year olds: lnpop1517
* Log population of 18-20 year olds: lnpop1820
* Log population of 21-24 year olds: lnpop2124
* Per capita pure alcohol consumption (annual, gallons): spircons
* % Southern Baptist: sobapt
* % Mormon: mormon

**Image 1.1** shows evidence that our panel data is balanced.

**Table 1.2** displays the summary for all the variables mentioned above and we found that the mean VFR is **0.6593** andmean beertax was $**0.5132** per case of beer. On average, ~**28%** of the of the 48 continuous states had mandatory jail sentences and ~**18.5%** of the states had mandatory community service.

Next, we used graphical representations to interpret the policies and some relevant variables for insight on the data.

**Graph 1.1** displays the mean mraidall (VFR) with respect to each state. The states with noticeable changes included *Mississippi, Montana, New Hampshire, Texas, Wyoming,* and *South Carolina*. The VFR in Mississippi experienced a sharp decline in the first 2 years followed by a sharp increase before it catches a constant rate. Montana had a bumpy decreasing trend as well as New Hampshire and Wyoming. Texas had a smooth decreasing trend from 1982 to 1988. South Carolina though had an increasing trend for four years before decreasing in the end.

**Graphs 1.2- 1.5** imply that during the period where unemployment rate decreased, the VFR also decreased. When the logarithmic values of personal income increased, the VFR decreased. We expected that with the increase on beer tax, VFR would go down; however, this was not the case. VFR decreased even when beer tax decreased, suggesting that beer tax is not an effective policy.

**Graphs 1.6 – 1.7** imply that mandatory jail sentences and mandatory community service helped reduce the VFR. However, when VFR peaks in 1986, so did mandatory jail time and community service, which implicates that these two variables may not be the most effective policies.

**Graph 1.8-1.10** shows that if the beer tax is above the mean, then VFR was higher on average and had a fluctuating trend. If the beer tax is below the mean, then VFR was lower overall. If the minimum legal drinking age is 18, VFR had an upward trend over the years. At 19, VFR decreased before spiking up in 1987. For age 20, VFR decreased before bouncing up in 1984 and then increasing sharply in 1986 onwards. For age 21, it was an overall decrease throughout the years with a more stable pattern compared to the others.

# Regression Analysis:

We ran a **pooled OLS model** with Cluster Robust standard errors that included all variables we thought would affect our dependent variable VFR. According to the results, we found that none of the variables were significant at the 5% level except lnperinc, spircons and mormon.

According to pooled model when other factors are kept constant, if per capita personal income increases by 1%, we expect VFR to decrease by approximately 0.00844 and a 1-gallon annual increase in the per capita consumption of pure alcohol is expected to increase the VFR by 0.062. A 1% increase in Mormon population is expected to decrease the VFR by 0.005.

This model though is not applicable to our data since there is an endogeneity problem.

We used the **fixed effects model** to control for unobserved heterogeneity with the same variables from the pooled model. The following are findings from the results compared to the pooled OLS:

* Magnitude for beertax has increased but is still insignificant even at the 10% significance level.
* Magnitude for jaild increased by more than twice its value from the pooled model. The coefficient for comserd increased by almost five times. These variables have now become statistically significant at the 5% level.
* If all factors are kept constant, a mandatory jail sentence is expected to increase VFR by 0.213 compared to if there was no jail time and mandatory community service is expected to decrease VFR by 0.2 compared to if there was no mandatory community service.
* Minimum legal drinking age is still insignificant.
* Spircons is even more significant, with its coefficient increasing by ~4 times. A 1-gallon annual increase in the per capita consumption of pure alcohol is expected to increase the VFR by 0.264.
* The magnitude for unrate is almost the same; however, it is now significant at the 10% level.
* lnperinc now has decreased by almost half and is not statistically significant anymore.
* The rest of the variables remain insignificant.

Next, we did an **entity and time fixed effects model** since omitted variables like the development and presence of safer cars might vary over time but not across economic entities. The results showed that jaild, spircons and comserd are significant at the 5% level but the rest are not. Even though beertax and mlda are not significant, we kept them in the model since they are the policies we are monitoring.

States with mandatory jail sentences are expected to have a higher VFR by 0.233 compared to states without and states with mandatory community service are expected to have a 0.22 lower VFR compared to those without, given all other variables are constant. A 1-gallon annual increase in the per capita consumption of pure alcohol is expected to increase the VFR by 0.311.

Then, we tested the significance of our time effects to see if they are jointly statistically significant. According to the test, we have a p-value of 0.0021 signifying that at least one year influences the model, so we continued to use the time variables.

We regressed a time fixed effect models without these insignificant variables: gspch, dry, pop, and vmiles **(restricted model 1)**. We saw that jaild, comserd, unrate and spircons are statistically significant. A mandatory jail sentence is expected to increase VFR by 0.24 more than if there was no jail time and mandatory community service is expected to decrease VFR by 0.21 more than if there was no mandatory community service, given all other variables are constant. A 1-gallon annual increase in the per capita consumption of pure alcohol is expected to increase the VFR by 0.299 and a 1% increase in unemployment rate is expected to decrease VFR by 0.03.

The coefficients for the different population ages and yngdrv are only insignificant at the 10% level so they were removed from the model and we proceeded with our new time fixed effect model **(restricted model 2).**

In this model, we have variables beertax, jaild, comserd, mlda, unrate and spircons. At the 5% level, jaild, comserd, spircons and unrate are still significant but beertax and mlda are not. The coefficients for this model have not changed much from restricted model 1. The time variables also show that each year compared to 1982 had a reduction in VFR that was statistically significant at the 5% level except 1986 at the 10% level.

Moving forward, we took restricted model 2 variables from a time fixed effects and fitted them into a random effects model to see which one is better for our data and which variables explain our dependent variable well.

In our **random effects model**, we finally saw beertax become significant but only at the 10% level. Jaild is significant at the 5% level but comserd and unrate are only significant at the 10% level while mlda is still insignificant.

Mandatory jail sentence is expected to increase VFR by 0.205 and mandatory community service is expected to decrease VFR by 0.15, given all other variables are constant. Under the same conditions, a 1% increase in unemployment rate is expected to decrease VFR by 0.0256.

In the last part of our regression analysis, we performed a **Hausman Test** to determine which model to choose – fixed (entity and time) or random – with the following explanatory variables: beertax, jaild, comserd, mlda, unrate, spircons and time variables. We rejected the null hypothesis that there is no endogeneity and selected the entity time fixed effects model.

# Summary and Conclusion:

After analyzing the models taken to observe how different factors and policies affected the alcohol-involved vehicle fatality rate, we concluded that the entity time fixed effects model was the most suitable approach **(restricted model 2).** This model controls for omitted variable bias and observed/unobserved heterogeneity, and is not randomly sampled data; therefore, the estimators will be unbiased and consistent.

The controlling variables that significantly impacted the VFR were per capita pure alcohol consumption and the unemployment rate. As alcohol consumption in a state increased annually by 1-gallon, the VFR increased by 0.264. A 1% increase in the unemployment rate resulted in a 0.032 decrease in VFR. While these factors are not policies, they can influence how states make policies to reduce alcohol-involved VFR.

All time indicator variables were significant at the 5% level except 1986 which was still significant at the 10% level. We saw that the VFR decreased each year when compared to 1982.

The beertax and minimum legal drinking age policies did not show to have a significant impact on the alcohol-involved VFR on this data. The policies that did significantly impact the alcohol-involved VFR were mandatory jail sentence and mandatory community service. States with a jail sentence had higher VFR on average than states without by 0.236; therefore, implementing a mandatory jail sentence is not an effective policy to reduce the alcohol-induced VFR. Having a mandatory community service though reduced the VFR by 0.195, so more states should consider implementing this policy.

# Appendix

## Table 1.1

Display **of organized data set**

Table

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## Image 1.1

Panel Data Set up

Text

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## Table 1.2

. xtsum

Variable | Mean Std. Dev. Min Max | Observations

-----------------+--------------------------------------------+----------------

state overall | 30.1875 15.30985 1 56 | N = 336

between | 15.44883 1 56 | n = 48

within | 0 30.1875 30.1875 | T = 7

| |

year overall | 1985 2.002983 1982 1988 | N = 336

between | 0 1985 1985 | n = 48

within | 2.002983 1982 1988 | T = 7

| |

VFR overall | .6592957 .2596777 .23372 1.77202 | N = 336

between | .2286467 .2606729 1.420347 | n = 48

within | .1268445 -.2769114 1.134474 | T = 7

| |

beertax overall | .513256 .4778442 .0433109 2.720764 | N = 336

between | .4789513 .0481679 2.440507 | n = 48

within | .0552203 .1415352 .7935126 | T = 7

| |

jaild overall | .280597 .449963 0 1 | N = 335

between | .4280223 0 1 | n = 48

within | .1491349 -.5765458 .7091684 | T = 6.97917

| |

comserd overall | .1850746 .388939 0 1 | N = 335

between | .3691987 0 1 | n = 48

within | .1308 -.6720682 .6136461 | T = 6.97917

| |

mlda overall | 20.45563 .8990255 18 21 | N = 336

between | .674607 18.78571 21 | n = 48

within | .6010849 18.74134 22.66991 | T = 7

| |

unrate overall | 7.346726 2.533405 2.4 18 | N = 336

between | 1.953377 4.1 13.2 | n = 48

within | 1.634257 4.046726 12.14673 | T = 7

| |

lnperinc overall | 9.525574 .15817 9.160495 10.00755 | N = 336

between | .1500003 9.204648 9.875391 | n = 48

within | .054043 9.367712 9.669338 | T = 7

| |

gspch overall | .0253135 .0431732 -.1236415 .1423609 | N = 336

between | .0297138 -.0652201 .0787735 | n = 48

within | .0315725 -.0801624 .10419 | T = 7

| |

yngdrv overall | .1859299 .0248736 .073137 .281625 | N = 336

between | .017161 .1375446 .222699 | n = 48

within | .0181513 .1215223 .2513753 | T = 7

| |

dry overall | 4.267074 9.500901 0 45.7921 | N = 336

between | 9.563572 0 42.21479 | n = 48

within | .6658347 1.155888 7.844387 | T = 7

| |

lnpop overall | 14.96255 .9772593 13.07946 17.15887 | N = 336

between | .9858179 13.12888 17.09024 | n = 48

within | .0245966 14.87011 15.06737 | T = 7

| |

lnp~1517 overall | 11.90349 .9846742 9.952279 13.97422 | N = 336

between | .9928369 10.0112 13.94328 | n = 48

within | .0388974 11.77784 12.00098 | T = 7

| |

lnp~1820 overall | 11.98732 .9713251 9.952276 14.0939 | N = 336

between | .9789808 10.08469 14.06552 | n = 48

within | .0472697 11.82639 12.08473 | T = 7

| |

lnp~2124 overall | 12.28173 .9728019 10.30896 14.45367 | N = 336

between | .9797092 10.47877 14.41847 | n = 48

within | .0608647 12.11193 12.40561 | T = 7

| |

lnvmiles overall | 8.960302 .1562787 8.428656 10.17154 | N = 336

between | .1275165 8.539781 9.266268 | n = 48

within | .0919447 8.71565 10.00649 | T = 7

| |

spircons overall | 1.75369 .6835745 .79 4.9 | N = 336

between | .6734649 .8614286 4.388572 | n = 48

within | .147792 1.255119 2.265119 | T = 7

| |

perinc overall | 13880.18 2253.046 9513.762 22193.46 | N = 336

between | 2122.712 9950.87 19515.82 | n = 48

within | 806.8547 11432.6 16557.82 | T = 7

| |

sobapt overall | 7.156925 9.762621 0 30.3557 | N = 336

between | 9.849453 0 30.28947 | n = 48

within | .185949 6.354682 7.974181 | T = 7

| |

mormon overall | 2.801933 9.665279 .1 65.9165 | N = 336

between | 9.750385 .1 63.768 | n = 48

within | .2244279 .6929348 4.950431 | T = 7

| |

vmiles overall | 7890.754 1475.659 4576.346 26148.27 | N = 336

between | 1018.511 5129.503 10592.69 | n = 48

within | 1076.468 4722.285 23678.73 | T = 7

| |

allmort overall | 928.6637 934.0515 79 5504 | N = 336

between | 937.6918 107.8571 5045 | n = 48

within | 94.52131 456.6637 1449.235 | T = 7

| |

mrall overall | .000204 .000057 .0000821 .0004218 | N = 336

between | .0000546 .000111 .0003653 | n = 48

within | .0000179 .0001456 .0002963 | T = 7

| |

allnite overall | 182.5833 188.4311 13 1049 | N = 336

between | 188.4657 19.71429 914.8571 | n = 48

within | 24.96232 29.29762 390.2976 | T = 7

| |

mralln overall | .0000388 .000011 .0000172 .0000944 | N = 336

between | 9.19e-06 .0000227 .0000681 | n = 48

within | 6.08e-06 .0000123 .00007 | T = 7

| |

allsvn overall | 109.9494 108.5397 8 603 | N = 336

between | 108.4998 12.71429 525.7143 | n = 48

within | 14.8158 18.23512 219.2351 | T = 7

| |

a1517 overall | 62.61012 55.72909 3 318 | N = 336

between | 55.26257 7 272.5714 | n = 48

within | 10.31876 22.03869 108.0387 | T = 7

| |

mra1517 overall | .0003034 .0000937 .0001163 .0006735 | N = 336

between | .0000739 .0001566 .0004865 | n = 48

within | .0000585 .0000682 .0004945 | T = 7

| |

a1517n overall | 12.2619 12.25341 0 76 | N = 336

between | 11.64903 1.285714 57.71429 | n = 48

within | 4.108133 -6.452381 30.54762 | T = 7

| |

mra1517n overall | .0000598 .000033 0 .0002571 | N = 336

between | .0000192 .0000297 .000131 | n = 48

within | .0000269 -.0000172 .0001859 | T = 7

| |

a1820 overall | 106.6607 104.2236 7 601 | N = 336

between | 104.2461 13 567.5714 | n = 48

within | 13.78232 52.08929 197.0893 | T = 7

| |

a1820n overall | 33.52679 33.23834 0 196 | N = 336

between | 32.5065 3.714286 150.5714 | n = 48

within | 8.187827 3.955357 79.09821 | T = 7

| |

mra1820 overall | .0004728 .0001522 .0001855 .0010952 | N = 336

between | .0001308 .0002679 .0009358 | n = 48

within | .0000798 .0001392 .0008032 | T = 7

| |

mra1820n overall | .0001436 .0000613 0 .0005238 | N = 336

between | .0000418 .0000933 .0003121 | n = 48

within | .0000452 -.0000865 .0003554 | T = 7

| |

a2124 overall | 126.872 131.7886 12 770 | N = 336

between | 131.8842 17.42857 738.2857 | n = 48

within | 16.92104 30.15774 230.1577 | T = 7

| |

mra2124 overall | .0004091 .0001225 .0002 .0008922 | N = 336

between | .0001044 .0002323 .0007501 | n = 48

within | .0000656 .000158 .0006783 | T = 7

| |

a2124n overall | 41.37798 42.93031 1 249 | N = 336

between | 42.38749 5.714286 211 | n = 48

within | 8.859577 -3.907738 88.09226 | T = 7

| |

mra2124n overall | .0001284 .0000422 .0000222 .0003143 | N = 336

between | .0000263 .0000545 .0001916 | n = 48

within | .0000333 .0000114 .0002773 | T = 7

| |

aidall overall | 293.3332 303.5807 24.6 2094.9 | N = 336

between | 298.4363 34.49 1525.471 | n = 48

within | 68.49986 -197.6582 862.7617 | T = 7

| |

mraidall overall | .0000659 .000026 .0000234 .0001772 | N = 336

between | .0000229 .0000261 .000142 | n = 48

within | .0000127 -.0000277 .0001134 | T = 7

| |

pop overall | 4930272 5073704 478999.7 2.83e+07 | N = 336

between | 5114958 503428.5 2.65e+07 | n = 48

within | 219679.6 3254075 6782127 | T = 7

| |

pop1517 overall | 230815.5 229896.3 21000.02 1172000 | N = 336

between | 231628.1 22285.71 1136572 | n = 48

within | 12713.51 140673.2 305675.2 | T = 7

| |

pop1820 overall | 249090.4 249345.6 20999.96 1321004 | N = 336

between | 251240.7 24020.29 1284364 | n = 48

within | 13486.92 174202.9 293807.6 | T = 7

| |

pop2124 overall | 336389.9 345304.4 30000.16 1892998 | N = 336

between | 347721.3 35714.24 1828428 | n = 48

within | 22148.45 238532.4 400959.9 | T = 7

| |

miles overall | 37101.49 37454.37 3993 241575 | N = 336

between | 37455.95 4670.143 205945 | n = 48

within | 5000.848 1155.489 72731.5 | T = 7

## Graph 1.1

***Alcohol Involved VFR by state:***

A picture containing text

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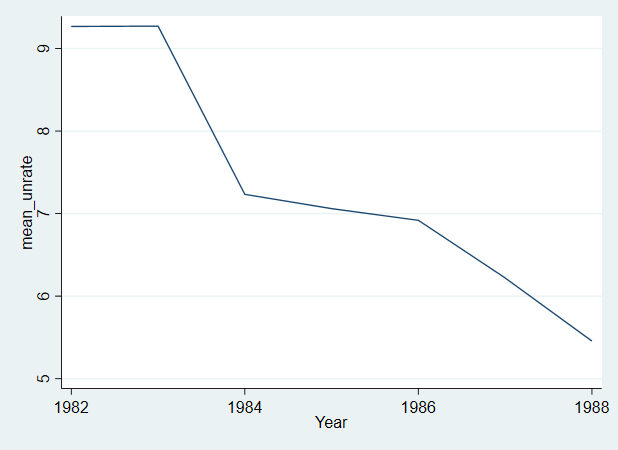
## Graph 1.2 – 1.5

***Overall Alcohol Involved Vehicle Fatality Rate over time:***

Chart, line chart

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***Overall State Unemployment Rate (%) over time:***

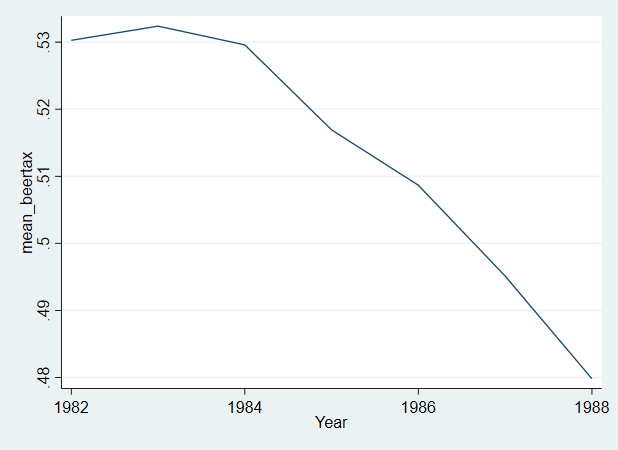
 ***Graph 1.3***

***Log Per Capita Personal Income ($) over time:***

***Chart, line chart

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***Overall Tax on Case of Beer ($) over time:***

 ***Graph 1.5***

## Graphs 1.6 – 1.10

***Overall Alcohol Involved VFR over time by Mandatory Jail Sentence:***

***Chart, line chart

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***Overall Alcohol Involved VFR over time by Mandatory Community Service:***

***Chart, line chart

Description automatically generated Graph 1.7***

***Overall Alcohol Involved VFR over time by Beer tax costs, above the tax mean and below the tax mean:***

***Chart, line chart

Description automatically generated Graph 1.8***

***Overall Alcohol Involved VFR over time by Policy:***

***Graph 1.9***

***Overall Alcohol Involved VFR over time by Minimum Legal Drinking Age:***

***Chart, line chart

Description automatically generatedGraph 1.10***

## Pooled OLS Cluster Robust model

. reg VFR beertax jaild comserd mlda unrate lnperinc gspch yngdrv dry lnpop lnpop1517 lnpop1820 lnpop2124 lnvmiles spircons mormon sobapt, vce(cluster state)

Linear regression Number of obs = 335

F(17, 47) = 9.63

Prob > F = 0.0000

R-squared = 0.5173

Root MSE = .18528

(Std. Err. adjusted for 48 clusters in state)

------------------------------------------------------------------------------

| Robust

VFR | Coef. Std. Err. t P>|t| [95% Conf. Interval]

-------------+----------------------------------------------------------------

beertax | -.0804664 .0618557 -1.30 0.200 -.2049039 .0439711

jaild | .088616 .064984 1.36 0.179 -.042115 .2193469

comserd | .0415562 .0645087 0.64 0.523 -.0882186 .171331

mlda | -.0133454 .0214923 -0.62 0.538 -.0565822 .0298915

unrate | -.0143687 .0109095 -1.32 0.194 -.0363159 .0075784

lnperinc | -.8446345 .2636253 -3.20 0.002 -1.37498 -.3142887

gspch | -.4702759 .4122397 -1.14 0.260 -1.299595 .3590433

yngdrv | 1.28328 .8838824 1.45 0.153 -.4948625 3.061422

dry | -.0007431 .0033982 -0.22 0.828 -.0075794 .0060933

lnpop | -.1486685 .3729984 -0.40 0.692 -.8990445 .6017076

lnpop1517 | .6403295 .3750191 1.71 0.094 -.1141117 1.394771

lnpop1820 | -.6705837 .3717515 -1.80 0.078 -1.418451 .0772838

lnpop2124 | .1699904 .3424886 0.50 0.622 -.5190078 .8589885

lnvmiles | .2729096 .1518297 1.80 0.079 -.0325324 .5783516

spircons | .0620481 .0284373 2.18 0.034 .0048395 .1192566

mormon | -.005345 .0019061 -2.80 0.007 -.0091795 -.0015105

sobapt | .0086388 .0052139 1.66 0.104 -.0018503 .0191278

\_cons | 6.820528 2.904737 2.35 0.023 .9769507 12.6641

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## Fixed Effects Model

. xtreg VFR beertax jaild comserd mlda unrate lnperinc gspch yngdrv dry lnpop lnpop1517 lnpop1820 lnpop2124 lnvmiles spircons mormon sobapt, fe vce(cluster state)

Fixed-effects (within) regression Number of obs = 335

Group variable: state Number of groups = 48

R-sq: Obs per group:

within = 0.1981 min = 6

between = 0.0476 avg = 7.0

overall = 0.0196 max = 7

F(16,47) = .

corr(u\_i, Xb) = -0.8060 Prob > F = .

(Std. Err. adjusted for 48 clusters in state)

------------------------------------------------------------------------------

| Robust

VFR | Coef. Std. Err. t P>|t| [95% Conf. Interval]

-------------+----------------------------------------------------------------

beertax | -.2136371 .2432033 -0.88 0.384 -.7028989 .2756248

jaild | .213851 .0166844 12.82 0.000 .1802863 .2474157

comserd | -.2005583 .0776259 -2.58 0.013 -.3567216 -.0443951

mlda | .0001963 .0210408 0.01 0.993 -.0421322 .0425249

unrate | -.0166716 .0088237 -1.89 0.065 -.0344227 .0010794

lnperinc | .4542481 .3670334 1.24 0.222 -.2841279 1.192624

gspch | -.0287489 .239672 -0.12 0.905 -.5109068 .453409

yngdrv | .5394726 .7048084 0.77 0.448 -.878419 1.957364

dry | .0047967 .0209808 0.23 0.820 -.0374112 .0470046

lnpop | -.7141909 .7008742 -1.02 0.313 -2.124168 .6957861

lnpop1517 | .6221713 .3232042 1.93 0.060 -.0280317 1.272374

lnpop1820 | .1713324 .3361131 0.51 0.613 -.50484 .8475048

lnpop2124 | .1153901 .3032457 0.38 0.705 -.4946615 .7254417

lnvmiles | -.0026777 .0899731 -0.03 0.976 -.1836803 .1783249

spircons | .2641379 .1113284 2.37 0.022 .040174 .4881019

mormon | .0023131 .0381183 0.06 0.952 -.074371 .0789973

sobapt | .0153176 .0831018 0.18 0.855 -.1518617 .1824969

\_cons | -4.326871 9.079105 -0.48 0.636 -22.59167 13.93793

-------------+----------------------------------------------------------------

sigma\_u | .39417947

sigma\_e | .12646998

rho | .90666711 (fraction of variance due to u\_i)

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## Entity and Time Fixed Effects Model

. xtreg VFR beertax jaild comserd mlda unrate lnperinc gspch yngdrv dry lnpop lnpop1517 lnpop1820 lnpop2124 lnvmil

> es spircons mormon sobapt i.year, fe vce(cluster state)

Fixed-effects (within) regression Number of obs = 335

Group variable: state Number of groups = 48

R-sq: Obs per group:

within = 0.2518 min = 6

between = 0.1310 avg = 7.0

overall = 0.0817 max = 7

F(22,47) = .

corr(u\_i, Xb) = -0.9473 Prob > F = .

(Std. Err. adjusted for 48 clusters in state)

------------------------------------------------------------------------------

| Robust

VFR | Coef. Std. Err. t P>|t| [95% Conf. Interval]

-------------+----------------------------------------------------------------

beertax | -.2566403 .2404 -1.07 0.291 -.7402626 .2269821

jaild | .2336855 .0197134 11.85 0.000 .1940272 .2733438

comserd | -.2204709 .0847925 -2.60 0.012 -.3910514 -.0498905

mlda | -.0024559 .0203543 -0.12 0.904 -.0434035 .0384917

unrate | -.0240344 .0146982 -1.64 0.109 -.0536034 .0055346

lnperinc | -.0066958 .3564415 -0.02 0.985 -.7237637 .7103721

gspch | .5722916 .388845 1.47 0.148 -.2099637 1.354547

yngdrv | .3380146 .6142037 0.55 0.585 -.8976038 1.573633

dry | .0010948 .0204524 0.05 0.958 -.0400501 .0422397

lnpop | .1462484 1.055865 0.14 0.890 -1.977878 2.270375

lnpop1517 | -.2688584 .3523672 -0.76 0.449 -.9777299 .440013

lnpop1820 | .4020457 .6672841 0.60 0.550 -.9403567 1.744448

lnpop2124 | .1065147 .4156998 0.26 0.799 -.7297654 .9427947

lnvmiles | -.0235105 .0892354 -0.26 0.793 -.203029 .156008

spircons | .311773 .0999927 3.12 0.003 .1106136 .5129323

mormon | -.0330543 .0339257 -0.97 0.335 -.1013041 .0351955

sobapt | -.0081206 .0743452 -0.11 0.913 -.1576839 .1414426

|

year |

1983 | -.0944925 .0323231 -2.92 0.005 -.1595182 -.0294668

1984 | -.1533695 .0613539 -2.50 0.016 -.2767976 -.0299414

1985 | -.1587423 .0886892 -1.79 0.080 -.3371619 .0196773

1986 | -.0748311 .1314172 -0.57 0.572 -.3392085 .1895462

1987 | -.1049265 .1708138 -0.61 0.542 -.4485595 .2387064

1988 | -.1031417 .21632 -0.48 0.636 -.5383214 .332038

|

\_cons | -4.223813 8.298766 -0.51 0.613 -20.91878 12.47115

-------------+----------------------------------------------------------------

sigma\_u | .70574478

sigma\_e | .1235399

rho | .97026888 (fraction of variance due to u\_i)

-------------------------------------------------------------------------------------

## Time Effects Hypothesis test

. do "C:\Users\JMA200~1\AppData\Local\Temp\340\STD53c8\_000000.tmp"

. testparm i.year

( 1) 1983.year = 0

( 2) 1984.year = 0

( 3) 1985.year = 0

( 4) 1986.year = 0

( 5) 1987.year = 0

( 6) 1988.year = 0

F( 6, 47) = 4.12

Prob > F = 0.0021

## Restricted Model 1

. xtreg VFR beertax jaild comserd mlda unrate spircons yngdrv lnpop1517 lnpop1820 lnpop2124 i.year, fe vce(cluster state)

Fixed-effects (within) regression Number of obs = 335

Group variable: state Number of groups = 48

R-sq: Obs per group:

within = 0.2433 min = 6

between = 0.2174 avg = 7.0

overall = 0.1359 max = 7

F(15,47) = .

corr(u\_i, Xb) = -0.9295 Prob > F = .

(Std. Err. adjusted for 48 clusters in state)

------------------------------------------------------------------------------

| Robust

VFR | Coef. Std. Err. t P>|t| [95% Conf. Interval]

-------------+----------------------------------------------------------------

beertax | -.2143359 .2247175 -0.95 0.345 -.6664091 .2377374

jaild | .2415373 .0148719 16.24 0.000 .2116189 .2714556

comserd | -.2104885 .0820478 -2.57 0.014 -.3755474 -.0454296

mlda | -.001835 .0179294 -0.10 0.919 -.0379042 .0342343

unrate | -.0303483 .0117827 -2.58 0.013 -.054052 -.0066445

spircons | .2989838 .0981135 3.05 0.004 .101605 .4963627

yngdrv | .1689624 .5457198 0.31 0.758 -.9288842 1.266809

lnpop1517 | -.147086 .2636389 -0.56 0.580 -.6774591 .3832871

lnpop1820 | .5982292 .4998909 1.20 0.237 -.4074215 1.60388

lnpop2124 | .0206503 .2987582 0.07 0.945 -.5803738 .6216743

|

year |

1983 | -.0608398 .0268285 -2.27 0.028 -.1148117 -.0068678

1984 | -.1100715 .0534971 -2.06 0.045 -.2176939 -.0024492

1985 | -.1353928 .0595096 -2.28 0.028 -.2551108 -.0156749

1986 | -.0610965 .0703016 -0.87 0.389 -.2025251 .080332

1987 | -.0914463 .0879144 -1.04 0.304 -.2683072 .0854146

1988 | -.0711227 .1141009 -0.62 0.536 -.3006641 .1584186

|

\_cons | -5.149056 5.787988 -0.89 0.378 -16.79299 6.494873

-------------+----------------------------------------------------------------

sigma\_u | .59068366

sigma\_e | .12262474

rho | .95868368 (fraction of variance due to u\_i)

------------------------------------------------------------------------------------------------------------------------------------------------------------

## Restricted model 2

. xtreg VFR beertax jaild comserd mlda unrate spircons i.year, fe vce(cluster state)

Fixed-effects (within) regression Number of obs = 335

Group variable: state Number of groups = 48

R-sq: Obs per group:

within = 0.2354 min = 6

between = 0.0771 avg = 7.0

overall = 0.0315 max = 7

F(11,47) = .

corr(u\_i, Xb) = -0.7947 Prob > F = .

(Std. Err. adjusted for 48 clusters in state)

------------------------------------------------------------------------------

| Robust

VFR | Coef. Std. Err. t P>|t| [95% Conf. Interval]

-------------+----------------------------------------------------------------

beertax | -.2191313 .2199808 -1.00 0.324 -.6616755 .223413

jaild | .2362551 .0130923 18.05 0.000 .2099168 .2625934

comserd | -.1953402 .0800332 -2.44 0.018 -.3563462 -.0343342

mlda | -.0011711 .017152 -0.07 0.946 -.0356764 .0333342

unrate | -.0317377 .0119645 -2.65 0.011 -.0558071 -.0076683

spircons | .2644314 .0816639 3.24 0.002 .1001449 .4287179

|

year |

1983 | -.0670637 .0239062 -2.81 0.007 -.1151568 -.0189705

1984 | -.1258915 .0459793 -2.74 0.009 -.21839 -.033393

1985 | -.1607316 .0494188 -3.25 0.002 -.2601495 -.0613137

1986 | -.1070452 .0622678 -1.72 0.092 -.2323119 .0182216

1987 | -.1528763 .0735304 -2.08 0.043 -.3008003 -.0049522

1988 | -.1698523 .0805474 -2.11 0.040 -.3318928 -.0078118

|

\_cons | .6478674 .4134844 1.57 0.124 -.1839559 1.479691

-------------+----------------------------------------------------------------

sigma\_u | .38257984

sigma\_e | .12236879

rho | .90718987 (fraction of variance due to u\_i)

------------------------------------------------------------------------------

## Random Effects Model

. xtreg VFR beertax jaild comserd mlda unrate spircons i.year, re cluster(state)

Random-effects GLS regression Number of obs = 335

Group variable: state Number of groups = 48

R-squared: Obs per group:

Within = 0.1851 min = 6

Between = 0.0349 avg = 7.0

Overall = 0.0606 max = 7

Wald chi2(12) = 64.52

corr(u\_i, X) = 0 (assumed) Prob > chi2 = 0.0000

(Std. err. adjusted for 48 clusters in state)

------------------------------------------------------------------------------

| Robust

VFR | Coefficient std. err. z P>|z| [95% conf. interval]

-------------+----------------------------------------------------------------

beertax | .0995879 .0536098 1.86 0.063 -.0054855 .2046612

jaild | .2045665 .053014 3.86 0.000 .100661 .308472

comserd | -.1475858 .077544 -1.90 0.057 -.2995693 .0043977

mlda | -.0064307 .016378 -0.39 0.695 -.0385309 .0256695

unrate | -.0258585 .0132601 -1.95 0.051 -.0518478 .0001309

spircons | .0056232 .0380779 0.15 0.883 -.0690081 .0802544

|

year |

1983 | -.0794518 .0234151 -3.39 0.001 -.1253446 -.033559

1984 | -.136258 .04781 -2.85 0.004 -.2299639 -.0425522

1985 | -.1804119 .0516694 -3.49 0.000 -.2816821 -.0791418

1986 | -.1537528 .063143 -2.43 0.015 -.2775108 -.0299948

1987 | -.2003318 .0745963 -2.69 0.007 -.3465379 -.0541258

1988 | -.2185893 .0832496 -2.63 0.009 -.3817556 -.0554231

|

\_cons | 1.02838 .3828008 2.69 0.007 .2781044 1.778656

-------------+----------------------------------------------------------------

sigma\_u | .20074109

sigma\_e | .12236879

rho | .72907869 (fraction of variance due to u\_i)

------------------------------------------------------------------------------

## Hausman Test 1

. hausman fixed1 random1

---- Coefficients ----

| (b) (B) (b-B) sqrt(diag(V\_b-V\_B))

| fixed1 random1 Difference S.E.

-------------+----------------------------------------------------------------

beertax | -.2191313 .0995879 -.3187191 .1159886

jaild | .2362551 .2045665 .0316886 .0710853

comserd | -.1953402 -.1475858 -.0477543 .0810085

mlda | -.0011711 -.0064307 .0052596 .0017058

unrate | -.0317377 -.0258585 -.0058792 .0024735

spircons | .2644314 .0056232 .2588082 .083734

year |

1983 | -.0670637 -.0794518 .0123882 .

1984 | -.1258915 -.136258 .0103666 .0075842

1985 | -.1607316 -.1804119 .0196803 .0136739

1986 | -.1070452 -.1537528 .0467076 .0246531

1987 | -.1528763 -.2003318 .0474556 .0292318

1988 | -.1698523 -.2185893 .048737 .0345069

------------------------------------------------------------------------------

b = consistent under Ho and Ha; obtained from xtreg

B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(12) = (b-B)'[(V\_b-V\_B)^(-1)](b-B)

= -50.07

Warning: chi2 < 0 ==> model fitted on these data

fails to meet the asymptotic assumptions

of the Hausman test; see suest for a

generalized test.

\* Prob > chi2 = 0.0000