DO MORE GUNS REDUCE CRIME?

APPLIED ECONOMETRICS AND TIME SERIES ANALYSIS

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OBJECTIVE

The aim of this project is to analyze and check whether shall-issue law helps to reduce crime rate or not from data of 51 states.

INTRODUCTION

What is “shall-issue” law?

A Shall-issue law is one that provides governments to issue concealed carry handgun permits to any applicant if they met the necessary criteria.
Following are criteria to issue permit:

- The applicant must be an adult
- The applicant should not have significant criminal record
- The applicant should not history of mental illness
- The applicant should complete, if required by law, a course in firearms safety training.

If the applicant fulfills the above criteria, he/she will be issued a permit to carry a gun without demonstrating “good cause".

View behind the law:

The view behind this idea is when law-abiding citizens are equipped with a gun, they are no longer defenseless against would-be criminals. This will make the crime rate go down.

EXPLORATORY DATA ANALYSIS

Data Overview:

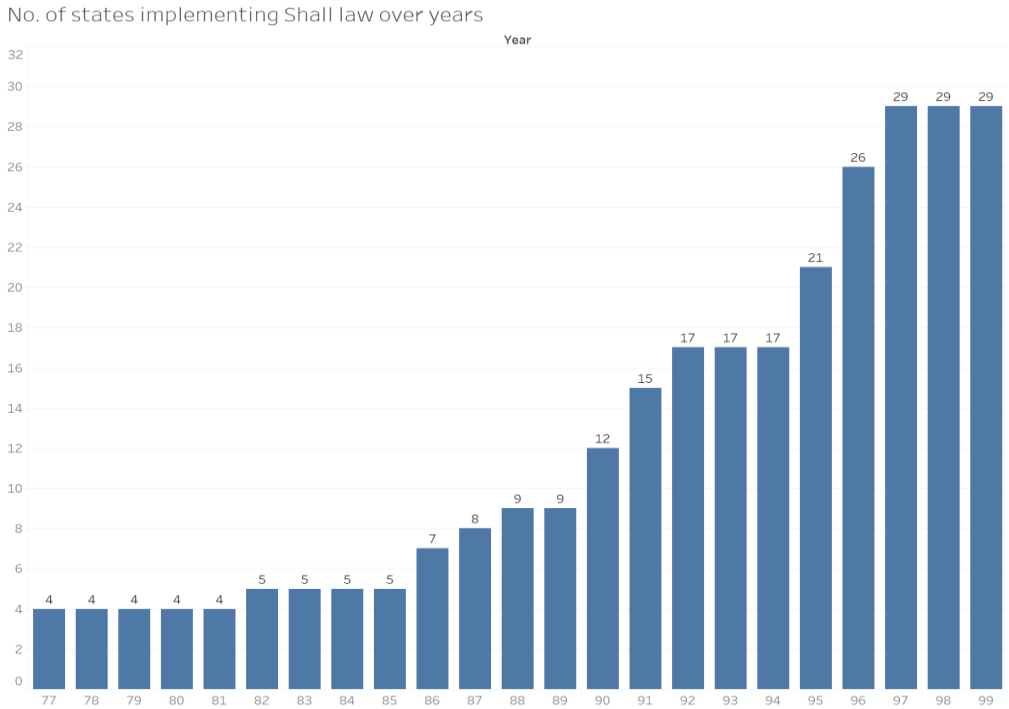
The guns dataset is a balanced panel data. The data is collected for 23 years (1977-1999) on 51 states of the USA (including District of Columbia). It has a total of 51 states x 23 years= 1173 observations. Each observation is a given state each year.
Following are features from dataset and their descriptions:

Variable	Definition
vio	violent crime rate (incidents per 100,000 members of the population)
rob	robbery rate (incidents per 100,000)
mur	murder rate (incidents per 100,000)
shall	= 1 if the state has a shall-carry law in effect in that year = 0 otherwise
incarc_rate	incarceration rate in the state in the previous year (sentenced prisoners per 100,000 residents; value for the previous year)
density	population per square mile of land area, divided by 1000
avginc	real per capita personal income in the state, in thousands of dollars
pop	state population, in millions of people
pm1029	percent of state population that is male, ages 10 to 29
pw1064	percent of state population that is white, ages 10 to 64
pb1064	percent of state population that is black, ages 10 to 64
stateid	ID number of states (Alabama = 1, Alaska = 2, etc.)
year	Year (1977-1999)

a. Shall-law - States:

There are 22 states which did not implement concealed weapon law between 1977-1999 and 29 states had implemented this law.

b. Number of states implementing law over years:

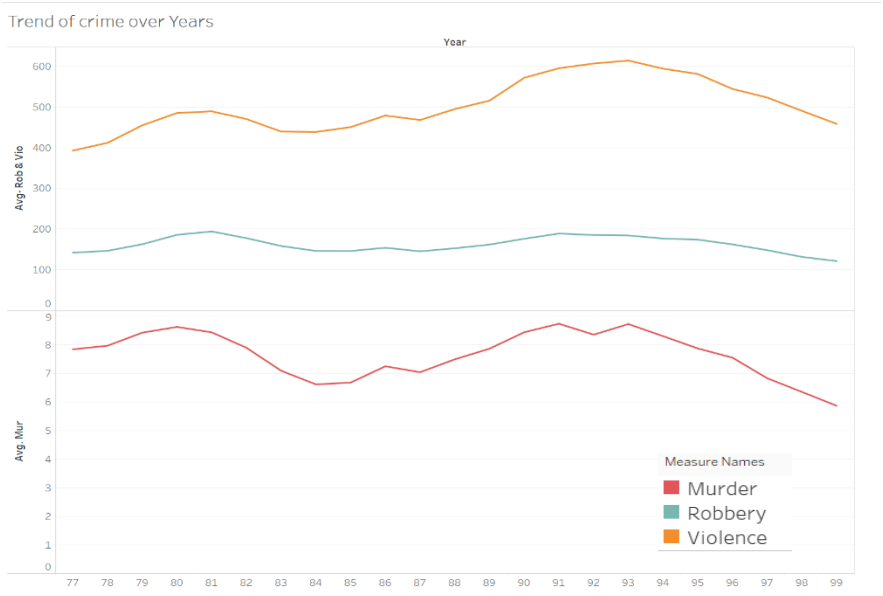


There are 4 states who had implemented shall laws before 1977. 25 states implemented shall law between 1977-1999. There might be a case, shall law might be successful and that's why states started to implement shall law.

c. Summary :

Variable	Obs	Mean	Std. Dev.	Min	Max
year	1,173	88	6.636079	77	99
vio	1,173	503.0747	334.2772	47	2921.8
mur	1,173	7.665132	7.52271	.2	80.6
rob	1,173	161.8202	170.51	6.4	1635.1
incarc_rate	1,173	226.5797	178.8881	19	1913
pb1064	1,173	5.336217	4.885688	.2482066	26.97957
pw1064	1,173	62.94543	9.761527	21.78043	76.52575
pm1029	1,173	16.08113	1.732143	12.21368	22.35269
pop	1,173	4.816341	5.252115	.402753	33.14512
avginc	1,173	13.7248	2.554543	8.554884	23.64671
density	1,173	.3520382	1.355472	.0007071	11.10212
stateid	1,173	28.96078	15.68352	1	56
shall	1,173	.2429668	.4290581	0	1

d. Crime Rate over the years:



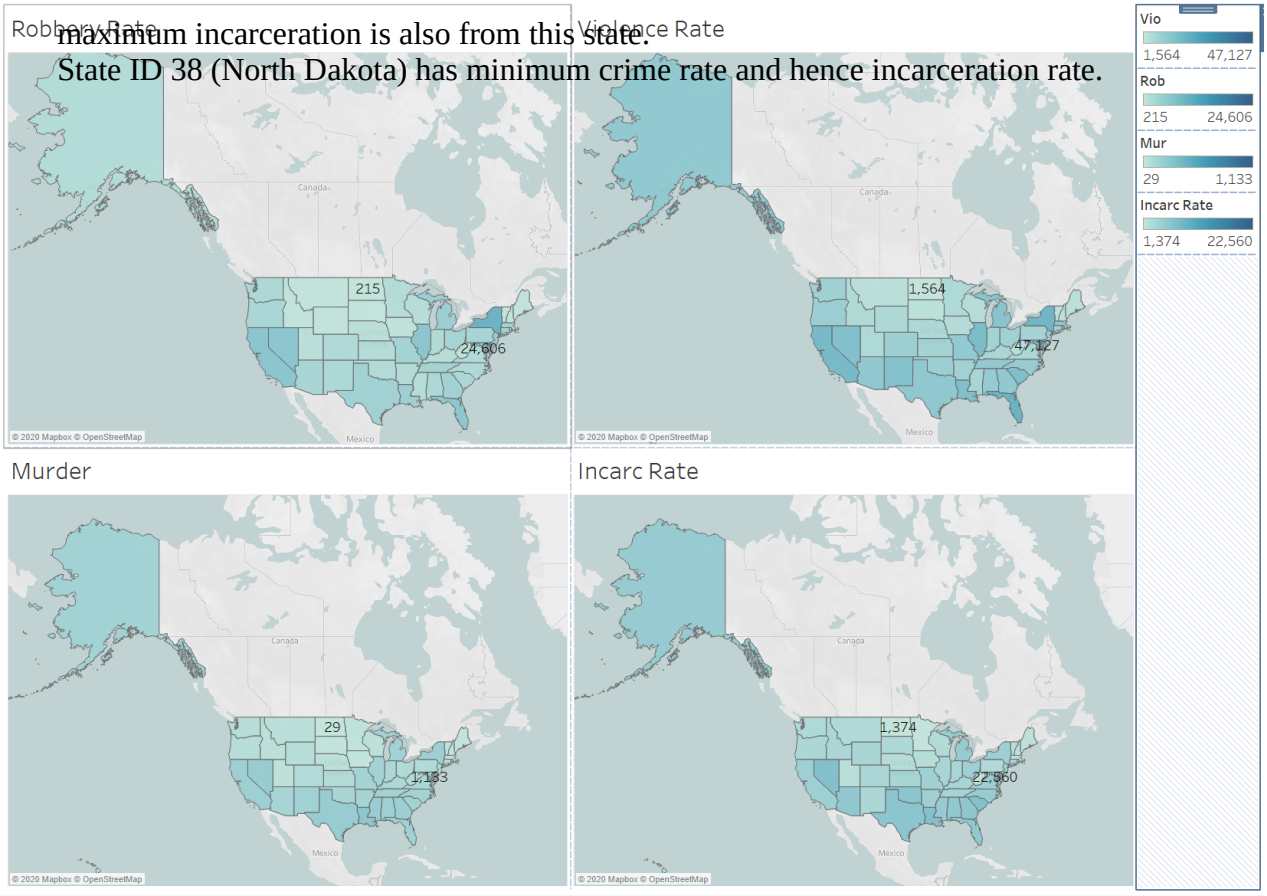
All the crimes were at peak during 1991-1993. After that there was decline in crime. US economy recovered after 1993, that might be the reason for decrease in crimes.

e. State-wise crime rate:

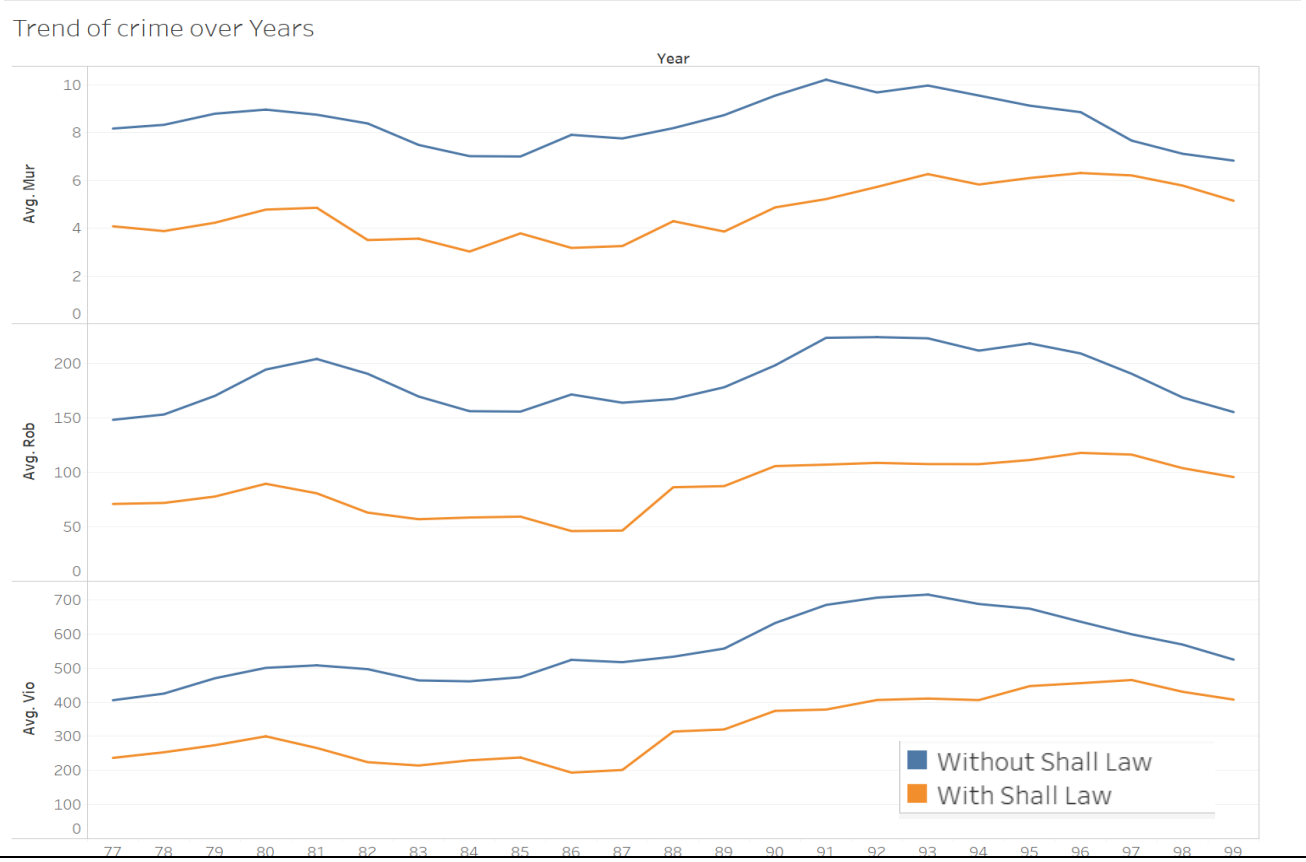
From below figure, maximum crime rate is in state ID 11 (District of Columbia). Also,

maximum incarceration is also from this state.

State ID 38 (North Dakota) has minimum crime rate and hence incarceration rate.



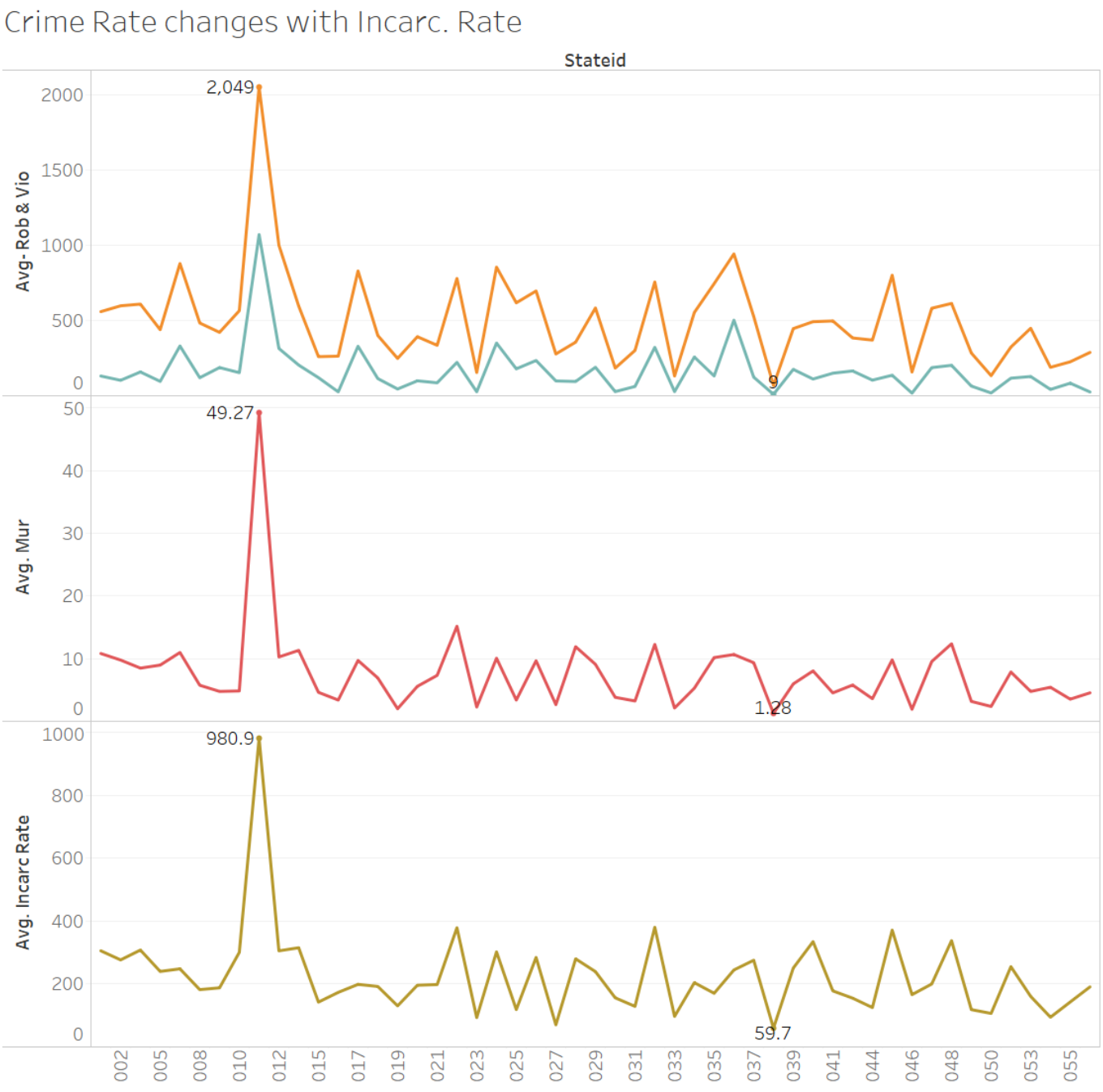
f. Shall-law vs Crime Rate:



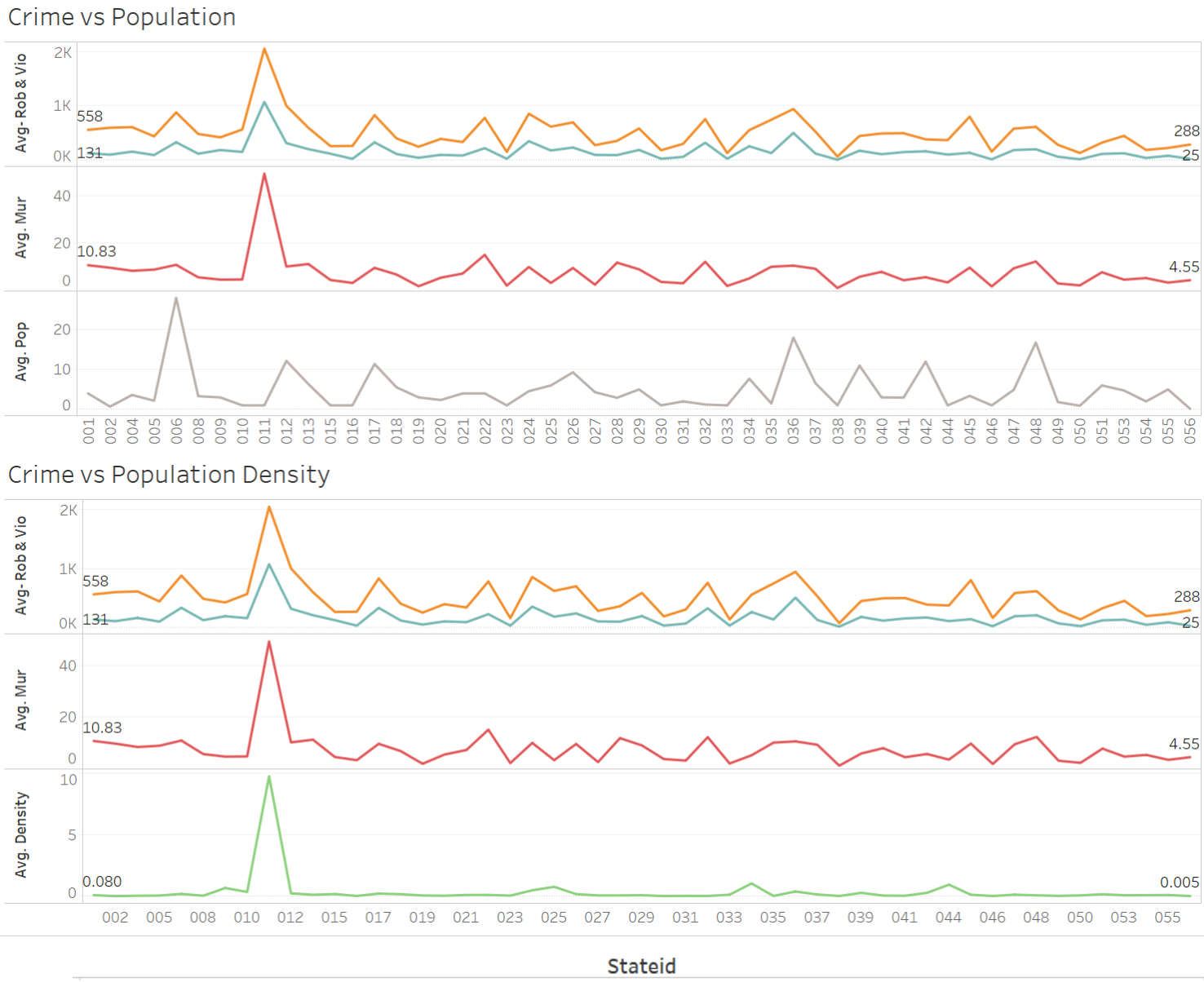
From the graphs above, we can conclude that shall law does effect on crime rate. As shall law was implemented in lot of other states after 1993, crime rate went down after that time.

g. Crime Rate vs Incarceration Rate:

We expect crime rate to go down with incarceration rate. From below graph, state (state ID 11) with highest crime rate has highest incarceration rate and state (state ID 38) with lowest crime rate has lowest incarceration rate. However, incarceration rate and crime rate go hand in hand, when crime rate increases, police do their jobs thoroughly and incarceration rate goes up. There is a simultaneous causality bias. This can be seen in graph of state with crime rate.



h. Crime Rate vs Population and Population Density:



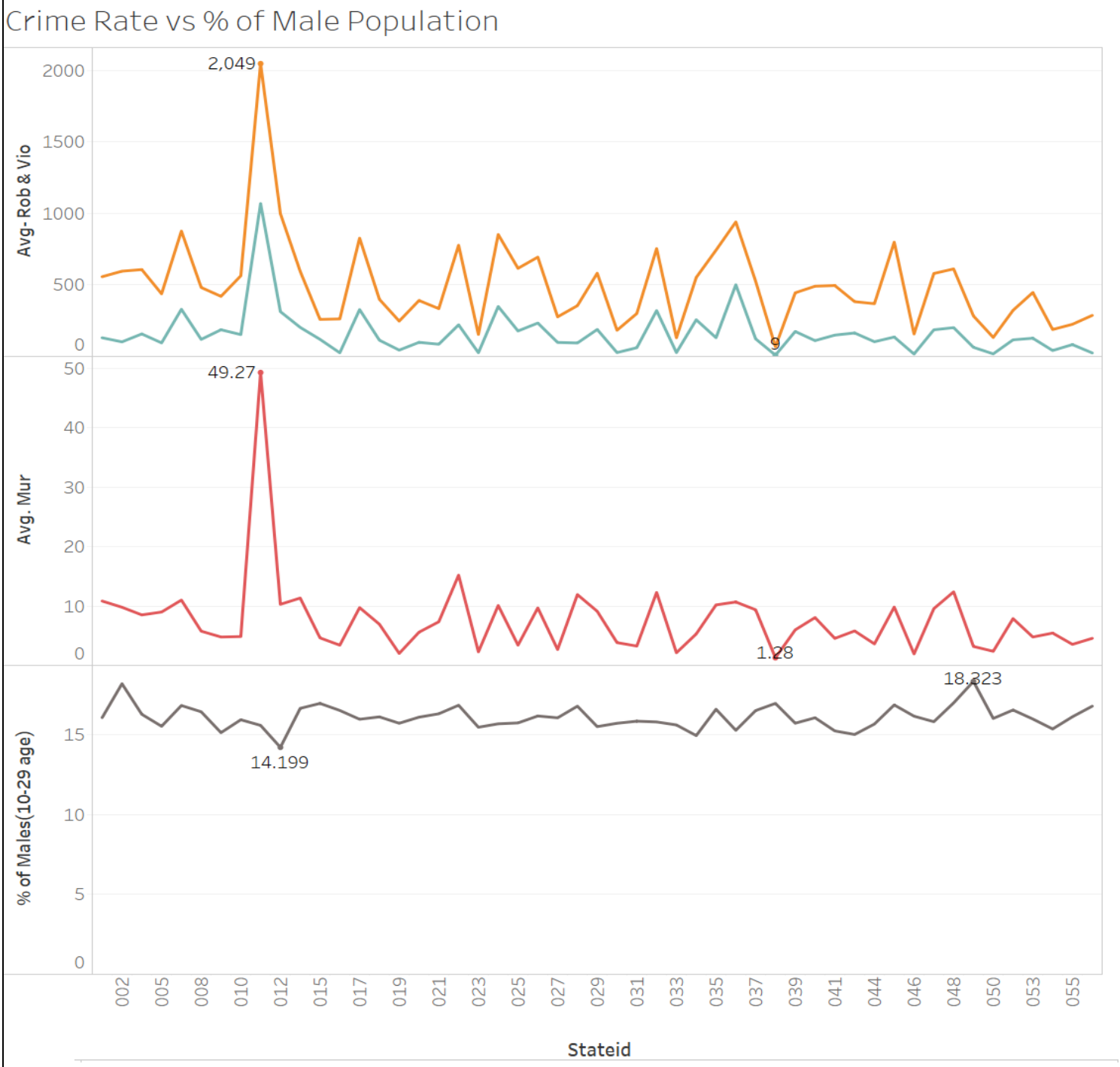
We expect crime rate to go up with increase in population density. On the other hand, population shouldn't cause any changes in crime rate.
From above graph states with high population density is has highest crime rate. But there is no relation between population and crime rate.

i. Crime Rate vs % of white population and % of black population:

From the graphs below, there seem to be no relation between population of black people and white people with crime rate. State ID 15 has highest percentage of black people and low percentage of white people still crime rate is low.

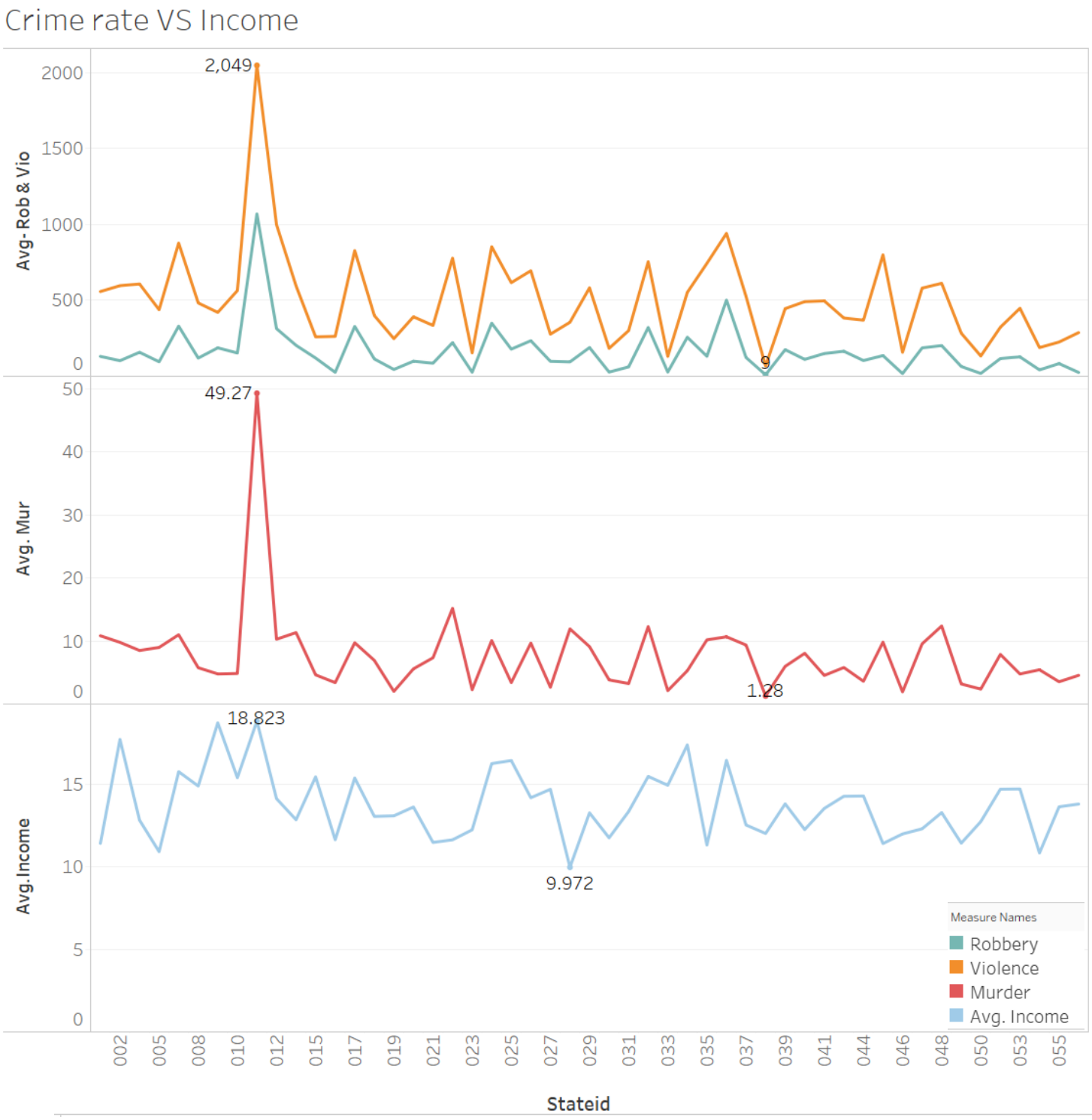
j. Crime Rate vs % of males 10-29 years old:

Males from age group of 10-29 are most likely to be involved in crimes. We expect states with high male population from age group of 10-29 should have higher crime rate. Graph below shows, states with high percentage of 10-29 males has lower percentage of crime.



k. Crime Rate vs Income:

State ID 11 has highest average income and highest crime rate but other states don't show any such relation. We expect crime rate to go down with increase in income. But this theory isn't applicable for this dataset.



HYPOTHESIS:

Based on exploratory data analysis and intuition we propose below hypothesis:

a. Shall-Issue Law & Crime Rate:

Number of states implementing shall law increased from 4 to 29 in given time period. That means more state governments trusted this law and we expect shall law to reduce crime.
There is no data after 1999 which would have been helpful to get analysis of aftereffects of shall law on all three different type of crimes.
We expect violent crime to go down but armed robbery, as more people will have access to weapon and murders (in self-defense) to go up.
Null Hypothesis: Shall-issue law will decrease violent crime but there will be increase in murders and armed robbery.
Alternate hypothesis: Shall-issue law doesn't have effect on crime rate.

b. Crime rate & Population:

As per economic theory we expect crime rate to go up with increase in population density.
From the graphs, there was no relationship between percentage of whites, blacks and males of age 10-29 with crime rate. Also, population didn't have any relation with crime rate. So these parameters are not that significant.
Null Hypothesis: Increase in population density will increase crime rate.
Alternate hypothesis: Population density doesn't have effect on crime rate.

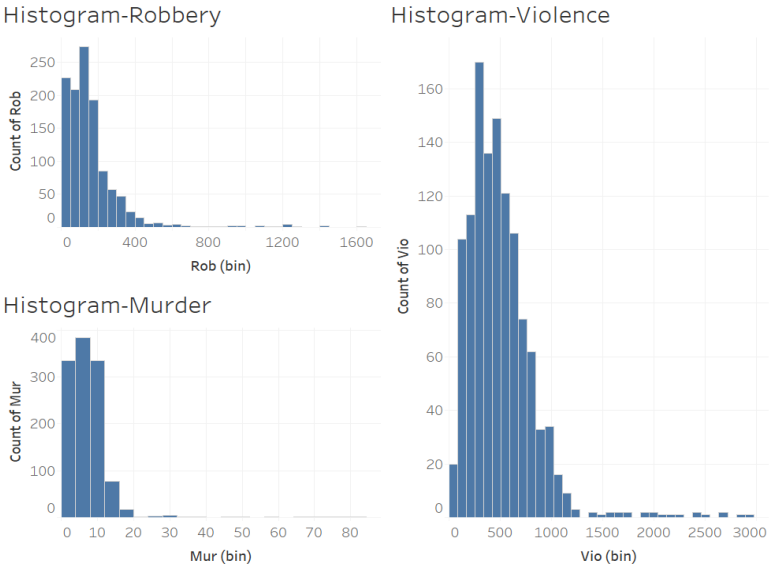
c. Crime rate & Incarceration Rate:

Crime rate and incarceration rate have simultaneous causality bias. We expect this variable to come out as insignificant.
Null Hypothesis: Incarceration rate will decrease crime rate.
Alternate hypothesis: Incarceration rate doesn't have effect on crime rate.

d. Crime rate & Income:

As per economic theory increase in income should reduce crime. But from graphs there seem to be no relationship between these two variables.
Null Hypothesis: Increase in income will decrease crime rate.
Alternate hypothesis: Income doesn't have effect on crime rate.

DATA MODELLING:



Histogram for all three dependent variables is highly skewed so we will take log transformation of those for further analysis.

Correlation analysis:

	shall	incarc~e	density	avginc	pop	pm1029	pb1064	pw1064
shall	1.0000							
incarc_rate	0.0424	1.0000						
density	-0.1126	0.5593	1.0000					
avginc	-0.0000	0.4615	0.3433	1.0000				
pop	-0.1244	0.0953	-0.0780	0.2152	1.0000			
pm1029	-0.2772	-0.4463	-0.0637	-0.5279	-0.0975	1.0000		
pb1064	-0.1839	0.5308	0.5432	0.2627	0.0581	0.0162	1.0000	
pw1064	0.2123	-0.5271	-0.5551	-0.1912	-0.0654	-0.0126	-0.9820	1.0000

There is obvious high correlation between population of black and white people. Other than these two variables there are no significant correlations.
We will keep these two variables in model though, from graph it was clear that these two variables don't have effect in crime rate. So in regression those should come insignificant.

1. Dependent variable – Violence:-

a. Pooled OLS with Cluster Robust Standard Error:

```
. reg ln_vio shall incarc_rate density avginc pop pm1029 pb1064 pw1064, vce(cluster state)

Linear regression                               Number of obs     =      1,173
                                                F(8, 50)          =      62.13
                                                Prob > F          =     0.0000
                                                R-squared         =     0.5643
                                                Root MSE          =     .42769

                                   (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
      ln_vio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.3683869    .113937    -3.23   0.002    -.5972361   -.1395378
 incarc_rate |   .0016126   .0005999     2.69   0.010     .0004076    .0028177
     density |   .0266885   .0414909     0.64   0.523    -.0566485    .1100255
      avginc |   .0012051   .0240808     0.05   0.960    -.0471626    .0495728
         pop |   .0427098    .011729     3.64   0.001     .0191515    .0662681
      pm1029 |   .0088709   .0340964     0.26   0.796    -.0596137    .0773554
      pb1064 |   .0808526   .0713875     1.13   0.263    -.0625334    .2242386
      pw1064 |   .0312005     .03409     0.92   0.364    -.0372713    .0996723
       _cons |   2.981738   2.166513     1.38   0.175    -1.369831    7.333307
------------------------------------------------------------------------------
```

Panel data generally have issues with:

- Heteroskedasticity
- Serial correlation – correlation between error term is not zero
- Endogeneity – Correlation between error term and variable –‘shall’

Pooled OLS doesn’t take of serial correlation, endogeneity. We have taken care of heteroskedasticity with White’s robust standard error.

The shall coefficient shows that shall-issue law has an impact on violent crimes rates where violent crimes can be reduced by 36.8%. While the coefficient is very significant, but the value is unrealistically high.

All other variables except incarceration rate are not significant. But we know that incarceration rate and crime rate have simultaneous casualty bias and the coefficient will be biased.

b. Fixed Effect Model :

Pooled OLS models don't consider unobserved heterogeneity. This model will take care of that.

```
. xtreg ln_vio shall incarc_rate density avginc pop pm1029 pb1064 pw1064, fe

Fixed-effects (within) regression               Number of obs      =      1,173
Group variable: stateid                         Number of groups   =         51

R-sq:                                           Obs per group:
     within  = 0.2178                                         min =         23
     between = 0.0033                                         avg =       23.0
     overall = 0.0001                                         max =         23

                                                F(8,1114)          =      38.77
corr(u_i, Xb)  = -0.3687                        Prob > F           =     0.0000

------------------------------------------------------------------------------
      ln_vio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.0461415   .0188668    -2.45   0.015      -.08316    -.009123
incarc_rate |   -.000071   .0000936    -0.76   0.448    -.0002547    .0001126
     density |  -.1722901   .0850362    -2.03   0.043    -.3391392   -.0054409
      avginc |  -.0092037   .0059083    -1.56   0.120    -.0207963    .0023889
         pop |   .0115247   .0087239     1.32   0.187    -.0055924    .0286417
      pm1029 |  -.0502725   .0064037    -7.85   0.000    -.0628373   -.0377078
      pb1064 |   .1042804   .0177564     5.87   0.000     .0694407    .1391201
      pw1064 |   .0408611   .0050745     8.05   0.000     .0309044    .0508177
       _cons |   3.866017   .3847716    10.05   0.000     3.111058    4.620975
-------------+----------------------------------------------------------------
     sigma_u |  .68024951
     sigma_e |  .16072287
         rho |  .94712779   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(50, 1114) = 142.57                     Prob > F = 0.0000
```

The shall coefficient shows a significant drop in the absolute value (from 36.8% to 4.6%) of the impact on violent crimes. This drop is mainly due to observed and unobserved heterogeneity within individual that is time invariant. Omitted variables can be attitude towards crime and using weapons, or police department efficiency towards crime control. The coefficient is significant at 5%. Fixed effects model has lower standard error than the cluster robust error. The advantage of using Fixed effect model is that it controls both observed and unobserved heterogeneity.

c. Fixed Effect Model with Cluster Robust Standard Error:

There still might be some variables that changes within states but varies with time. For example, if state government implemented any laws within observed time period that can reduce crime rate in that state but over the years. This unobserved time variant heterogeneity will be taken care by this model.

```
. xtreg ln_vio shall incarc_rate density avginc pop pm1029 pb1064 pw1064, fe cluster (state)

Fixed-effects (within) regression               Number of obs      =       1,173
Group variable: stateid                         Number of groups   =          51

R-sq:                                           Obs per group:
     within  = 0.2178                                         min =          23
     between = 0.0033                                         avg =        23.0
     overall = 0.0001                                         max =          23

                                                F(8,50)            =       34.10
corr(u_i, Xb)  = -0.3687                        Prob > F           =      0.0000

                                 (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
      ln_vio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.0461415   .0417616    -1.10   0.275    -.1300223    .0377392
 incarc_rate |   -.000071   .0002504    -0.28   0.778    -.0005739    .0004318
     density |  -.1722901   .1376129    -1.25   0.216    -.4486936    .1041135
      avginc |  -.0092037   .0129649    -0.71   0.481    -.0352445     .016837
         pop |   .0115247    .014224     0.81   0.422    -.0170452    .0400945
      pm1029 |  -.0502725   .0206949    -2.43   0.019    -.0918394   -.0087057
      pb1064 |   .1042804   .0326849     3.19   0.002     .0386308    .1699301
      pw1064 |   .0408611   .0134585     3.04   0.004     .0138289    .0678932
       _cons |   3.866017   .7701057     5.02   0.000     2.319214    5.412819
-------------+----------------------------------------------------------------
     sigma_u |  .68024951
     sigma_e |  .16072287
         rho |  .94712779   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

The shall coefficient is same as fixed effect model. But the standard errors are much higher than with least square standard errors. This proves there was some time variant heterogeneity. Coefficient of shall is insignificant.

Coefficients of pm1029,pb1064,pw1064 are significant. Those suggest as population of male aged between 10-29 goes up by 1%, crime rate goes down by 5%. This is in contrast with economic theory so this variable is biased.

All other coefficients are insignificant.

d. Fixed Effect Model with Time Fixed Effect:

There might be some variables which changes over time but are constant for each state. For example, federal laws to reduce crime rate, countries economy. Fixed effect with time fixed models will address bias from such omitted variables.

```
. xtreg ln_vio shall incarc_rate density avginc pop pm1029 pb1064 pw1064 i.year, fe cluster (state)

Fixed-effects (within) regression               Number of obs      =      1,173
Group variable: stateid                         Number of groups   =         51

R-sq:                                           Obs per group:
     within  = 0.4180                                         min =         23
     between = 0.0419                                         avg =       23.0
     overall = 0.0009                                         max =         23

                                                F(30,50)           =      56.86
corr(u_i, Xb)  = -0.2929                        Prob > F           =     0.0000

                              (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
      ln_vio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.0279935   .0407168    -0.69   0.495    -.1097757    .0537886
 incarc_rate |    .000076   .0002079     0.37   0.716    -.0003416    .0004935
     density |   -.091555   .1238622    -0.74   0.463    -.3403396    .1572296
      avginc |   .0009587   .0164931     0.06   0.954    -.0321688    .0340861
         pop |  -.0047544   .0152294    -0.31   0.756    -.0353436    .0258347
      pm1029 |   .0733254   .0524733     1.40   0.168    -.0320704    .1787211
      pb1064 |   .0291862   .0495407     0.59   0.558    -.0703192    .1286916
      pw1064 |   .0092501   .0237564     0.39   0.699    -.0384659    .0569662
             |
        year |
          78 |   .0585261   .0161556     3.62   0.001     .0260767    .0909755
          79 |   .1639486   .0244579     6.70   0.000     .1148233    .2130738
          80 |   .2170759   .0334184     6.50   0.000     .1499531    .2841987
          81 |   .2172551   .0391956     5.54   0.000     .1385284    .2959819
          82 |   .1946328   .0465743     4.18   0.000     .1010856     .28818
          83 |    .158645   .0593845     2.67   0.010     .0393676    .2779223
          84 |   .1929883   .0770021     2.51   0.015     .0383251    .3476515
          85 |   .2444764   .0922217     2.65   0.011     .0592438    .4297091
          86 |   .3240904   .1089181     2.98   0.004     .1053219    .5428589
          87 |    .324365   .1249881     2.60   0.012      .073319    .5754111
          88 |   .3867412   .1397074     2.77   0.008     .1061305    .6673518
          89 |   .4422143   .1535358     2.88   0.006     .1338286    .7505999
          90 |   .5430478   .1960859     2.77   0.008     .1491976     .936898
          91 |   .5959456   .2040685     2.92   0.005     .1860618    1.005829
          92 |   .6275171   .2170306     2.89   0.006     .1915982    1.063436
          93 |   .6497414   .2246177     2.89   0.006     .1985834    1.100899
          94 |   .6354187   .2332437     2.72   0.009     .1669349    1.103903
          95 |   .6276831   .2423607     2.59   0.013     .1408874    1.114479
          96 |   .5713423   .2534067     2.25   0.029      .06236    1.080325
          97 |   .5501153   .2613516     2.10   0.040     .0251751    1.075055
          98 |   .4932904   .2746546     1.80   0.079    -.0583697     1.04495
          99 |   .4328776   .2862197     1.51   0.137    -.1420117    1.007767
             |
       _cons |   3.765525   1.152108     3.27   0.002     1.451448    6.079603
------------------------------------------------------------------------------
```

The shall coefficient is further reduced, leading to a decrease on violent crimes by 2.8%. But the coefficient is still insignificant. The year variable has been added.

All variable coefficients are highly insignificant.

All time variables except year 1998 and 1999 are significant at alpha=5%. We can run F-test to check whether time variables are significant or not.

Null Hypothesis : All year variables are zero

Alternate Hypothesis : At least one of the year variable is not zero.

F-test:

```
. testparm i.year

 ( 1)  78.year = 0
 ( 2)  79.year = 0
 ( 3)  80.year = 0
 ( 4)  81.year = 0
 ( 5)  82.year = 0
 ( 6)  83.year = 0
 ( 7)  84.year = 0
 ( 8)  85.year = 0
 ( 9)  86.year = 0
 (10)  87.year = 0
 (11)  88.year = 0
 (12)  89.year = 0
 (13)  90.year = 0
 (14)  91.year = 0
 (15)  92.year = 0
 (16)  93.year = 0
 (17)  94.year = 0
 (18)  95.year = 0
 (19)  96.year = 0
 (20)  97.year = 0
 (21)  98.year = 0
 (22)  99.year = 0

       F( 22,    50) =   21.62
            Prob > F =    0.0000
```

P-value for F-test is zero, so we reject the null hypothesis and can say that at least one of the year variable is non-zero.

e. Random Effect Model

Fixed effect model is not feasible as data is collected from 51 states not randomly drawn from a population. It is a population, but to see whether endogeneity exists in data we will run random effect model.

```
. xtreg ln_vio shall incarc_rate density avginc pop pm1029 pb1064 pw1064, re

Random-effects GLS regression                   Number of obs     =      1,173
Group variable: stateid                         Number of groups  =         51

R-sq:                                           Obs per group:
     within  = 0.2044                                         min =         23
     between = 0.4908                                         avg =       23.0
     overall = 0.4591                                         max =         23

                                                Wald chi2(8)      =     337.19
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

ln_vio	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
shall	-.069609	.0190835	-3.65	0.000	-.107012	-.032206
incarc_rate	.0001888	.0000687	2.75	0.006	.0000541	.0003235
density	.0661588	.037363	1.77	0.077	-.0070713	.1393889
avginc	-.0105112	.0058749	-1.79	0.074	-.0220258	.0010034
pop	.0225755	.0063498	3.56	0.000	.0101301	.035021
pm1029	-.0375292	.0060462	-6.21	0.000	-.0493794	-.0256789
pb1064	.1067022	.0132976	8.02	0.000	.0806394	.1327649
pw1064	.0400716	.0050987	7.86	0.000	.0300783	.050065
_cons	3.525463	.3874011	9.10	0.000	2.766171	4.284755
sigma_u	.33790775					
sigma_e	.16072287					
rho	.81550462	(fraction of variance due to u_i)				

From this model, we get a significant coefficient for shall, which suggest violence in states with shall law is lower by 7% than without shall law.
We will perform Hausman test to check if endogeneity exists.

Hausman Test –

```
. hausman fixed random
```

	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
shall	-.0461415	-.069609	.0234675	.
incarc_rate	-.000071	.0001888	-.0002598	.0000635
density	-.1722901	.0661588	-.2384489	.0763882
avginc	-.0092037	-.0105112	.0013075	.0006269
pop	.0115247	.0225755	-.0110508	.0059821
pm1029	-.0502725	-.0375292	-.0127434	.0021099
pb1064	.1042804	.1067022	-.0024217	.011767
pw1064	.0408611	.0400716	.0007895	.

```
                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(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                        =       31.86
              Prob>chi2 =      0.0001
              (V_b-V_B is not positive definite)
```

The value of the chi-square statistic: 31.86. P-value is small almost approaching zero. Hence, we reject the null hypothesis of no endogeneity and conclude that we should use the fixed effect model.

Best Model (d) is the fixed effect model using robust standard errors with both state and time fixed effects. As per the model results the shall-issue law doesn't have an impact on violent crime rates.

We will perform same operations for dependent variable robbery and murder.

2. Dependent variable – Robbery:-

a. Pooled OLS with Cluster Robust Standard Error:

```
. reg ln_rob shall incarc_rate density avginc pop pm1029 pb1064 pw1064, vce(cluster state)

Linear regression                               Number of obs     =      1,173
                                                F(8, 50)          =      27.22
                                                Prob > F          =     0.0000
                                                R-squared         =     0.5962
                                                Root MSE          =     .60869

                                   (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
      ln_rob |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.5288202   .1608765    -3.29   0.002    -.8519501   -.2056903
 incarc_rate |   .0010057   .0006401     1.57   0.122    -.0002799    .0022914
     density |   .0905048   .0459796     1.97   0.055     -.001848    .1828576
      avginc |   .0407325   .0281568     1.45   0.154     -.015822     .097287
         pop |   .0778176   .0225194     3.46   0.001     .0325862    .1230491
      pm1029 |   .0272565   .0417254     0.65   0.517    -.0565515    .1110645
      pb1064 |   .1021881   .0894076     1.14   0.259    -.0773923    .2817686
      pw1064 |   .0275209   .0450088     0.61   0.544     -.062882    .1179237
       _cons |   .9041383     3.0615     0.30   0.769    -5.245065    7.053341
------------------------------------------------------------------------------
```

The shall coefficient shows that shall-issue law has an impact on robbery crime rates where robbery crimes can be reduced by 52.9%. While the coefficient is very significant, but the value is unrealistically high.

b. Fixed Effect Model

```
. xtreg ln_rob shall incarc_rate density avginc pop pm1029 pb1064 pw1064, fe

Fixed-effects (within) regression               Number of obs     =      1,173
Group variable: stateid                         Number of groups  =         51

R-sq:                                           Obs per group:
     within  = 0.0366                                         min =         23
     between = 0.0531                                         avg =       23.0
     overall = 0.0521                                         max =         23

                                                F(8,1114)         =       5.29
corr(u_i, Xb)  = -0.0859                        Prob > F          =     0.0000

------------------------------------------------------------------------------
      ln_rob |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.0078189   .0252557    -0.31   0.757    -.0573731    .0417352
 incarc_rate |  -.0000763   .0001253    -0.61   0.542    -.0003222    .0001695
     density |  -.1860917   .1138322    -1.63   0.102    -.4094413     .037258
      avginc |  -.0175195    .007909    -2.22   0.027    -.0330377   -.0020012
         pop |   .0163332   .0116781     1.40   0.162    -.0065803    .0392466
      pm1029 |   .0111817   .0085722     1.30   0.192    -.0056378    .0280012
      pb1064 |   .1115421   .0237693     4.69   0.000     .0649045    .1581796
      pw1064 |   .0271807   .0067929     4.00   0.000     .0138525     .040509
       _cons |   2.445723   .5150678     4.75   0.000     1.435111    3.456335
-------------+----------------------------------------------------------------
     sigma_u |   .9174441
     sigma_e |   .21514885
         rho |   .94787229   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(50, 1114) = 164.06                     Prob > F = 0.0000
```

The shall coefficient shows a significant drop in the absolute value (from 52.9% to 7.8%) of the impact on robbery crimes. This drop is mainly due to an omitted variable bias. Coefficient is insignificant at 5%. Fixed effects model has lower standard error than the cluster robust error. The advantage of using

Fixed effect model is that it controls both observed and unobserved heterogeneity.

c. Fixed Effect Model with Cluster Robust Standard Error:

```
. xtreg ln_rob shall incarc_rate density avginc pop pm1029 pb1064 pw1064, fe cluster (state)

Fixed-effects (within) regression               Number of obs      =       1,173
Group variable: stateid                         Number of groups   =          51

R-sq:                                           Obs per group:
     within  = 0.0366                                         min =          23
     between = 0.0531                                         avg =        23.0
     overall = 0.0521                                         max =          23

                                                F(8,50)            =        2.86
corr(u_i, Xb)  = -0.0859                        Prob > F           =      0.0108

                              (Std. Err. adjusted for 51 clusters in stateid)
```

ln_rob	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
shall	-.0078189	.0551653	-0.14	0.888	-.1186217	.1029838
incarc_rate	-.0000763	.000321	-0.24	0.813	-.0007211	.0005685
density	-.1860917	.1663413	-1.12	0.269	-.520198	.1480147
avginc	-.0175195	.0220352	-0.80	0.430	-.0617784	.0267395
pop	.0163332	.0275874	0.59	0.556	-.0390778	.0717441
pm1029	.0111817	.0290976	0.38	0.702	-.0472626	.069626
pb1064	.1115421	.0511546	2.18	0.034	.008795	.2142891
pw1064	.0271807	.0164344	1.65	0.104	-.0058286	.0601901
_cons	2.445723	1.012584	2.42	0.019	.4118887	4.479557
sigma_u	.9174441					
sigma_e	.21514885					
rho	.94787229	(fraction of variance due to u_i)				

The shall coefficient shows that shall-issue law has an impact on robbery crimes where robberies can be reduced by 7.8%. But the coefficient is insignificant. The same coefficient is seen in the previous model, but the difference is in the significance.

d. Fixed Effect Model with time fixed Effect:

```
. xtreg ln_rob shall incarc_rate density avginc pop pm1029 pb1064 pw1064 i.year, fe cluster (state)

Fixed-effects (within) regression               Number of obs      =       1,173
Group variable: stateid                         Number of groups   =          51

R-sq:                                           Obs per group:
     within  = 0.2359                                         min =          23
     between = 0.1358                                         avg =        23.0
     overall = 0.1362                                         max =          23

                                                F(30,50)           =       40.77
corr(u_i, Xb)  = 0.1441                         Prob > F           =      0.0000

                                (Std. Err. adjusted for 51 clusters in stateid)
```

ln_rob	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
shall	.0268298	.0521753	0.51	0.609	-.0779673	.1316269
incarc_rate	.0000314	.0003477	0.09	0.928	-.000667	.0007297
density	-.0447449	.1982135	-0.23	0.822	-.4428684	.3533786
avginc	.0143569	.0247676	0.58	0.565	-.0353903	.064104
pop	.0000164	.0259374	0.00	0.999	-.0520805	.0521133
pm1029	.1046049	.072997	1.43	0.158	-.0420138	.2512236
pb1064	.0141078	.0840609	0.17	0.867	-.1547335	.1829491
pw1064	-.0128322	.0327626	-0.39	0.697	-.0786379	.0529734
year						
78	.0328497	.0216897	1.51	0.136	-.0107154	.0764148
79	.1375917	.032117	4.28	0.000	.0730828	.2021006
80	.243408	.045464	5.35	0.000	.1520908	.3347251
81	.2737088	.0508793	5.38	0.000	.1715147	.375903
82	.21599	.0644109	3.35	0.002	.0866168	.3453632
83	.1208158	.0867066	1.39	0.170	-.0533395	.2949711
84	.078831	.1064308	0.74	0.462	-.1349416	.2926036
85	.1131495	.1272629	0.89	0.378	-.1424655	.3687645
86	.1895678	.1521449	1.25	0.219	-.1160242	.4951598
87	.1572151	.1688872	0.93	0.356	-.1820049	.496435
88	.1927596	.1878849	1.03	0.310	-.1846184	.5701376
89	.2487313	.2140573	1.16	0.251	-.1812154	.6786781
90	.3509806	.2668617	1.32	0.194	-.185027	.8869881
91	.4668537	.2791767	1.67	0.101	-.0938891	1.027596
92	.4633221	.2951262	1.57	0.123	-.1294562	1.0561
93	.4796983	.3082342	1.56	0.126	-.1394084	1.098805
94	.4943754	.3234124	1.53	0.133	-.1552175	1.143968
95	.4940171	.3338462	1.48	0.145	-.1765328	1.164567
96	.4341625	.3504351	1.24	0.221	-.2697072	1.138032
97	.3652393	.3581743	1.02	0.313	-.354175	1.084654
98	.2677144	.3690383	0.73	0.472	-.4735208	1.00895
99	.1894683	.3845414	0.49	0.624	-.5829059	.9618425
_cons	3.27912	1.676644	1.96	0.056	-.088518	6.646759

The shall coefficient is further changed with sign reversal, leading to an increase in robbery crimes by 2.7%. But the coefficient is still insignificant. The year variable has been added. 5 of the year variables are significant. All other are not significant.
All variables are insignificant.

F-test –

```
. testparm i.year

 ( 1)  78.year = 0
 ( 2)  79.year = 0
 ( 3)  80.year = 0
 ( 4)  81.year = 0
 ( 5)  82.year = 0
 ( 6)  83.year = 0
 ( 7)  84.year = 0
 ( 8)  85.year = 0
 ( 9)  86.year = 0
 (10)  87.year = 0
 (11)  88.year = 0
 (12)  89.year = 0
 (13)  90.year = 0
 (14)  91.year = 0
 (15)  92.year = 0
 (16)  93.year = 0
 (17)  94.year = 0
 (18)  95.year = 0
 (19)  96.year = 0
 (20)  97.year = 0
 (21)  98.year = 0
 (22)  99.year = 0

       F( 22,    50) =   25.86
            Prob > F =    0.0000
```

P-value for F-test is zero, so we reject the null hypothesis and can say that at least one of the year variable is non-zero.

e. Random Effect Model

Fixed effect model is not feasible as data is collected from 51 states not randomly drawn from a population.

```
. xtreg ln_rob shall incarc_rate density avginc pop pm1029 pb1064 pw1064, re

Random-effects GLS regression                   Number of obs     =      1,173
Group variable: stateid                         Number of groups  =         51

R-sq:                                           Obs per group:
     within  = 0.0269                                         min =         23
     between = 0.5183                                         avg =       23.0
     overall = 0.4910                                         max =         23

                                                Wald chi2(8)      =      99.59
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

ln_rob	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
shall	-.0411192	.0255899	-1.61	0.108	-.0912745	.0090362
incarc_rate	.0001735	.0000931	1.86	0.062	-9.02e-06	.000356
density	.0997518	.0527672	1.89	0.059	-.0036699	.2031735
avginc	-.0152975	.0078914	-1.94	0.053	-.0307643	.0001693
pop	.0405861	.0087624	4.63	0.000	.0234121	.05776
pm1029	.0252997	.0081299	3.11	0.002	.0093654	.041234
pb1064	.1074485	.0181757	5.91	0.000	.0718247	.1430723
pw1064	.0282639	.0068389	4.13	0.000	.0148598	.041668
_cons	1.8759	.52089	3.60	0.000	.8549742	2.896826
sigma_u	.48469008					
sigma_e	.21514885					
rho	.83539542	(fraction of variance due to u_i)				

From this model, we get a significant coefficient for shall, which suggest robbery in states with shall law is lower by 4.1% than states without shall law.
We will perform Hausman test to check if endogeneity exists.

Hausman Test –

```
. hausman fixed random
```

	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
shall	-.0078189	-.0411192	.0333002	.
incarc_rate	-.0000763	.0001735	-.0002498	.0000838
density	-.1860917	.0997518	-.2858435	.1008633
avginc	-.0175195	-.0152975	-.002222	.0005277
pop	.0163332	.0405861	-.0242529	.00772
pm1029	.0111817	.0252997	-.014118	.002718
pb1064	.1115421	.1074485	.0040936	.0153173
pw1064	.0271807	.0282639	-.0010832	.

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(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 26.94
Prob>chi2 = 0.0007
(V_b-V_B is not positive definite)

The value of the chi-square statistic: 26.94. P-value is small almost approaching zero. Hence, we reject the null hypothesis of no endogeneity and conclude that we should use the fixed effect model.

Best Model (d) is the fixed effect model using robust standard errors with both state and time fixed effects. As per the model results the shall-issue law doesn't have an impact on robbery rates.

3. Dependent variable – Murder:-

a. Pooled OLS with Cluster Robust Standard Error:

```
. reg ln_mur shall incarc_rate density avginc pop pm1029 pb1064 pw1064, vce (cluster state)

Linear regression                               Number of obs     =      1,173
                                                F(8, 50)          =     138.04
                                                Prob > F          =     0.0000
                                                R-squared         =     0.6059
                                                Root MSE          =     .44312

                                    (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
      ln_mur |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.3131735   .0990416    -3.16   0.003    -.5121045   -.1142425
 incarc_rate |    .002097   .0004603     4.56   0.000     .0011723    .0030216
     density |   .0396669    .039893     0.99   0.325    -.0404606    .1197944
      avginc |  -.0772578    .027044    -2.86   0.006    -.1315773   -.0229382
         pop |   .0416175    .011926     3.49   0.001     .0176633    .0655717
      pm1029 |   .0655308   .0361641     1.81   0.076     -.007107    .1381685
      pb1064 |   .1307641   .0611915     2.14   0.038     .0078573    .2536709
      pw1064 |   .0470796   .0285914     1.65   0.106    -.0103479     .104507
       _cons |  -2.485593   1.992083    -1.25   0.218    -6.486809    1.515622
------------------------------------------------------------------------------
```

The shall coefficient shows that shall-issue law has an impact on murder rates where murder crimes can be reduced by 31.3%. While the coefficient is very significant, but the value is unrealistically high.

b. Fixed Effect Model

```
. xtreg ln_mur shall incarc_rate density avginc pop pm1029 pb1064 pw1064, fe

Fixed-effects (within) regression               Number of obs      =       1,173
Group variable: stateid                         Number of groups   =          51

R-sq:                                           Obs per group:
     within  = 0.1528                                         min =          23
     between = 0.2221                                         avg =        23.0
     overall = 0.1846                                         max =          23

                                                F(8,1114)          =       25.12
corr(u_i, Xb)  = -0.8961                        Prob > F           =      0.0000

------------------------------------------------------------------------------
      ln_mur |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |    -.06081   .0257579    -2.36   0.018    -.1113495   -.0102704
 incarc_rate |    -.00036   .0001278    -2.82   0.005    -.0006107   -.0001093
     density |   -.6707132   .1160957    -5.78   0.000     -.898504   -.4429224
      avginc |    .0243114   .0080663     3.01   0.003     .0084846    .0401382
         pop |   -.0257054   .0119103    -2.16   0.031    -.0490745   -.0023363
      pm1029 |    .0392384   .0087427     4.49   0.000     .0220844    .0563923
      pb1064 |    .0307009   .0242419     1.27   0.206    -.0168641    .0782658
      pw1064 |    .0103313    .006928     1.49   0.136     -.003262    .0239246
       _cons |    .4600088   .5253095     0.88   0.381    -.5706989    1.490716
-------------+----------------------------------------------------------------
     sigma_u |     1.36035
     sigma_e |    .21942693
         rho |    .97464151   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0: F(50, 1114) = 72.66                     Prob > F = 0.0000
```

The shall coefficient shows a significant drop in the absolute value (from 31.3% to 6.1%) of the impact on murder crimes. This drop is mainly due to an omitted variable bias. Coefficient is insignificant at 5%. Fixed effects model has lower standard error than the cluster robust error. The advantage of using Fixed effect model is that it controls both observed and unobserved heterogeneity.

c. Fixed Effect Model with Cluster Robust Standard Error:

```
. xtreg ln_mur shall incarc_rate density avginc pop pm1029 pb1064 pw1064, fe cluster (state)

Fixed-effects (within) regression               Number of obs      =       1,173
Group variable: stateid                         Number of groups   =          51

R-sq:                                           Obs per group:
     within  = 0.1528                                         min =          23
     between = 0.2221                                         avg =        23.0
     overall = 0.1846                                         max =          23

                                                F(8,50)            =      156.39
corr(u_i, Xb)  = -0.8961                        Prob > F           =      0.0000

                                 (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
      ln_mur |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |    -.06081   .0369632    -1.65   0.106    -.1350527    .0134327
  incarc_rate |    -.00036   .0004231    -0.85   0.399    -.0012099    .0004899
     density |   -.6707132   .3957745    -1.69   0.096     -1.46565    .1242232
      avginc |    .0243114   .0156779     1.55   0.127    -.0071786    .0558013
         pop |   -.0257054   .0203457    -1.26   0.212    -.0665709    .0151602
      pm1029 |    .0392384   .0215964     1.82   0.075    -.0041394    .0826161
      pb1064 |    .0307009   .0781245     0.39   0.696    -.1262169    .1876186
      pw1064 |    .0103313   .0128776     0.80   0.426    -.0155341    .0361967
       _cons |    .4600088   .8425884     0.55   0.588     -1.23238    2.152397
-------------+----------------------------------------------------------------
     sigma_u |     1.36035
     sigma_e |    .21942693
         rho |    .97464151   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

The shall coefficient shows that shall-issue law has an impact on murder crimes where robberies can be reduced by 6.1%. But the coefficient is insignificant. The same coefficient is seen in the previous model, but the difference is in the significance.

d. Fixed Effect Model with time fixed Effect:

```
. xtreg ln_mur shall incarc_rate density avginc pop pm1029 pb1064 pw1064 i.year, fe cluster (state)

Fixed-effects (within) regression               Number of obs      =       1,173
Group variable: stateid                         Number of groups   =          51

R-sq:                                           Obs per group:
     within  = 0.2905                                         min =          23
     between = 0.1945                                         avg =        23.0
     overall = 0.1413                                         max =          23

                                                F(30,50)           =       81.49
corr(u_i, Xb)  = -0.8336                        Prob > F           =      0.0000

                                 (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
      ln_mur |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.0149524   .0382403    -0.39   0.697    -.0917603    .0618556
 incarc_rate |  -.0001164   .0003631    -0.32   0.750    -.0008457    .0006129
     density |  -.5442635   .3192203    -1.70   0.094    -1.185436    .0969093
      avginc |   .0566492   .0165554     3.42   0.001     .0233967    .0899017
         pop |  -.0320769   .0209819    -1.53   0.133    -.0742202    .0100664
      pm1029 |   .0691941   .0417945     1.66   0.104    -.0147526    .1531408
      pb1064 |   .0219833   .0758151     0.29   0.773    -.1302958    .1742624
      pw1064 |  -.0004893   .0201044    -0.02   0.981    -.0408701    .0398915
             |
        year |
          78 |  -.0007195   .0322722    -0.02   0.982    -.0655401    .0641011
          79 |   .0592481   .0311141     1.90   0.063    -.0032465    .1217427
          80 |   .0901814    .041058     2.20   0.033     .0077139    .1726489
          81 |   .1021543   .0510636     2.00   0.051      -.00041    .2047186
          82 |   .0224098   .0581861     0.39   0.702    -.0944604    .1392799
          83 |  -.0314385   .0640621    -0.49   0.626    -.1601111    .0972341
          84 |  -.1359192    .071662    -1.90   0.064    -.2798565    .0080181
          85 |  -.0866144   .0856965    -1.01   0.317    -.2587409    .0855122
          86 |  -.0122752   .0927286    -0.13   0.895    -.1985262    .1739758
          87 |  -.0290338   .0999408    -0.29   0.773    -.2297707    .1717032
          88 |  -.0174594   .1196893    -0.15   0.885    -.2578626    .2229437
          89 |  -.0145617   .1321034    -0.11   0.913    -.2798993    .2507759
          90 |    .059998   .1649718     0.36   0.718    -.2713577    .3913537
          91 |   .1053071   .1754909     0.60   0.551    -.2471767    .4577909
          92 |   .0681002   .1828352     0.37   0.711    -.2991352    .4353355
          93 |   .1544297   .1898113     0.81   0.420    -.2268176     .535677
          94 |   .0442648   .1971908     0.22   0.823    -.3518047    .4403342
          95 |   .0556601   .1989082     0.28   0.781    -.3438588     .455179
          96 |   -.015709   .2125365    -0.07   0.941    -.4426011    .4111831
          97 |  -.1221824   .2186706    -0.56   0.579    -.5613952    .3170304
          98 |  -.1863381   .2332966    -0.80   0.428    -.6549281    .2822519
          99 |  -.2554286   .2420434    -1.06   0.296     -.741587    .2307298
             |
       _cons |   .1882653   1.056771     0.18   0.859    -1.934322    2.310853
------------------------------------------------------------------------------
```

The shall coefficient is further reduced, leading to a decrease on murder crimes by 1.5%. But the coefficient is still insignificant. The year variable has been added.

F-test

```
. testparm i.year

 ( 1)  78.year = 0
 ( 2)  79.year = 0
 ( 3)  80.year = 0
 ( 4)  81.year = 0
 ( 5)  82.year = 0
 ( 6)  83.year = 0
 ( 7)  84.year = 0
 ( 8)  85.year = 0
 ( 9)  86.year = 0
 (10)  87.year = 0
 (11)  88.year = 0
 (12)  89.year = 0
 (13)  90.year = 0
 (14)  91.year = 0
 (15)  92.year = 0
 (16)  93.year = 0
 (17)  94.year = 0
 (18)  95.year = 0
 (19)  96.year = 0
 (20)  97.year = 0
 (21)  98.year = 0
 (22)  99.year = 0

       F( 22,    50) =   19.61
            Prob > F =    0.0000
```

P-value for F-test is zero, so we reject the null hypothesis and can say that at least one of the year variable is non-zero.

e. Random Effect Model

```
. xtreg ln_mur shall incarc_rate density avginc pop pm1029 pb1064 pw1064, re

Random-effects GLS regression                   Number of obs     =      1,173
Group variable: stateid                         Number of groups  =         51

R-sq:                                           Obs per group:
     within  = 0.0813                                         min =         23
     between = 0.4921                                         avg =       23.0
     overall = 0.4381                                         max =         23

                                                Wald chi2(8)      =     169.92
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000
```

ln_mur	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
shall	-.1153705	.0268844	-4.29	0.000	-.1680629	-.062678
incarc_rate	.0004438	.0000925	4.80	0.000	.0002625	.000625
density	.0163429	.0381659	0.43	0.669	-.0584609	.0911467
avginc	.0093982	.0081589	1.15	0.249	-.0065929	.0253893
pop	.0029126	.0072821	0.40	0.689	-.01136	.0171851
pm1029	.0734716	.0084037	8.74	0.000	.0570007	.0899426
pb1064	.0512656	.0168244	3.05	0.002	.0182903	.0842409
pw1064	.0069318	.0071688	0.97	0.334	-.0071188	.0209824
_cons	-.3301384	.536504	-0.62	0.538	-1.381667	.7213902
sigma_u	.30755149					
sigma_e	.21942693					
rho	.66267693	(fraction of variance due to u_i)				

From this model, we get a significant coefficient for shall, which suggest murder in states with shall law is lower by 11.5 % than states without shall law.
We will perform Hausman test to check if endogeneity exists

Hausman Test -

```
. hausman fixed random
```

	Coefficients (b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
shall	-.06081	-.1153705	.0545605	.
incarc_rate	-.00036	.0004438	-.0008037	.0000882
density	-.6707132	.0163429	-.6870561	.1096429
avginc	.0243114	.0093982	.0149132	.
pop	-.0257054	.0029126	-.0286179	.0094248
pm1029	.0392384	.0734716	-.0342333	.0024109
pb1064	.0307009	.0512656	-.0205648	.017453
pw1064	.0103313	.0069318	.0033995	.

```
                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(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                  =       91.44
        Prob>chi2 =      0.0000
        (V_b-V_B is not positive definite)
```

The value of the chi-square statistic: 91.44. P-value is small almost approaching zero. Hence, we reject the null hypothesis of no endogeneity and conclude that we should use the fixed effect model.

Best Model (d) is the fixed effect model using robust standard errors with both state and time fixed effects. As per the model results the shall-issue law doesn't have an impact on murder rates.

CONCLUSION:

Estimate of coefficient of explanatory variable shall-issue law for all three dependent variables is as shown in below tables.

Violence rate : Variable - ln(Vio)			
Model Name	**Coef. for shall**	**P-value**	**Significant**
Pooled OLS with Robust std. error	-0.368	0.002	Yes
Fixed Effect Model	-0.046	0.015	Yes
Fixed Effect with Robust std. error	-0.046	0.275	No
Fixed effect with Time fixed effect	-0.027	0.495	No
Random Effect	-0.069	0.000	Yes

Robbery : Variable - ln(Rob)			
Model Name	**Coef. for shall**	**P-value**	**Significant**
Pooled OLS with Robust std. error	-0.529	0.002	Yes
Fixed Effect Model	-0.007	0.757	No
Fixed Effect with Robust std. error	-0.007	0.888	No
Fixed effect with Time fixed effect	0.027	0.609	No
Random Effect	-0.041	0.108	No

Murder : Variable - ln(Mur)			
Model Name	**Coef. for shall**	**P-value**	**Significant**
Pooled OLS with Robust std. error	-0.313	0.003	Yes
Fixed Effect Model	-0.061	0.018	Yes
Fixed Effect with Robust std. error	-0.061	0.106	No
Fixed effect with Time fixed effect	-0.015	0.697	No
Random Effect	-0.115	0.000	Yes

Fixed effect model with time fixed effect is best model as it addresses heterogeneities that are changing with time but constant across states and time variant heterogeneities within state.

Sign of estimate of shall-issue law for violence rate and robbery is as expected, sign for murder is opposite that proposed. However, all the coefficients are insignificant.

All other variables also don't have any impact on crime rate.

We conclude that - ***" MORE GUNS DO NOT REDUCE CRIME".***

LIMITATION:

If the unobserved variable that is heterogeneous and it is changing over time also, it is correlated with the regressors, even though the Fixed Effect estimator is going to remain biased.

For instance, if a variable like, the people notion about having gun changes over time then it will not be captured. Hence, we need more data to see its effect on our evaluation, but it is difficult to comprehend.