Applied Econometrics and Time Series
BUAN 6312.004

FINAL PROJECT: DO "SHALL-ISSUE LAW" REDUCES CRIME OR NOT?

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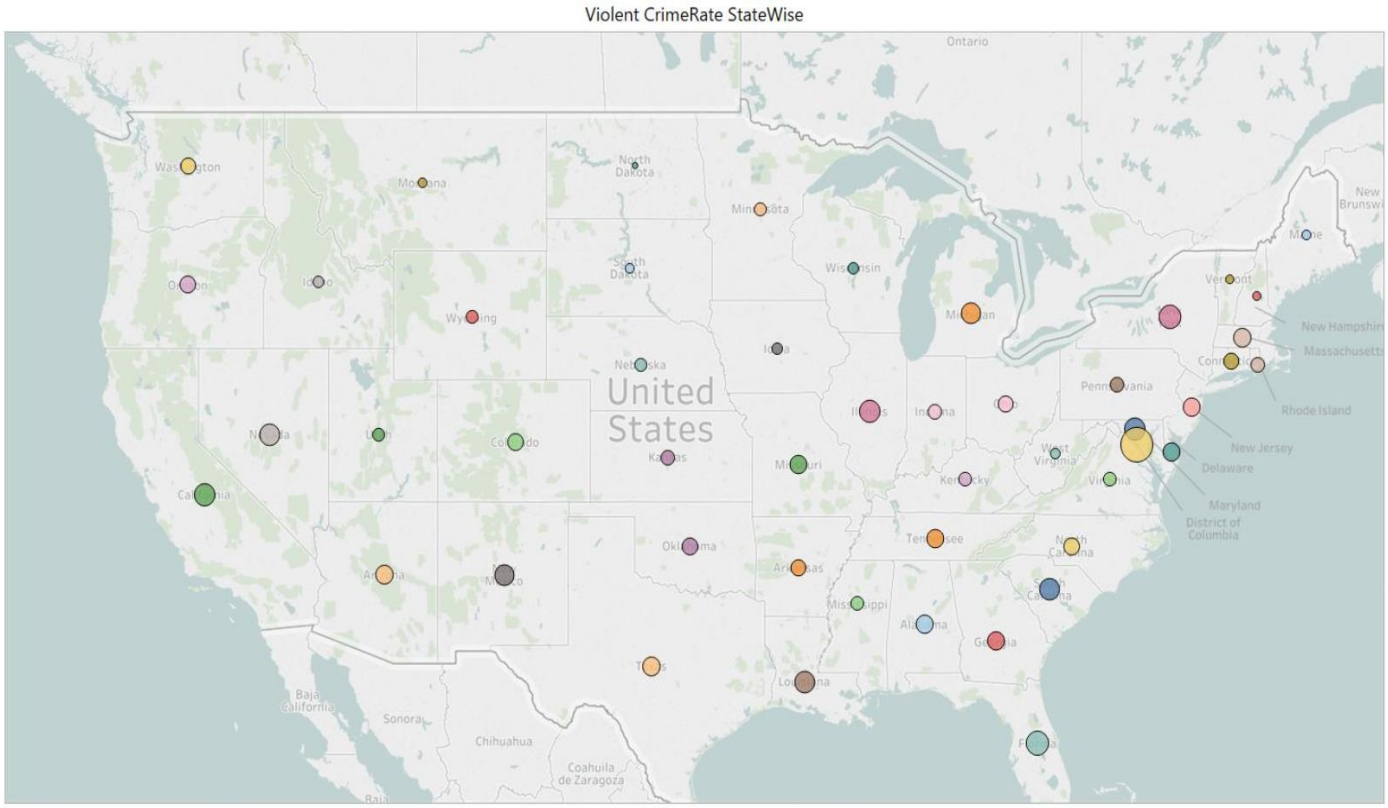
Overview

The impact of guns on crime in America has triggered a lot of public debate in the recent past. The proponents strongly believe that state laws enabling citizens to carry concealed handguns have reduced crime. Proponents argue that gun control laws take away guns from law-abiding citizens, which would leave potential victims defenseless.

Following this view, The National Rifle Association (NRA) and many politicians across the country advance the cause of greater freedom to carry guns. As a result, many states in the United States have passed right-to-carry laws (also known as a shall-issue laws). A Shall-issue law is one that requires that governments issue concealed carry handgun permits to any applicant who meets the necessary criteria.

In this report, we analyze historical data on crime in the U.S to answer the question "Do shall-issues law reduce crime-or not?"

The distribution of average violent crime rate over 50 US states over a period of 23 years. District of Columbia can be visualized below with the highest crime rate followed by Florida and New York.



1. Understanding the data

We have data for 51 states for 23 periods, from 1977 to 1999. There are 12 explanatory variables in the dataset. The shall column is the variable that indicates whether the State has implemented the law or not. There are 3 variables which explain the crime rate which are as follows: Violent Crime rate(vio), Robbery rate(rob) and Murder rate(mur). The remaining variables account for Average Income, population, density and percentage of white and black in that state. The project is based on the analysis of the dependent variable violent crime rate and explanatory variable shall-carry law and other explanatory variable which might impact the crime rate in the states.

2. Correlation amongst variables

Our very first exploration was to determine the correlations amongst the variables. Below is the screenshot of the correlation matrix.

```
. cor rob mur shall incarc_rate density avginc pop pm1029 pw1064 pb1064
(obs=1,173)
```

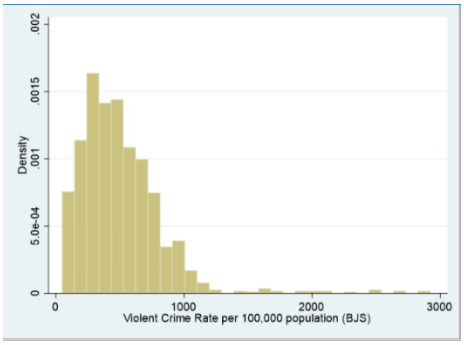
	rob	mur	shall	incarc~e	density	avginc	pop	pm1029	pw1064	pb1064
rob	1.0000									
mur	0.7976	1.0000								
shall	-0.2125	-0.1794	1.0000							
incarc_rate	0.5668	0.7096	0.0424	1.0000						
density	0.7818	0.7486	-0.1126	0.5593	1.0000					
avginc	0.4148	0.2206	-0.0000	0.4615	0.3433	1.0000				
pop	0.3172	0.0999	-0.1244	0.0953	-0.0780	0.2152	1.0000			
pm1029	-0.0860	0.0150	-0.2772	-0.4463	-0.0637	-0.5279	-0.0975	1.0000		
pw1064	-0.5842	-0.6154	0.2123	-0.5271	-0.5551	-0.1912	-0.0654	-0.0126	1.0000	
pb1064	0.5812	0.6018	-0.1839	0.5308	0.5432	0.2627	0.0581	0.0162	-0.9820	1.0000

Conclusion: Variables pb1064 and pw1064 are highly correlated. Since the variables capture the same metric, that is population diversity, we can drop one variable from our analysis from here on. We chose to drop pw1064 since we were interested in exploring the effect of pb1064 on violent crime rate (not being racist here but we suspected that black population could affect the crime rate).

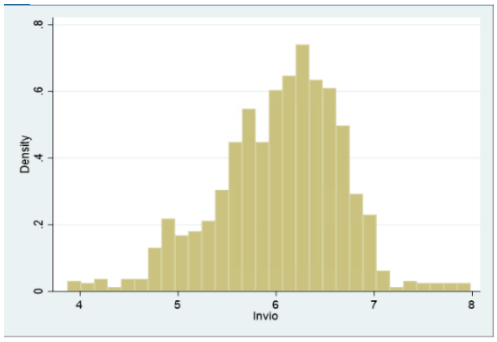
3. Distribution of variables

To determine the distribution of different variables we drew histograms for all the variables. If we found skewness in their distribution, we took log transform of the variable. Below are the histograms for all the variables and their corresponding histogram of log transform if histogram for that variable was found to be skewed.

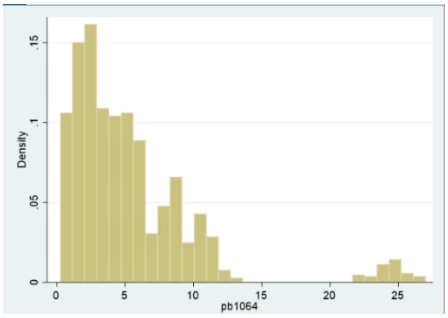
1.Vio



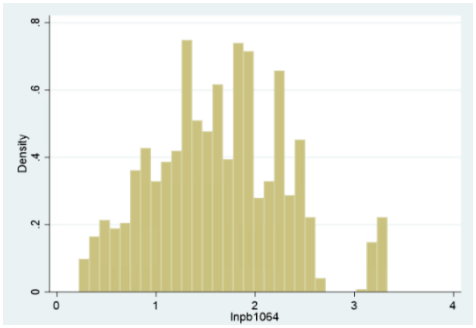
lnvio



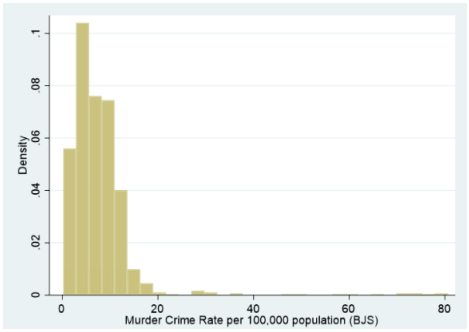
2.pb1064



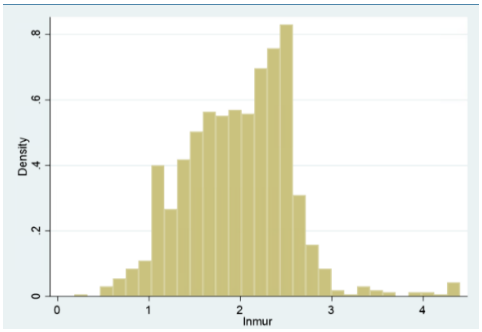
lnpb1064



3.Mur



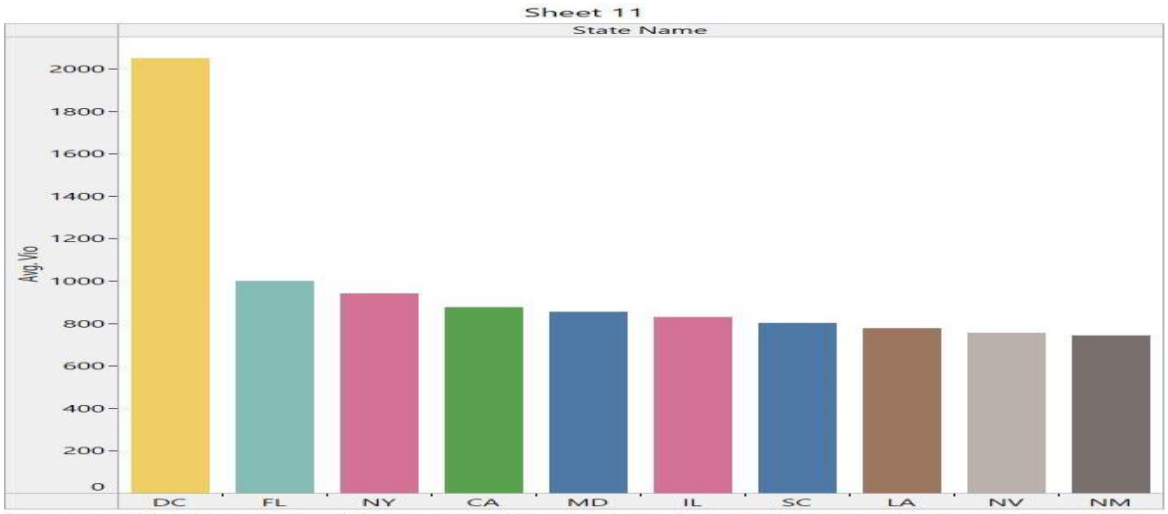
lnmur



Similarly, we did log transformation for rob, incarc_rate, pop, den, avginc and the transformed variable was named as lnrob, lnincarc_rate, lnpop, lnden, lnavginc

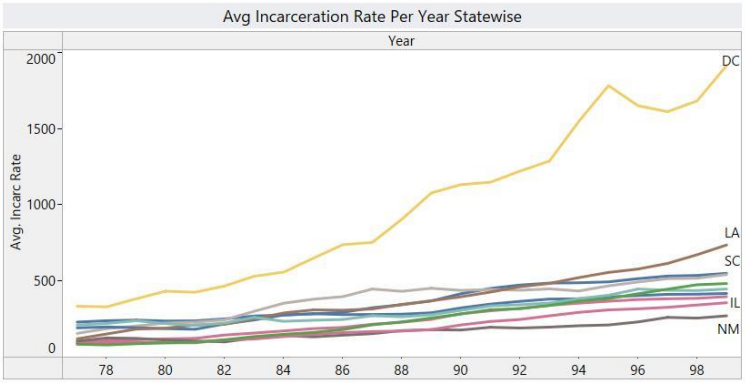
4. Exploratory Data Analysis

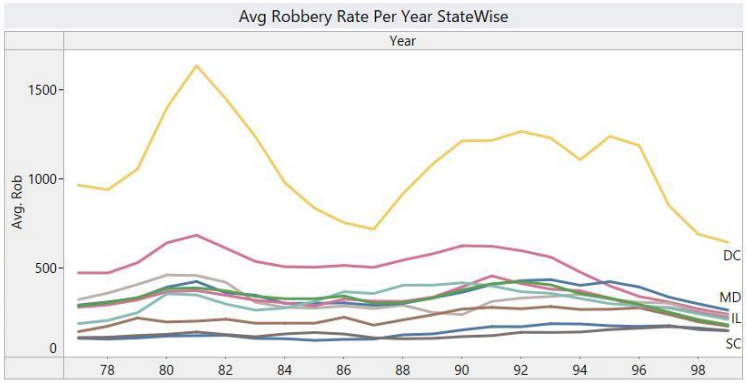
We found top 10 states based on average violent crime rate. District of Columbia (DC) is significantly highest in violent crime rate w.r.t other states.

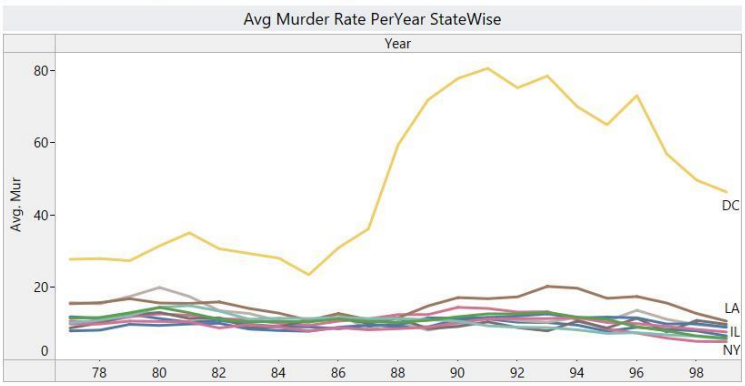


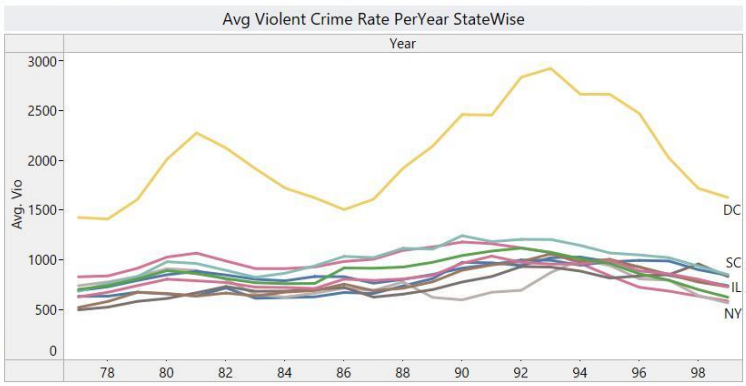
District of Columbia has the highest average murder rate, robbery rate and incarceration rate along with average violent crime rate throughout years 1977-1999.

The distribution of crime rate for all the states can be seen below.









5. Hypothesis Testing

We performed one-way ANOVA hypothesis tests.

1)Check whether average violent crime rate is significantly different for shall law states and non-shall law states.

Null Hypothesis, Ho: Average violent crime rate across shall law states and non-shall law states is not significantly different.

Alternate hypothesis, Ha: Average violent crime rate is significantly different across shall law states and non-shall law states.

```
anova lnvio shall

                          Number of obs =      1,173    R-squared     =  0.0865
                          Root MSE      =   .615238    Adj R-squared =  0.0858

                 Source | Partial SS         df         MS        F     Prob>F
------------------------+----------------------------------------------------
                  Model |  41.992856          1   41.992856    110.94  0.0000
                  shall |  41.992856          1   41.992856    110.94  0.0000
               Residual |  443.24385      1,171   .37851738
------------------------+----------------------------------------------------
                  Total |  485.23671      1,172    .4140245
```

Conclusion: p-value ≈ 0, which implies that we can reject our null hypothesis, and that we can state that average violent crime is different across shall law states and non-shall law states.

2)Check whether density of a state is an important indicator whether the state has shall law or not.

Null Hypothesis, Ho: Average density across shall law states and non-shall law states is not significantly different.

Alternate Hypothesis, Ha: Average density across shall law states and non-shall law states is significantly different.

```
anova lnden shall

                          Number of obs =      1,173    R-squared     =  0.0275
                          Root MSE      =   .346382    Adj R-squared =  0.0267

                 Source | Partial SS         df         MS        F     Prob>F
------------------------+----------------------------------------------------
                  Model |  3.9709599          1  3.9709599     33.10  0.0000
                  shall |  3.9709599          1  3.9709599     33.10  0.0000
               Residual |  140.49754      1,171  .11998082
------------------------+----------------------------------------------------
                  Total |   144.4685      1,172  .12326664
```

Conclusion: Density of a state is an important indicator whether the state has shall law or not.

3)Check whether average income across shall law states and non-shall law states is significantly different or not.

Null Hypothesis, Ho: Average income across shall law states and non-shall law states is not significantly different.

Alternate Hypothesis, Ha: Average income across shall law states and non-shall law states is significantly different.

```
anova lnavginc shall

                           Number of obs =      1,173    R-squared     =  0.0005
                           Root MSE      =   .168865    Adj R-squared = -0.0003

                  Source | Partial SS         df         MS        F     Prob>F
              -----------+----------------------------------------------------
                   Model |  .01775409          1    .01775409     0.62   0.4302
                         |
                   shall |  .01775409          1    .01775409     0.62   0.4302
                         |
                Residual |  33.391646      1,171    .0285155
              -----------+----------------------------------------------------
                   Total |    33.4094      1,172    .02850631
```

Conclusion: Average income is not significantly different across shall law states and non-shall law states.

4)Check whether average percentage of blacks is different across shall law states and non-shall law states.

Null Hypothesis, Ho: Average percentage of blacks across shall law states and no-shall states is not significantly different.

Alternate Hypothesis, Ha: Average percentage of blacks across shall law states and non-shall law states is significantly different.

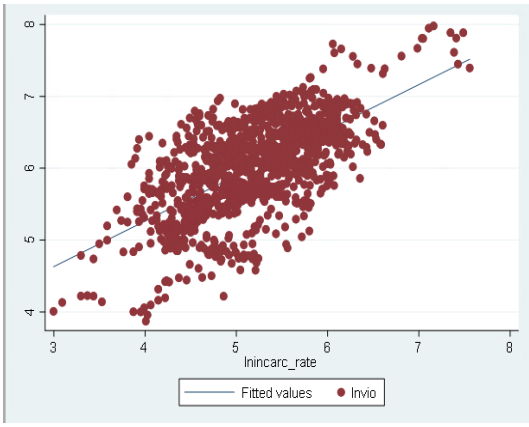
```
anova lnpb1064 shall

                           Number of obs =      1,173    R-squared     =  0.0624
                           Root MSE      =   .635248    Adj R-squared =  0.0616

                  Source | Partial SS         df         MS        F     Prob>F
              -----------+----------------------------------------------------
                   Model |  31.459642          1   31.459642    77.96   0.0000
                         |
                   shall |  31.459642          1   31.459642    77.96   0.0000
                         |
                Residual |  472.54606      1,171   .40354062
              -----------+----------------------------------------------------
                   Total |  504.0057       1,172    .430039
```

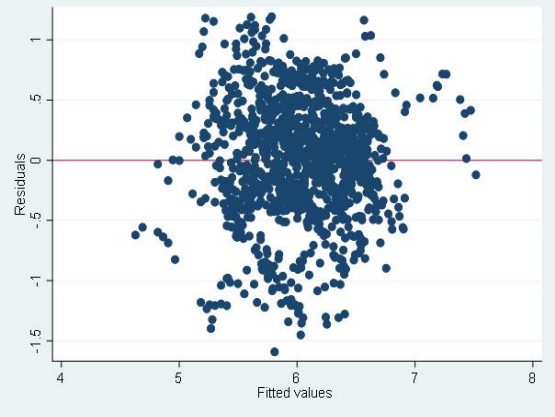
Conclusion: Average percentage of blacks across shall law states and non-shall law states is significantly different.

6. Checking relationship among variables and Error Variance form

1) Incarceration Rate (incarc_rate) and Violent Crime Rate (vio)

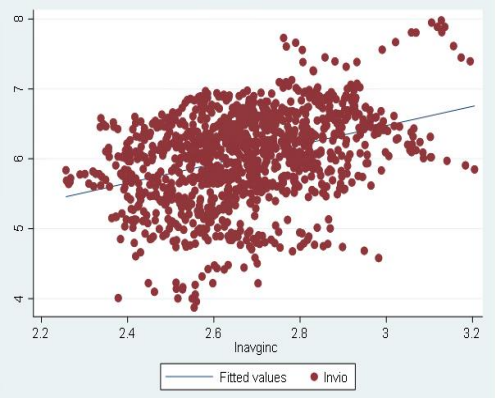
As Incarceration rate increases, violent crime rate increases i.e. incarceration rate and violent crime rate are positively correlated. This is evident from the residual plot that there is no error variance pattern and residual errors are evenly distributed about mean = 0.

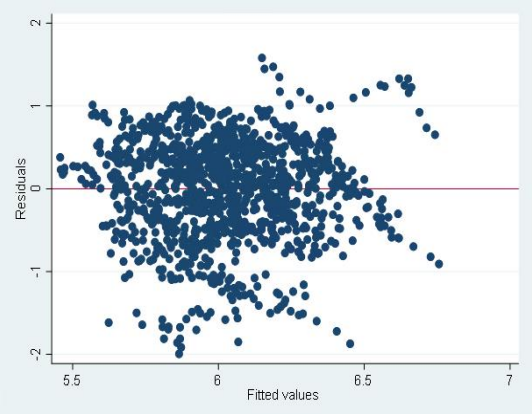




2) Average Income (avginc) and Violent Crime Rate (vio)

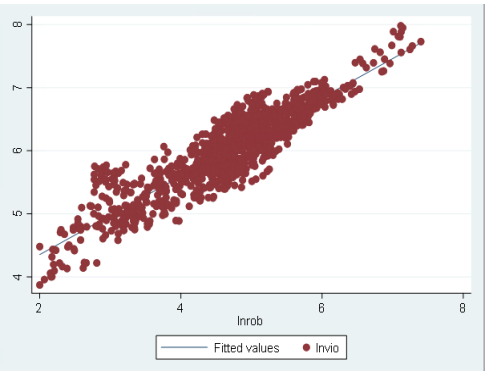
There are multiple points which is not covered with the predicted line which confirms the presence of outliers for income variable; however, in general there is positive relationship between violent crime rate and average income. There is no clear error variance form and errors are mostly evenly distributed across mean = 0.

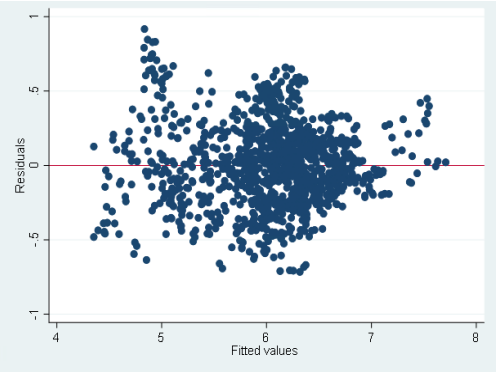




3) Robbery Rate (rob) and Violent Crime Rate (vio)

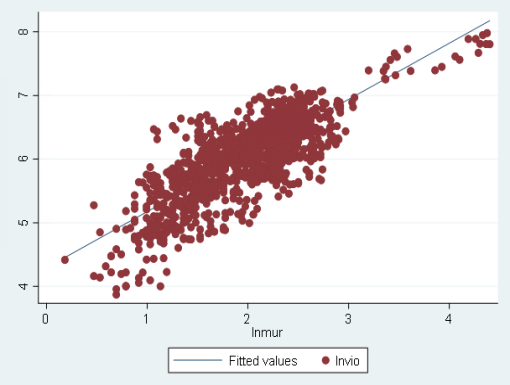
Robbery rate is directly proportional to violent crime rate. This suggests that with increase in robbery rate will result in increase in violent crime rate. There is no heteroscedasticity w.r.t. to lnrob variable and errors are evenly distributed across mean error = 0.

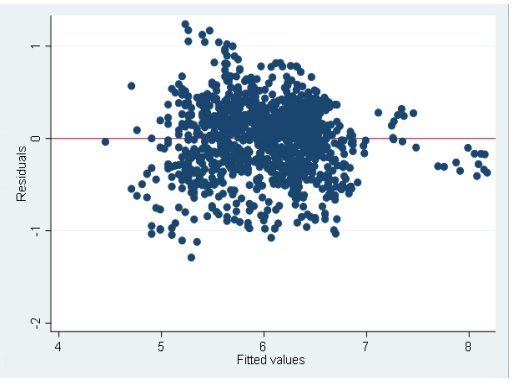




4) **Murder Rate (mur) and Violent Crime Rate (vio)**

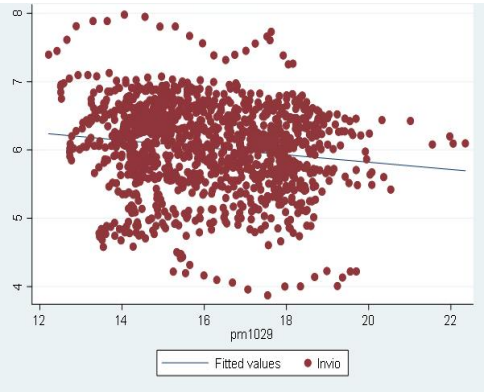
Murder rate is directly proportional to violent crime rate. This suggests that with increase in murder rate will result in increase in violent crime rate. There is no heteroscedasticity w.r.t. to lnmur variable and errors are evenly distributed across mean error = 0.

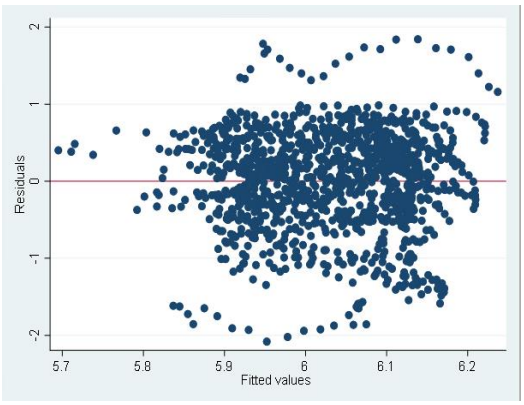




4) **Percentage of Male Population- 10-29 age (pm1029) and Violent Crime Rate (vio)**

Percentage of male population aged 10-29 “pm1029” is slightly inversely proportional to violent rate. This suggests that with increase in male population aged between 10-29, there would be decline in violent crime rate. Residual errors are also distributed across mean = 0 with detection of few outliers.





7. Regression Analysis

Following are the four different models to estimate effect of "shall" and other variables on violent crime rate.

1) Pooled OLS
2) Fixed Entity Effects
3) Fixed Time and Entity Effects
4) Random Effects

Transformed Variable Definitions used in models

Variable	Definition
lnvio	Log of violent crime rate (incidents per 100,000 members of the population)
lnrob	Log of robbery rate (incidents per 100,000)
lnmur	Log of murder rate (incidents per 100,000)
shall	= 1 if the state has a shall-carry law in effect in that year = 0 otherwise
lnincarc_rate	Log of incarceration rate in the state in the previous year (sentenced prisoners per 100,000 residents; value for the previous year)
lndensity	Log of population per square mile of land area, divided by 1000
lnavginc	Log of real per capita personal income in the state, in thousands of dollars
lnpop	Log of state population, in millions of people
pm1029	percent of state population that is male, ages 10 to 29
lnpb1064	Log of 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)

Dependent Variable: lnvio (Violent Crime Rate)

Basic Steps Followed to Find the Best Model for Pooled, Fixed Entity Effect and Fixed Time and Entity Effect:

- Regression using all the given variables without Cluster Robust Standard Errors
- Regression using all the given variables with Cluster Robust Standard Errors
- Regression using only the significant variables with Cluster Robust Standard Errors
- Regression using "shall" and significant variables with Cluster Robust Standard Errors
- Regression using "shall", significant variables and adding and removing other insignificant variables one by one and deciding best model based on the lowest BIC value with Cluster Robust Standard Errors

1. Pooled OLS Estimates

The given data is a panel, running pooled OLS model on it will not consider individual state and time effects i.e. it will violate below two assumptions:

I. No correlation between errors corresponding to the same entity - Entity may have observed or unobserved heterogeneity hiding in the error terms causing serial correlation.
II. Constant variance of the error term - variance may differ in different time

However, for now, we assume that the errors for different states are uncorrelated, thus not considering endogeneity problem for Pooled OLS model.

Solution: We will use Cluster Robust Standard Errors to overcome the problem of serial correlation and heteroskedasticity by correcting the standard errors. While the standard errors are correct, the estimator will still be inefficient.
But, if an unobserved variable is correlated with an explanatory variable, the estimated effect of those variables on the dependent variable violent crime rate will be upward or downward bias.

Below table shows the combination of different explanatory variables to find the best model based on significance of the variables and BIC of the model.

MODEL1_7 is the best model since it has the lowest BIC

POOLED OLS	BIC	Independent Variables Used
MODEL 1_2	-317	lnincarc_rate, shall, lnpb1064, pm1029, lnpop, lnden, lnmur, lnrob, lnavginc
MODEL 1_3	-278	lnincarc_rate, lnpb1064, lnmur lnrob
MODEL 1_4	-291	shall, lnincarc_rate, lnpb1064, lnmur, lnrob
MODEL 1_5	-306	lnincarc_rate, lnpb1064, pm1029, lnmur, lnrob
MODEL 1_6	-307	shall, lnincarc_rate, lnpb1064, pm1029, lnmur, lnrob, lnden
MODEL 1_7	-324	shall, lnincarc_rate, lnpb1064, pm1029, lnmur, lnrob, lnden, lnpop

Model1_2: Pooled OLS with cluster-Robust standard errors

```
. reg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden lnmur lnrob lnavginc, vce(cluster stateid)

Linear regression                               Number of obs     =      1,173
                                                F(9, 50)          =     190.38
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8983
                                                Root MSE          =     .20599

                                  (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnincarc_rate |   .3308061   .0590076     5.61   0.000     .2122859    .4493262
       shall |  -.0589598    .040524    -1.45   0.152    -.1403546     .022435
    lnpb1064 |  -.1386792   .0614845    -2.26   0.029    -.2621745   -.0151839
      pm1029 |   .0186458   .0180098     1.04   0.306    -.0175279    .0548195
       lnpop |  -.0579515   .0555871    -1.04   0.302    -.1696014    .0536985
       lnden |  -.0996981   .0901016    -1.11   0.274    -.2806724    .0812763
       lnmur |   .1535501   .0700273     2.19   0.033     .0128961     .294204
       lnrob |   .5402218   .0595007     9.08   0.000     .4207111    .6597324
    lnavginc |  -.009638   .1983124    -0.05   0.961    -.4079602    .3886841
       _cons |   1.533443   .7603481     2.02   0.049     .0062389    3.060647
------------------------------------------------------------------------------
```

Effect of Shall law on violent Crime Rate: Keeping other variables constant, if the state has a shall-carry law in effect in that year the violent crime rate decreases approximately by 5.8% compared to the state with no shall-carry law in that year.

Model1_7: Best Pooled OLS model with cluster-Robust standard errors as per BIC

```
. reg lnvio shall lnincarc_rate lnpb1064 pm1029 lnmur lnrob lnden lnpop, vce (cluster stateid)

Linear regression                               Number of obs     =      1,173
                                                F(8, 50)          =     213.34
                                                Prob > F          =     0.0000
                                                R-squared         =     0.8983
                                                Root MSE          =     .20591

                                   (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |  -.0590532   .0403381    -1.46   0.149    -.1400745    .0219682
lnincarc_rate|   .3302438   .0601298     5.49   0.000     .2094695    .4510182
     lnpb1064|  -.1388187   .0612444    -2.27   0.028    -.2618318   -.0158057
      pm1029 |   .0189029   .0162186     1.17   0.249    -.0136732    .0514789
       lnmur |   .1552896   .0688229     2.26   0.028     .0170547    .2935245
       lnrob |   .5391388   .0576843     9.35   0.000     .4232765     .655001
       lnden |  -.1008833   .0875875    -1.15   0.255    -.2768081    .0750414
       lnpop |  -.0577938   .0557736    -1.04   0.305    -.1698183    .0542307
       _cons |    1.50835   .4679348     3.22   0.002     .5684755    2.448225
------------------------------------------------------------------------------
```

Effect of Shall law on violet Crime Rate: Keeping other variables constant, if the state has a shall-carry law in effect in that year the violent crime rate decreases approximately by 5.9% compared to the state with no shall-carry law in that year.

2. Fixed Entity Effects Estimates

The estimates/effects of explanatory variables might be different for different states and can cause endogeneity problem because of observed and unobserved heterogeneity, which accounts for the pooled OLS estimates being biased and inconsistent. Running Fixed effect model allow us to control for unobserved heterogeneity among entities (states), making estimates unbiased and consistent; however, time effects will still not be accounted.
Below table shows the combination of different explanatory variables to find the best model based on significance of the variables and BIC of the model.

MODEL2_9 is the best model since it has the lowest BIC

FIXED ENTITY EFFECT	BIC	Independent Variables Used
MODEL 2_2	-1804.703	lnincarc_rate, shall, lnpb1064, pm1029, lnpop, lnden, lnmur, lnrob, lnavginc
MODEL 2_3	-1802.934	pm1029, lnmur, lnrob
MODEL 2_4	-1795.868	shall, pm1029, lnmur, lnrob
MODEL 2_5	-1796.282	shall, pm1029, lnmur, lnrob, lnpb1064
MODEL 2_6	-1802.365	shall, pm1029, lnmur, lnrob, lnpb1064, lnden
MODEL 2_7	-1797.17	shall, pm1029, lnmur, lnrob, lnpb1064, lnden, lnavginc
MODEL 2_8	-1805.752	shall, pm1029, lnmur, lnrob, lnpb1064, lnden, lnpop
MODEL 2_9	-1811.136	shall, pm1029, lnmur, lnrob, lnpb1064, lnden, lnpop, lnincarc_rate

Model2_2: Fixed Entity Effect with Cluster-Robust standard errors

```
. xtreg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden lnmur lnrob lnavginc, fe vce (cluster stateid)

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

R-sq:                                           Obs per group:
     within  = 0.6179                                         min =          23
     between = 0.7955                                         avg =        23.0
     overall = 0.7810                                         max =          23

                                                F(9,50)            =       59.65
corr(u_i, Xb)  = 0.2567                         Prob > F           =      0.0000

                                (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnincarc_rate |   .0617937   .0503234     1.23   0.225    -.0392838    .1628712
       shall |  -.0010026   .0302662    -0.03   0.974     -.061794    .0597888
     lnpb1064 |   .1759719   .1618315     1.09   0.282    -.1490762     .50102
      pm1029 |  -.0373956   .0140429    -2.66   0.010    -.0656016   -.0091895
       lnpop |  -.2702397   .1885807    -1.43   0.158    -.6490152    .1085359
       lnden |  -.5513626   .6489013    -0.85   0.400    -1.854719     .751994
       lnmur |   .0790516    .02856     2.77   0.008     .0216871    .136416
       lnrob |   .5430485   .034028    15.96   0.000     .4747013    .6113956
    lnavginc |   .0509784   .149821     0.34   0.735    -.2499458    .3519027
       _cons |   3.675818   .6466882     5.68   0.000     2.376906    4.974729
-------------+----------------------------------------------------------------
     sigma_u |  .29314285
     sigma_e |   .1120213
         rho |  .87257737   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Effect of Shall law on violent Crime Rate: Keeping other variables constant, if the state has a shall-carry law in effect in that year the violent crime rate decreases approximately by 0.1% compared to the state with no shall-carry law in that year.

Model2_9: Best Fixed Entity Effect Model with Cluster-Robust standard errors as per BIC

```
. xtreg lnvio shall pm1029 lnmur lnrob lnpb1064 lnden lnpop  lnincarc_rate, fe vce (cluster stateid)

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

R-sq:                                           Obs per group:
     within  = 0.6177                                         min =          23
     between = 0.7996                                         avg =        23.0
     overall = 0.7850                                         max =          23

                                                F(8,50)            =       66.87
corr(u_i, Xb)  = 0.2397                         Prob > F           =      0.0000

                                (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       shall |   .0000894   .0303625     0.00   0.998    -.0608954    .0610742
      pm1029 |  -.0385358   .0140708    -2.74   0.009    -.0667978   -.0102737
       lnmur |   .0816308    .028107     2.90   0.005     .0251761    .1380854
       lnrob |   .5429988   .0337221    16.10   0.000     .4752659    .6107316
     lnpb1064 |   .1845555   .1569155     1.18   0.245    -.1306185    .4997296
       lnden |   -.539933   .6329484    -0.85   0.398    -1.811247    .7313813
       lnpop |   -.263511   .1892361    -1.39   0.170    -.6436029    .1165808
lnincarc_rate |   .0658703   .0471004     1.40   0.168    -.0287335    .1604742
       _cons |   3.778317   .5884176     6.42   0.000     2.596445    4.960188
-------------+----------------------------------------------------------------
     sigma_u |  .28873478
     sigma_e |  .11200128
         rho |  .86921054   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Effect of Shall law on violent Crime Rate: Keeping other variables constant, there is negligible effect of shall law on the violent crime rate compared to the state with no shall-carry law in that year.

3. Fixed Entity and Time Effect Estimates

The estimates/effects of explanatory variables might be different for different states over time. Time Fixed Effects regression are useful in dealing with omitted variables, if the omitted variables are constant across entities but vary over time. Running Fixed entity and time effect model allow us to control for unobserved heterogeneity among entities (states) as well as for those variables which vary over time, making estimates unbiased and consistent.

Below table shows the combination of different explanatory variables to find the best model based on significance of the variables and BIC of the model.

MODEL3_7 is the best model since it has the lowest BIC

FIXED TIME AND ENTITY EFFECT	BIC	Independent Variables Used
MODEL 3_2	-1842.005	lnincarc_rate, shall, lnpb1064, pm1029, lnpop, lnden, lnmur, lnrob, lnavginc, i.year
MODEL 3_3	-1834.535	pm1029, lnrob, i.year
MODEL 3_4	-1835.151	pm1029, lnrob, shall, i.year
MODEL 3_5	-1830.807	pm1029, lnrob, shall, lnpb1064, i.year
MODEL 3_6	-1848.091	pm1029, lnrob, shall, lnpb1064, lnden, i.year
MODEL 3_7	-1856.611	pm1029, lnrob, shall, lnpb1064, lnden, lnpop, i.year
MODEL 3_8	-1850.564	pm1029, lnrob, shall, lnpb1064, lnden, lnpop, lnavginc, i.year
MODEL 3_9	-1853.711	pm1029, lnrob, shall, lnpb1064, lnden, lnpop, lnmur, i.year
MODEL 3_10	-1846.688	pm1029, lnrob, shall, lnpb1064, lnden, lnpop, lnmur, lnincarc_rate, i.year

Model 3_2: Fixed Entity and Time Effects with Cluster-Robust standard errors

```
. xtreg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden lnmur lnrob lnavginc i.year, fe vce(cluster stateid)

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

R-sq:                                           Obs per group:
     within  = 0.6758                                         min =          23
     between = 0.5718                                         avg =        23.0
     overall = 0.5619                                         max =          23

                                                F(31,50)           =      110.96
corr(u_i, Xb)  = 0.3719                         Prob > F           =      0.0000

                                (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnincarc_rate |  -.0041201   .0592242    -0.07   0.945    -.1230755    .1148353
       shall |  -.0299454   .0288532    -1.04   0.304    -.0878987     .028008
     lnpb1064 |   -.027411   .1836866    -0.15   0.882    -.3963563    .3415344
       pm1029 |   .0384271   .0192401     2.00   0.051    -.0002177    .077072
        lnpop |  -.2997561   .1685498    -1.78   0.081    -.6382983    .0387861
        lnden |  -.5725517   .4087528    -1.40   0.167    -1.393556    .2484525
        lnmur |    .049223    .028407     1.73   0.089    -.0078342    .1062802
        lnrob |   .4768532   .0372789    12.79   0.000     .4019764     .55173
     lnavginc |  -.1177747   .2006829    -0.59   0.560    -.5208582    .2853087
              |
         year |
           78 |   .0496742   .0130306     3.81   0.000     .0235015    .0758468
           79 |   .1089603   .0197485     5.52   0.000     .0692942    .1486263
           80 |   .1149285   .0258125     4.45   0.000     .0630826    .1667744
           81 |   .1073847   .0306315     3.51   0.001     .0458595     .16891
           82 |   .1204283   .0386741     3.11   0.003     .0427492    .1981075
           83 |   .1373779   .0452062     3.04   0.004     .0465786    .2281772
           84 |   .2010825   .0539679     3.73   0.000     .0926848    .3094802
           85 |   .2393366   .0618038     3.87   0.000        .1152    .3634732
           86 |   .2840803   .0735775     3.86   0.000     .1362955     .431865
           87 |   .3056825   .0819664     3.73   0.000     .1410483    .4703168
           88 |   .3563915   .0920065     3.87   0.000      .171591     .541192
           89 |   .3903557   .1023984     3.81   0.000     .1846824     .596029
           90 |    .474207   .1102501     4.30   0.000     .2527631    .6956509
           91 |   .4773074   .1148394     4.16   0.000     .2466457    .7079691
           92 |   .5182075   .1213541     4.27   0.000     .2744606    .7619544
           93 |   .5359566    .126554     4.24   0.000     .2817653    .7901478
           94 |   .5256749   .1321586     3.98   0.000     .2602266    .7911232
           95 |    .525475   .1376786     3.82   0.000     .2489394    .8020107
           96 |   .5060943   .1433813     3.53   0.001     .2181044    .7940843
```

Effect of Shall law on violent Crime Rate: Keeping other variables constant, if the state has a shall-carry law in effect in that year the violent crime rate decreases approximately by 3% compared to the state with no shall-carry law in that year. However, still shall variable be insignificant.

F-test to check the significance of Time Effect in Fixed model

The fixed entity and time effects model allows us to test if there are time fixed effects by conducting joint significance f-tests for the year dummy variables.

Null Hypothesis, Ho: The year dummy variables coefficients are all equal to zero.
Alternate Hypothesis, Ha: At least one or more-year dummy coefficients are not equal to zero.

```
. 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,  1091) =    8.86
            Prob > F =    0.0000
```

Since, for the f-test, p-value <0.05. Null hypothesis can be rejected and conclude that there is at least one or more of the year intercept that is significantly different from zero.

Model 3_7: Best Fixed Entity and Time Effects with Cluster-Robust standard errors as per BIC

```
. xtreg lnvio pm1029 lnrob shall lnpb1064 lnden lnpop i.year, fe vce (cluster stateid)

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

R-sq:                                           Obs per group:
     within  = 0.6740                                         min =          23
     between = 0.3874                                         avg =        23.0
     overall = 0.4045                                         max =          23

                                                F(28,50)           =       96.60
corr(u_i, Xb)  = 0.1744                         Prob > F           =      0.0000

                              (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      pm1029 |    .037292   .0191589     1.95   0.057    -.0011897    .0757737
       lnrob |   .4894918   .0371094    13.19   0.000     .4149554    .5640282
       shall |  -.0286511   .0300385    -0.95   0.345    -.0889851     .031683
    lnpb1064 |  -.0067272   .1814566    -0.04   0.971    -.3711935     .357739
       lnden |  -.7967832   .4092568    -1.95   0.057      -1.6188    .0252332
       lnpop |  -.3062501   .1584566    -1.93   0.059    -.6245196    .0120195
             |
        year |
          78 |   .0450831   .0114793     3.93   0.000     .0220263    .0681399
          79 |   .1051321   .0159612     6.59   0.000     .0730732    .1371911
          80 |   .1134354   .0218324     5.20   0.000     .0695837    .1572872
          81 |   .1041519    .026437     3.94   0.000     .0510517    .1572521
          82 |   .1141891   .0302669     3.77   0.000     .0533962     .174982
          83 |    .126602   .0334011     3.79   0.000     .0595139    .1936901
          84 |   .1814549   .0384078     4.72   0.000     .1043104    .2585993
          85 |   .2179403   .0443275     4.92   0.000     .1289059    .3069747
          86 |   .2615472   .0508026     5.15   0.000     .1595072    .3635873
          87 |   .2800558   .0564371     4.96   0.000     .1666986     .393413
          88 |   .3279556    .061823     5.30   0.000     .2037804    .4521308
          89 |   .3589758   .0710763     5.05   0.000     .2162148    .5017368
          90 |   .4431598   .0780969     5.67   0.000     .2862977    .6000219
          91 |   .4465117   .0829858     5.38   0.000      .27983     .6131935
          92 |   .4832675   .0876577     5.51   0.000     .3072018    .6593332
          93 |    .502804   .0909838     5.53   0.000     .3200575    .6855504
          94 |   .4870197   .0947501     5.14   0.000     .2967085    .6773308
          95 |    .484326   .0974396     4.97   0.000     .2886129    .6800391
          96 |   .4605056    .100676     4.57   0.000     .2582919    .6627192
          97 |   .4744865   .1017139     4.66   0.000      .270188    .6787849
          98 |   .4671973   .1041924     4.48   0.000     .2579206    .6764739
          99 |   .4489365   .1108072     4.05   0.000     .2263737    .6714992
```

Effect of Shall law on violent Crime Rate: Keeping other variables constant, if the state has a shall-carry law in effect in that year the violent crime rate decreases by 2.8% compared to the state with no shall-carry law in that year.

Comparing "Shall" coefficients for Pooled OLS, Fixed Entity and Fixed Entity and Time Effect

The violent crime rate decreases by 5.8% for Pooled OLS, negligible for Entity Fixed Effect, and decreases by 3% for Entity-Time Fixed Effect model; however, the "shall" variable is not significant in all these models. Thus, we can state that whether a state has shall law or not has no statistically significant effect on violent crime rate.

4. Random Effect Estimates

Random Effects model works best for the data sample that is randomly selected from a population. Here, we have a balanced panel of data on 50 US states, plus the District of Columbia (for a total of 51 "states"), by year for 1977 – 1999. Clearly, the data consists of only the population of US States and it is not a random draw from a large population. Hence, using Random Effects model for such data is insensible and fixed effects model should be used theoretically.

However, the Random Effects model are obtained to conduct Hausman test. The Hausman test will check whether the random component, u_i is correlated with the explanatory variables in the model i.e. whether random effect estimates are significantly different from fixed effect estimates.

Model 4_1: Random Effect estimates with all variables

```
. xtreg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden lnmur lnrob lnavginc , re

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

R-sq:                                           Obs per group:
     within  = 0.6144                                         min =         23
     between = 0.8929                                         avg =       23.0
     overall = 0.8717                                         max =         23

                                                Wald chi2(9)      =    2261.92
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000

------------------------------------------------------------------------------
       lnvio |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnincarc_rate |   .0945506   .0189998     4.98   0.000     .0573116    .1317895
       shall |  -.0081662   .0122065    -0.67   0.503    -.0320905    .0157581
    lnpb1064 |   .0777505   .0397477     1.96   0.050    -.0001536    .1556546
      pm1029 |  -.0318047   .0052591    -6.05   0.000    -.0421124   -.0214969
       lnpop |    -.10333   .0347689    -2.97   0.003    -.1714758   -.0351841
       lnden |  -.1490923   .0790706    -1.89   0.059    -.3040678    .0058833
       lnmur |   .1103124   .0203142     5.43   0.000     .0704974    .1501275
       lnrob |   .5381089   .0171298    31.41   0.000      .504535    .5716827
    lnavginc |   .0112977   .0616676     0.18   0.855    -.1095685     .132164
       _cons |   3.326692   .2402333    13.85   0.000     2.855844    3.797541
-------------+----------------------------------------------------------------
     sigma_u |  .18118924
     sigma_e |   .1120213
         rho |  .72346321   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

5. The Hausman Test

Ho: There is no significant difference between Random Effect and Fixed Effect estimates.

Ha: There is significant difference between Random Effect and Fixed Effect estimates.

Hausman Test 1: Fixed Entity Effect with Random Effect Estimates

```
. hausman fixed2_1 random4_1

                 ---- Coefficients ----
                 (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                 fixed2_1     random4_1      Difference          S.E.
-------------------------------------------------------------------------------
lnincarc_r~e     .0617937     .0945506       -.0327568         .0056335
       shall    -.0010026    -.0081662        .0071636          .002555
    lnpb1064     .1759719     .0777505        .0982214         .0554076
      pm1029    -.0373956    -.0318047       -.0055909         .0020155
       lnpop    -.2702397     -.10333        -.1669097         .0767184
       lnden    -.5513626    -.1490923       -.4022703         .3309051
       lnmur     .0790516     .1103124       -.0312609         .0085224
       lnrob     .5430485     .5381089        .0049396         .0055163
    lnavginc     .0509784     .0112977        .0396807         .0227193
-------------------------------------------------------------------------------
                           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(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       32.99
                Prob>chi2 =      0.0001
                (V_b-V_B is not positive definite)
```

p-value = 0.001. Hence, Null hypothesis can be rejected, and we should use Fixed Effects model.

Hausman Test 2: Fixed Entity and Time Effect with Random Effect Estimates

```
. hausman fixed3_1 random4_1

                 ---- Coefficients ----
                 (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
                 fixed3_1     random4_1      Difference          S.E.
-------------------------------------------------------------------------------
lnincarc_r~e    -.0041201     .0945506       -.0986706         .0097671
       shall    -.0299454    -.0081662       -.0217792         .0042315
    lnpb1064     -.027411     .0777505       -.1051615         .0580199
      pm1029     .0384271    -.0318047        .0702318         .0066706
       lnpop    -.2997561     -.10333        -.1964261         .0729734
       lnden    -.5725517    -.1490923       -.4234594         .3139368
       lnmur      .049223     .1103124       -.0610894         .0076739
       lnrob     .4768532     .5381089       -.0612556         .0070749
    lnavginc    -.1177747     .0112977       -.1290725         .0494496
-------------------------------------------------------------------------------
                           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(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =      240.65
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)
```

p-value ≈ 0.0000. Hence, Null hypothesis can be rejected, and we should use Time Fixed Effects.

As per the Hausman Test, at 5 % significance level, Null hypothesis can be rejected, and it can be concluded that Fixed Effects model should be used as it allow us to control for unobserved heterogeneity among entities (states), making estimates unbiased and consistent.

8. Inference – Estimating the Effect of "*shall*" on crime rates

As per our analysis of historical balanced panel data on 50 US states, plus the District of Columbia (for a total of 51 "states"), by year for 1977 – 1999. We conclude that, despite being efficient, Random Effect model for such sample of data is insensible as it is not randomly selected. This is evident from the Hausman test as well. Therefore, we selected Fixed Effect model over Random Effect model.

Among Fixed Entity and Entity Time Effect model, we selected Time Fixed Effect model as the best model for our analysis. This is evident from the joint hypothesis f-test of time dummy variables, which concludes that time has significant effect.

Estimating the effect of "shall" on violent crime rate (lnvio)

Based on lowest BIC, Best Fixed Entity and Time effect model as per our analysis is

$$lnvio = \beta_0 + \beta_1\, pm1029 + \beta_2\, lnrob + \beta_3\, shall + \beta_4\, lnpb1064 + \beta_5\, lnden + \beta_6\, lnpop + \beta_7\, t_{78} + \beta_8\, t_{79} + \ldots\ldots\ldots\ldots + \beta_9\, t_{99}$$

```
. xtreg lnvio pm1029 lnrob shall lnpb1064 lnden lnpop i.year, fe vce (cluster stateid)

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

R-sq:                                           Obs per group:
     within  = 0.6740                                         min =          23
     between = 0.3874                                         avg =        23.0
     overall = 0.4045                                         max =          23

                                                F(28,50)           =       96.60
corr(u_i, Xb)  = 0.1744                         Prob > F           =      0.0000

                                (Std. Err. adjusted for 51 clusters in stateid)
------------------------------------------------------------------------------
             |               Robust
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      pm1029 |    .037292   .0191589     1.95   0.057    -.0011897    .0757737
       lnrob |   .4894918   .0371094    13.19   0.000     .4149554    .5640282
       shall |  -.0286511   .0300385    -0.95   0.345    -.0889851     .031683
    lnpb1064 |  -.0067272   .1814566    -0.04   0.971    -.3711935     .357739
       lnden |  -.7967832   .4092568    -1.95   0.057      -1.6188    .0252332
       lnpop |  -.3062501   .1584566    -1.93   0.059    -.6245196    .0120195
             |
        year |
          78 |   .0450831   .0114793     3.93   0.000     .0220263    .0681399
          79 |   .1051321   .0159612     6.59   0.000     .0730732    .1371911
          80 |   .1134354   .0218324     5.20   0.000     .0695837    .1572872
          81 |   .1041519    .026437     3.94   0.000     .0510517    .1572521
          82 |   .1141891   .0302669     3.77   0.000     .0533962     .174982
          83 |    .126602   .0334011     3.79   0.000     .0595139    .1936901
          84 |   .1814549   .0384078     4.72   0.000     .1043104    .2585993
          85 |   .2179403   .0443275     4.92   0.000     .1289059    .3069747
          86 |   .2615472   .0508026     5.15   0.000     .1595072    .3635873
          87 |   .2800558   .0564371     4.96   0.000     .1666986     .393413
          88 |   .3279556    .061823     5.30   0.000     .2037804    .4521308
          89 |   .3589758   .0710763     5.05   0.000     .2162148    .5017368
          90 |   .4431598   .0780969     5.67   0.000     .2862977    .6000219
          91 |   .4465117   .0829858     5.38   0.000      .27983     .6131935
          92 |   .4832675   .0876577     5.51   0.000     .3072018    .6593332
          93 |    .502804   .0909838     5.53   0.000     .3200575    .6855504
          94 |   .4870197   .0947501     5.14   0.000     .2967085    .6773308
          95 |    .484326   .0974396     4.97   0.000     .2886129    .6800391
          96 |   .4605056    .100676     4.57   0.000     .2582919    .6627192
          97 |   .4744865   .1017139     4.66   0.000      .270188    .6787849
          98 |   .4671973   .1041924     4.48   0.000     .2579206    .6764739
          99 |   .4489365   .1108072     4.05   0.000     .2263737    .6714992
```

Interpretations:

- Keeping other variables constant, if the state has a shall-carry law in effect in that year the violent crime rate decreases by 2.8% compared to the state with no shall-carry law in that year; however, the "shall" variable is not significant.
- Keeping other variables constant, with 1% increase in Percentage of male population aged 10-29 "pm1029", the violent crime rate increases by approximately 3.73% at 10% significance level.
- Keeping other variables constant, with 1% increase in robbery rate, the violent crime rate increases by approximately 0.49% at 1% significance level.
- Keeping other variables constant, with 1% increase in density (population per square mile of land area, divided by 1000), the violent crime rate decreases by approximately 0.79% at 10% significance level.
- Keeping other variables constant, with 1% increase in state population (in millions of people), the violent crime rate decreases by approximately 0.30% at 10% significance level.

Estimating the effect of "shall" on robbery rate (lnrob)

$$lnrob = \beta_0 + \beta_1\, pm1029 + \beta_2\, shall + \beta_3\, lnpb1064 + \beta_4\, lnden + \beta_5\, lnpop + \beta_6\, lnincarc\_rate + \beta_7\, lnmur + \beta_8\, lnavginc + \beta_9\, t_{78} + \beta_{10}\, t_{79} + \ldots\ldots\ldots\ldots + \beta_{11}\, t_{99}$$

```
. xtreg lnrob lnincarc_rate shall lnpb1064 pm1029 lnpop lnmur lnden lnavginc i.year, fe

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

R-sq:                                           Obs per group:
     within  = 0.3862                                         min =          23
     between = 0.1262                                         avg =        23.0
     overall = 0.1298                                         max =          23

                                                F(30,1092)         =       22.91
corr(u_i, Xb)  = -0.6628                        Prob > F           =      0.0000
```

lnrob	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnincarc_rate	-.1566441	.0345584	-4.53	0.000	-.2244525	-.0888357
shall	-.0138187	.0210903	-0.66	0.512	-.0552007	.0275633
lnpb1064	-.9202159	.1114062	-8.26	0.000	-1.13881	-.7016214
pm1029	.0800614	.0136566	5.86	0.000	.0532653	.1068574
lnpop	.2167857	.1318216	1.64	0.100	-.0418666	.475438
lnmur	.4026039	.0332979	12.09	0.000	.3372688	.467939
lnden	3.340829	.5188487	6.44	0.000	2.322776	4.358882
lnavginc	.2110164	.1289074	1.64	0.102	-.0419178	.4639505
year						
78	.0373609	.0342387	1.09	0.275	-.0298201	.104542
79	.1421364	.0347821	4.09	0.000	.073889	.2103837
80	.2645959	.0353066	7.49	0.000	.1953194	.3338725
81	.3073517	.0363432	8.46	0.000	.2360414	.3786621
82	.3054505	.0384877	7.94	0.000	.2299323	.3809687
83	.2582604	.0417212	6.19	0.000	.1763976	.3401231
84	.2552461	.0461669	5.53	0.000	.1646602	.3458319
85	.2875538	.0501289	5.74	0.000	.189194	.3859137
86	.3542113	.054888	6.45	0.000	.2465135	.4619091
87	.3465208	.0596008	5.81	0.000	.2295757	.4634659
88	.3938068	.0645394	6.10	0.000	.2671716	.520442
89	.4612815	.0693138	6.65	0.000	.3252783	.5972848
90	.545515	.0739789	7.37	0.000	.4003581	.6906718
91	.6663156	.0775127	8.60	0.000	.5142248	.8184064
92	.6901816	.0820067	8.42	0.000	.5292731	.8510902
93	.6963886	.0850527	8.19	0.000	.5295034	.8632737
94	.7464904	.0886739	8.42	0.000	.5724999	.9204808
95	.7710419	.092464	8.34	0.000	.5896147	.9524692
96	.7554019	.0963279	7.84	0.000	.5663933	.9444105
97	.7345574	.0999595	7.35	0.000	.5384229	.9306918
98	.6694237	.1039236	6.44	0.000	.4655111	.8733362
99	.6278357	.106942	5.87	0.000	.4180007	.8376708

Interpretations:

- Keeping other variables constant, if the state has a shall-carry law in effect in that year the robbery rate decreases by 1.38 % compared to the state with no shall-carry law in that year; however, the "shall" variable is not significant.
- Keeping other variables constant, with 1% increase in incarceration rate, the robbery rate decreases by approximately 0.15% at 1% significance level.
- Keeping other variables constant, with 1% increase in percentage of black population (aged 10-64), the robbery rate decreases by approximately 0.92% at 1% significance level.
- Keeping other variables constant, with 1% increase in Percentage of male population aged 10-29 "pm1029", the robbery rate increases by approximately 8% at 1% significance level.
- Keeping other variables constant, with 1% increase in density (population per square mile of land area, divided by 1000), the robbery rate increases by approximately 3.34 % at 1% significance level.
- Keeping other variables constant, with 1% increase in murder rate, the robbery rate increases by approximately 0.40% at 1% significance level.

Estimating the effect of "shall" on murder rate (lnmur)

$$lnmur = \beta_0 + \beta_1\, pm1029 + \beta_2\, shall + \beta_3\, lnpb1064 + \beta_4\, lnden + \beta_5\, lnpop + \beta_6\, lnincarc\_rate + \beta_7\, lnrob + \beta_8\, lnavginc + \beta_9\, t_{78} + \beta_{10}\, t_{79} + \ldots\ldots\ldots\ldots + \beta_{11}\, t_{99}$$

```
. xtreg lnmur lnincarc_rate shall lnpb1064 pm1029 lnpop lnden lnrob  lnavginc i.year, fe

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

R-sq:                                           Obs per group:
     within  = 0.4259                                         min =          23
     between = 0.0433                                         avg =        23.0
     overall = 0.0315                                         max =          23

                                                F(30,1092)         =       27.00
corr(u_i, Xb)  = -0.9321                        Prob > F           =      0.0000
```

lnmur	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnincarc_rate	-.0226387	.0297629	-0.76	0.447	-.0810377	.0357602
shall	-.0132913	.017999	-0.74	0.460	-.0486078	.0220252
lnpb1064	.4438217	.0970828	4.57	0.000	.2533319	.6343116
pm1029	.0011957	.0118374	0.10	0.920	-.022031	.0244224
lnpop	-.1919847	.1124953	-1.71	0.088	-.4127161	.0287467
lnden	-4.452737	.4305582	-10.34	0.000	-5.297552	-3.607922
lnrob	.2932622	.0242547	12.09	0.000	.2456712	.3408532
lnavginc	.8705185	.1069573	8.14	0.000	.6606533	1.080384
year						
78	-.0280543	.0292253	-0.96	0.337	-.0853985	.0292898
79	-.0100755	.0299101	-0.34	0.736	-.0687632	.0486123
80	-.0059463	.0308979	-0.19	0.847	-.0665722	.0546796
81	-.0240646	.0320092	-0.75	0.452	-.0868711	.038742
82	-.0718874	.0337121	-2.13	0.033	-.1380352	-.0057396
83	-.114926	.0360599	-3.19	0.001	-.1856805	-.0441715
84	-.2073431	.039454	-5.26	0.000	-.2847573	-.1299288
85	-.1973026	.043011	-4.59	0.000	-.2816961	-.1129091
86	-.171989	.0474456	-3.62	0.000	-.2650839	-.0788942
87	-.1938961	.0513145	-3.78	0.000	-.2945824	-.0932099
88	-.2074015	.0556609	-3.73	0.000	-.3166159	-.098187
89	-.2257178	.0599572	-3.76	0.000	-.3433622	-.1080734
90	-.1970216	.0644164	-3.06	0.002	-.3234156	-.0706276
91	-.1952502	.0681008	-2.87	0.004	-.3288734	-.061627
92	-.235559	.071872	-3.28	0.001	-.3765819	-.0945361
93	-.184635	.074576	-2.48	0.013	-.3309635	-.0383064
94	-.2630483	.0776911	-3.39	0.001	-.4154889	-.1106076
95	-.2836493	.0809353	-3.50	0.000	-.4424556	-.1248429
96	-.3360811	.083882	-4.01	0.000	-.5006693	-.1714929
97	-.4057441	.0865298	-4.69	0.000	-.5755275	-.2359607
98	-.4440551	.0893605	-4.97	0.000	-.6193928	-.2687173
99	-.4885137	.0915148	-5.34	0.000	-.6680785	-.3089489

Interpretations:

- Keeping other variables constant, if the state has a shall-carry law in effect in that year the robbery rate decreases by 1.33 % compared to the state with no shall-carry law in that year; however, the "shall" variable is not significant.
- Keeping other variables constant, with 1% increase in percentage of black population (aged 10-64), the murder rate increases by approximately 0.44% at 1% significance level.
- Keeping other variables constant, with 1% increase in density (population per square mile of land area, divided by 1000), the murder rate decreases by approximately 4.45 % at 1% significance level.
- Keeping other variables constant, with 1% increase in robbery rate, the murder rate increases by approximately 0.30% at 1% significance level.
- Keeping other variables constant, with 1% increase in average income, the murder rate increases by approximately 0.87% at 1% significance level.

9. Conclusion

As per our analysis there is deterrent effect of "shall-carry law" on crime rates; however, the estimates are not significant. All the crime rates, Violent Crime rate (vio), Robbery rate (rob) and Murder rate(mur) decreases by approximately 2.8%, 1.38% and 1.33%, respectively if the state has a "shall-carry law" in effect in that year compared to the state with no "shall-carry law".

10. Recommendation

We can explain the effect on crime rates more precisely if information regarding variables such as National/State law policies, number of police units in the state, percentage of intoxicated people, education status, social or cultural attitudes, rich-to-poor ratio etc. were known besides what is provided.

As per our analysis on the given data, we suggest the government to come up with following policies to curb the crime rate: -

- ✓ More stringent National or State policies as shall-law has no significant impact on crime rates.
- ✓ Deployment of police forces in more population dense areas may deter crime rates.
- ✓ Increase in employment opportunities.
- ✓ Technological advancements for better surveillance.

Appendix

Please refer the STATA codes and outputs for more details.

```
____  ____(R)                                                  ___  ____  ____
/   ____/                                                    /__    /   ____/
/___/                                                       ___/   /   /___/   /
                                                              Statistics/Data
Analysis

      ___  ____  ____  ____  ____ (R)
     /__    /   ____/   /   ____/
    ___/   /   /___/   /   /___/   15.1   Copyright 1985-2017 StataCorp
LLC
      Statistics/Data Analysis            StataCorp
                                          4905 Lakeway Drive
         Special Edition                  College Station, Texas 77845
USA
                                          800-STATA-PC
http://www.stata.com
                                          979-696-4600
stata@stata.com
                                          979-696-4601 (fax)

    55-user Stata network license expires  4 Oct 2019:
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                           Jindal School of Management

    Notes:
          1.  Unicode is supported; see help unicode_advice.
          2.  Maximum number of variables is set to 5000; see help
set_maxvar.
          3.  New update available; type -update all-

    1 . doedit "C:\Users\sxm180029\Desktop\Project\Stata_codev1.do"

    2 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD237c_000000.tmp"

    3 . use "C:\Users\sxm180029\Desktop\guns.dta",clear

    4 . *giving panel state and year id
    5 . xtset stateid year
            panel variable:  stateid (strongly balanced)
             time variable:  year, 77 to 99
                     delta:  1 unit

    6 . xtdescribe

      stateid:  1, 2, ..., 56                                     n =
51
         year:  77, 78, ..., 99                                   T =
23
                Delta(year) = 1 unit
                Span(year)  = 23 periods
                (stateid*year uniquely identifies each observation)

    Distribution of T_i:   min      5%     25%       50%       75%
95%     max
```

```
                           23      23      23        23        23
23      23

      Freq.  Percent    Cum. |  Pattern
     ----------------------------+-------------------------
           51    100.00  100.00 |  11111111111111111111
     ----------------------------+-------------------------
           51    100.00         |  XXXXXXXXXXXXXXXXXXXXX

     7 . cor vio rob mur shall incarc_rate density avginc pop pm1029
pw1064 pb1064
      (obs=1,173)

                    |      vio      rob      mur    shall incarc~e
density   avginc      pop   pm1029   pw1064   pb1064
      -------------+------------------------------------------------------
----------------------------------------------
               vio |   1.0000
               rob |   0.9071   1.0000
               mur |   0.8265   0.7976   1.0000
             shall |  -0.2069  -0.2125  -0.1794   1.0000
       incarc_rate |   0.7027   0.5668   0.7096   0.0424   1.0000
           density |   0.6647   0.7818   0.7486  -0.1126   0.5593
1.0000
            avginc |   0.4080   0.4148   0.2206  -0.0000   0.4615
0.3433   1.0000
               pop |   0.3190   0.3172   0.0999  -0.1244   0.0953  -
0.0780   0.2152   1.0000
            pm1029 |  -0.1696  -0.0860   0.0150  -0.2772  -0.4463  -
0.0637  -0.5279  -0.0975   1.0000
            pw1064 |  -0.5730  -0.5842  -0.6154   0.2123  -0.5271  -
0.5551  -0.1912  -0.0654  -0.0126   1.0000
            pb1064 |   0.5698   0.5812   0.6018  -0.1839   0.5308
0.5432   0.2627   0.0581   0.0162  -0.9820   1.0000


     8 . *since the overall maximum population will consists of black and
white,highly corelated keeping only 1 percentage of black
     9 .
    10 . *corelation after generating rate for population percentage
    11 . cor rob mur shall incarc_rate density avginc pop pm1029 pb1064
      (obs=1,173)

                    |      rob      mur    shall incarc~e  density
avginc      pop   pm1029   pb1064
      -------------+------------------------------------------------------
----------------------------
               rob |   1.0000
               mur |   0.7976   1.0000
             shall |  -0.2125  -0.1794   1.0000
       incarc_rate |   0.5668   0.7096   0.0424   1.0000
           density |   0.7818   0.7486  -0.1126   0.5593   1.0000
            avginc |   0.4148   0.2206  -0.0000   0.4615   0.3433
1.0000
               pop |   0.3172   0.0999  -0.1244   0.0953  -0.0780
0.2152   1.0000
            pm1029 |  -0.0860   0.0150  -0.2772  -0.4463  -0.0637  -
0.5279  -0.0975   1.0000
            pb1064 |   0.5812   0.6018  -0.1839   0.5308   0.5432
0.2627   0.0581   0.0162   1.0000
```

```
    12 .
    13 . *Analyzing different variables
    14 . ***********************************************************
    15 . *Crime Rate
    16 . *1.checking the distribution of crime rate
    17 . histogram vio
      (bin=30, start=47, width=95.826668)

    18 . *Left Skewed
    19 . *Taking log to make it normal distribution
    20 . gen lnvio=ln(vio+1)

    21 . histogram lnvio
      (bin=30, start=3.871201, width=.13696988)

    22 . ***********************************************************
    23 .
    24 . *Sentenced Prisoner
    25 . *1.checking the distribution of sentenced prisoners in previous
year
    26 . histogram incarc_rate
      (bin=30, start=19, width=63.133333)

    27 . *left skewed data
    28 . *Taking log to make it normal distribution
    29 . gen lnincarc_rate=ln(incarc_rate+1)

    30 . histogram lnincarc_rate
      (bin=30, start=2.9957323, width=.15204061)

    31 . *2. Linear prediction Plot
    32 . graph twoway (scatter lnvio lnincarc_rate)(lfit lnvio
lnincarc_rate)

    33 . reg lnvio lnincarc_rate

           Source |       SS           df       MS      Number of obs
=     1,173
      -------------+----------------------------------   F(1, 1171)
=    844.67
            Model |  203.339955         1  203.339955   Prob > F
=    0.0000
         Residual |  281.896753     1,171  .240731642   R-squared
=    0.4191
      -------------+----------------------------------   Adj R-squared
=    0.4186
            Total |  485.236708     1,172  .414024495   Root MSE
=    .49064

      ------------------------------------------------------------------
------------
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
      lnincarc_rate |   .6333718   .0217928    29.06   0.000     .5906144
.6761291
```

```
             _cons |   2.730736   .1144313    23.86   0.000     2.506222
2.955249
      ------------------------------------------------------------------------
------------

    34 . *3. Residual Plot
    35 . rvfplot, yline(0)

    36 . ********************************************************
    37 .
    38 . *Per Capita Income
    39 . *1.checking the distribution of per capita income
    40 . histogram avginc
      (bin=30, start=8.554884, width=.50306098)

    41 . gen lnavginc=ln(avginc+1)

    42 . histogram lnavginc
      (bin=30, start=2.2570524, width=.03158637)

    43 . * approx normally distributed
    44 . *2. Linear prediction Plot
    45 . graph twoway (lfit lnvio lnavginc) (scatter lnvio lnavginc)

    46 . reg lnvio lnavginc

            Source |       SS           df       MS      Number of obs
=     1,173
      -------------+----------------------------------   F(1, 1171)
=    174.06
             Model |  62.7928171         1  62.7928171   Prob > F
=    0.0000
          Residual |  422.443891     1,171  .360754817   R-squared
=    0.1294
      -------------+----------------------------------   Adj R-squared
=    0.1287
             Total |  485.236708     1,172  .414024495   Root MSE
=    .60063

      ------------------------------------------------------------------------
-----------
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------------
-----------
          lnavginc |   1.370947   .1039134    13.19   0.000      1.16707
1.574824
             _cons |   2.362909   .2785308     8.48   0.000     1.816433
2.909384
      ------------------------------------------------------------------------
-----------

    47 . *3. Residual Plot
    48 . rvfplot, yline(0)

    49 . ********************************************************
    50 .
    51 . *Robbery Rate
    52 . *1.checking the distribution of per capita income
    53 . histogram rob
```

```
  (bin=30, start=6.4000001, width=54.289999)

54 . *left skewed data
55 . *Taking log to make it normal distribution
56 . gen lnrob=ln(rob+1)

57 . histogram lnrob
  (bin=30, start=2.0014801, width=.17995302)

58 . *2. Linear prediction Plot
59 . graph twoway (lfit lnvio lnrob) (scatter lnvio lnrob)

60 . reg lnvio lnrob

      Source |       SS           df       MS      Number of obs
=     1,173
-------------+----------------------------------   F(1, 1171)
=   5358.04
       Model |  398.208244         1  398.208244   Prob > F
=    0.0000
    Residual |  87.0284644     1,171  .074319782   R-squared
=    0.8206
-------------+----------------------------------   Adj R-squared
=    0.8205
       Total |  485.236708     1,172  .414024495   Root MSE
=    .27262

------------------------------------------------------------------------
-----------
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------
-----------
       lnrob |   .6217551   .0084941    73.20   0.000     .6050898
.6384205
       _cons |   3.107806   .0407115    76.34   0.000      3.02793
3.187681
------------------------------------------------------------------------
-----------

61 . *3. Residual Plot
62 . rvfplot, yline(0)

63 . ********************************************************
64 . *Mur Rate
65 . *1.checking the distribution of per capita income
66 . histogram mur
  (bin=30, start=.2, width=2.6799999)

67 . *left skewed data
68 . *Taking log to make it normal distribution
69 . gen lnmur=ln(mur+1)

70 . histogram lnmur
  (bin=30, start=.18232156, width=.14065026)

71 . *2. Linear prediction Plot
72 . graph twoway (lfit lnvio lnmur) (scatter lnvio lnmur)

73 . reg lnvio lnmur
```

```
      Source |       SS           df       MS      Number of obs
=     1,173
-------------+----------------------------------   F(1, 1171)
=   2055.63
       Model |  309.135662         1  309.135662   Prob > F
=    0.0000
    Residual |  176.101046     1,171  .150385181   R-squared
=    0.6371
-------------+----------------------------------   Adj R-squared
=    0.6368
       Total |  485.236708     1,172  .414024495   Root MSE
=     .3878

------------------------------------------------------------------------
-----------
        lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------
-----------
        lnmur |   .8821594    .019457    45.34   0.000      .843985
.9203338
        _cons |   4.292458   .0399678   107.40   0.000     4.214041
4.370874
------------------------------------------------------------------------
-----------

. *3. Residual Plot
. rvfplot, yline(0)

. ************************************************************
.
. *Density (population per square mile of land area, divided by
1000)
. *1.checking the distribution of per capita income
. histogram density
  (bin=30, start=.00070708, width=.37004695)

. *left skewed data
. *Taking log to make it normal distribution
. gen lnden=ln(density+1)

. histogram lnden
  (bin=30, start=.00070683, width=.08308912)

. *2. Linear prediction Plot
. graph twoway (lfit lnvio lnden) (scatter lnvio lnden)

. reg lnvio lnden

      Source |       SS           df       MS      Number of obs
=     1,173
-------------+----------------------------------   F(1, 1171)
=    263.01
       Model |  88.9966353         1  88.9966353   Prob > F
=    0.0000
    Residual |  396.240073     1,171  .338377517   R-squared
=    0.1834
-------------+----------------------------------   Adj R-squared
=    0.1827
```

```
             Total |  485.236708     1,172  .414024495   Root MSE
=     .5817

      ------------------------------------------------------------------
------------
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
             lnden |   .7848745   .0483965    16.22   0.000     .6899209
.8798281
             _cons |   5.888921   .0190916   308.46   0.000     5.851463
5.926379
      ------------------------------------------------------------------
------------

    88 . *3. Residual Plot
    89 . rvfplot, yline(0)

    90 . ************************************************************
    91 .
    92 . *population (millions of people)
    93 . *1.checking the distribution of per capita income
    94 . histogram pop
      (bin=30, start=.402753, width=1.0914123)

    95 . *left skewed data
    96 . *Taking log to make it normal distribution
    97 . gen lnpop=ln(pop+1)

    98 . histogram lnpop
      (bin=30, start=.33843672, width=.1064061)

    99 . *2. Linear prediction Plot
   100 . graph twoway (lfit lnvio lnpop) (scatter lnvio lnpop)

   101 . reg lnvio lnpop

            Source |       SS           df       MS      Number of obs
=     1,173
      -------------+----------------------------------   F(1, 1171)
=    331.28
             Model |  107.003144         1  107.003144   Prob > F
=    0.0000
          Residual |  378.233565     1,171  .323000482   R-squared
=    0.2205
      -------------+----------------------------------   Adj R-squared
=    0.2199
             Total |  485.236708     1,172  .414024495   Root MSE
=    .56833

      ------------------------------------------------------------------
------------
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
             lnpop |   .4099296   .0225223    18.20   0.000      .365741
.4541182
```

```
             _cons |     5.4287   .0369856   146.78   0.000     5.356135
5.501266
      ------------------------------------------------------------------------
----------

   102 . *3. Residual Plot
   103 . rvfplot, yline(0)

   104 . ************************************************************
   105 .
   106 . *pm1029 (millions of people)
   107 . *1.checking the distribution of per capita income
   108 . histogram pm1029
      (bin=30, start=12.21368, width=.33796686)

   109 . *approx. normal skewed data
   110 . *2. Linear prediction Plot
   111 . graph twoway (lfit lnvio pm1029) (scatter lnvio pm1029)

   112 . reg lnvio pm1029

            Source |       SS           df       MS      Number of obs
=     1,173
      -------------+----------------------------------   F(1, 1171)
=     24.75
             Model |  10.0445119         1  10.0445119   Prob > F
=    0.0000
          Residual |  475.192196     1,171  .405800338   R-squared
=    0.0207
      -------------+----------------------------------   Adj R-squared
=    0.0199
             Total |  485.236708     1,172  .414024495   Root MSE
=    .63702

      ------------------------------------------------------------------------
----------
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------------
----------
            pm1029 |  -.0534462   .0107426    -4.98   0.000     -.074523
-.0323693
             _cons |   6.889795   .1737512    39.65   0.000     6.548896
7.230693
      ------------------------------------------------------------------------
----------

   113 . *3. Residual Plot
   114 . rvfplot, yline(0)

   115 . ************************************************************
   116 .
   117 . *percentage of black
   118 . *1.checking the distribution of per capita income
   119 . histogram pb1064
      (bin=30, start=.24820656, width=.89104546)

   120 . *left skewed data
   121 . *Taking log to make it normal distribution
   122 . gen lnpb1064=ln(pb1064+1)
```

```
   123 . histogram lnpb1064
      (bin=30, start=.22170776, width=.10365889)

   124 . *2. Linear prediction Plot
   125 . graph twoway (lfit lnvio lnpb1064) (scatter lnvio lnpb1064)

   126 . reg lnvio lnpb1064

      Source |       SS           df       MS      Number of obs
=     1,173
-------------+----------------------------------   F(1, 1171)
=    909.81
       Model |  212.164363         1  212.164363   Prob > F
=    0.0000
    Residual |  273.072345     1,171  .233195854   R-squared
=    0.4372
-------------+----------------------------------   Adj R-squared
=    0.4368
       Total |  485.236708     1,172  .414024495   Root MSE
=     .4829

------------------------------------------------------------------------
-----------
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------
-----------
    lnpb1064 |   .6488114   .0215101    30.16   0.000     .6066088
.6910141
       _cons |   4.977803   .0376352   132.26   0.000     4.903963
5.051643
------------------------------------------------------------------------
-----------

   127 . *3. Residual Plot
   128 . rvfplot, yline(0)

   129 . *4. Panel line plot
   130 . xtline lnpb1064, t(year) i(stateid) overlay

   131 .
   132 . ******HYPOTHESIS TESTING*********
   133 . anova lnvio shall

                           Number of obs =      1,173    R-squared
=  0.0865
                           Root MSE      =    .615238    Adj R-
squared =  0.0858

                  Source | Partial SS         df         MS
F    Prob>F
              -----------+----------------------------------------
-----------
                   Model |  41.992856          1   41.992856
110.94  0.0000
                         |
                   shall |  41.992856          1   41.992856
110.94  0.0000
                         |
```

```
                    Residual |  443.24385      1,171   .37851738
                -------------+----------------------------------------
-----------
                       Total |  485.23671      1,172    .4140245

   134 . anova lnden shall

                                Number of obs =      1,173    R-squared
=  0.0275
                                Root MSE      =    .346382    Adj R-
squared =  0.0267

                      Source | Partial SS         df         MS
F    Prob>F
                -------------+----------------------------------------
-----------
                       Model |  3.9709599          1   3.9709599
33.10  0.0000
                             |
                       shall |  3.9709599          1   3.9709599
33.10  0.0000
                             |
                    Residual |  140.49754      1,171   .11998082
                -------------+----------------------------------------
-----------
                       Total |   144.4685      1,172   .12326664

   135 . anova lnavginc shall

                                Number of obs =      1,173    R-squared
=  0.0005
                                Root MSE      =    .168865    Adj R-
squared = -0.0003

                      Source | Partial SS         df         MS
F    Prob>F
                -------------+----------------------------------------
-----------
                       Model |  .01775409          1   .01775409
0.62  0.4302
                             |
                       shall |  .01775409          1   .01775409
0.62  0.4302
                             |
                    Residual |  33.391646      1,171    .0285155
                -------------+----------------------------------------
-----------
                       Total |    33.4094      1,172   .02850631

   136 . *Not significant
   137 . anova lnpb1064 shall

                                Number of obs =      1,173    R-squared
=  0.0624
                                Root MSE      =    .635248    Adj R-
squared =  0.0616

                      Source | Partial SS         df         MS
F    Prob>F
```

```
                  -----------+------------------------------------------
-----------
                       Model |  31.459642           1   31.459642
77.96  0.0000
                             |
                       shall |  31.459642           1   31.459642
77.96  0.0000
                             |
                    Residual |  472.54606       1,171   .40354062
                  -----------+------------------------------------------
-----------
                       Total |   504.0057       1,172     .430039

  138 .
      end of do-file

  139 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD237c_000000.tmp"

  140 . translate @Results stata_res1.txt
```

```
____  ____(R)                                                  ___  ____  ____
                                                             /__    /   ____/
/   ____/                                                   ___/   /   /___/   /
/___/                                                          Statistics/Data
Analysis

      ___  ____  ____  ____  ____ (R)
     /__    /   ____/   /   ____/
    ___/   /   /___/   /   /___/   15.1   Copyright 1985-2017 StataCorp
LLC
      Statistics/Data Analysis            StataCorp
                                          4905 Lakeway Drive
         Special Edition                  College Station, Texas 77845
USA
                                          800-STATA-PC
http://www.stata.com
                                          979-696-4600
stata@stata.com
                                          979-696-4601 (fax)

     55-user Stata network license expires  4 Oct 2019:
            Serial number:  401509214975
              Licensed to:  University of Texas at Dallas
                            Jindal School of Management

     Notes:
           1.  Unicode is supported; see help unicode_advice.
           2.  Maximum number of variables is set to 5000; see help
set_maxvar.
           3.  New update available; type -update all-

    1 . doedit "C:\Users\sxm180029\Desktop\Project\Stata_codev1.do"

    2 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    3 . use "C:\Users\sxm180029\Desktop\guns.dta",clear

    4 . *giving panel state and year id
    5 . xtset stateid year
            panel variable:  stateid (strongly balanced)
             time variable:  year, 77 to 99
                     delta:  1 unit

    6 .
     end of do-file

    7 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    8 . gen lnvio=ln(vio+1)

    9 .
     end of do-file

   10 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

   11 . gen lnincarc_rate=ln(incarc_rate+1)
```

```
    12 .
      end of do-file

    13 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    14 . gen lnavginc=ln(avginc+1)

    15 .
      end of do-file

    16 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    17 . gen lnrob=ln(rob+1)

    18 .
      end of do-file

    19 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    20 . gen lnmur=ln(mur+1)

    21 .
      end of do-file

    22 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    23 . gen lnden=ln(density+1)

    24 .
      end of do-file

    25 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    26 . gen lnpop=ln(pop+1)

    27 .
      end of do-file

    28 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    29 . gen lnpb1064=ln(pb1064+1)

    30 .
      end of do-file

    31 . do "C:\Users\SXM180~1\AppData\Local\Temp\15\STD2750_000000.tmp"

    32 . **********REGRESSION ANALYSIS(PANEL DATA)***************
    33 . *MODEL1.1: with all the variables
    34 . reg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden lnmur
lnrob lnavginc

      Source |       SS           df       MS      Number of obs
=     1,173
      -------------+----------------------------------   F(9, 1163)
=   1141.38
       Model |  435.887293         9  48.4319215   Prob > F
=    0.0000
```

```
          Residual |  49.3494149     1,163  .042432859   R-squared
=    0.8983
      -------------+----------------------------------   Adj R-squared
=    0.8975
             Total |  485.236708     1,172  .414024495   Root MSE
=    .20599

      ------------------------------------------------------------------
------------
              lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      --------------+---------------------------------------------------
------------
      lnincarc_rate |   .3308061   .0182369    18.14   0.000     .2950252
.3665869
             shall |  -.0589598   .0159681    -3.69   0.000    -.0902894
-.0276302
           lnpb1064 |  -.1386792   .0153401    -9.04   0.000    -.1687766
-.1085818
            pm1029 |   .0186458   .0057596     3.24   0.001     .0073454
.0299462
             lnpop |  -.0579515   .0116839    -4.96   0.000    -.0808754
-.0350275
             lnden |  -.0996981   .0232494    -4.29   0.000    -.1453134
-.0540827
             lnmur |   .1535501   .0229828     6.68   0.000     .1084576
.1986426
             lnrob |   .5402218   .0153783    35.13   0.000     .5100494
.5703941
           lnavginc |   -.009638   .0535771    -0.18   0.857    -.1147566
.0954805
             _cons |   1.533443    .208285     7.36   0.000     1.124787
1.942099
      ------------------------------------------------------------------
------------

    35 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+---------------------------------------------------
----------
                 . |      1,173 -1146.721   193.8481      10   -367.6963
-317.0231
      ------------------------------------------------------------------
----------
                      Note: N=Obs used in calculating BIC; see [R] BIC
note.

    36 . *bic:-317.02 *insignificant variables -lnavginc
    37 .
    38 . *MODEL1.2: without robust standard error since running pooled in
panel data is heteroescdacity
    39 . reg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden lnmur
lnrob lnavginc, vce(cluster stateid)
```

```
      Linear regression                               Number of obs     =
1,173
                                                      F(9, 50)          =
190.38
                                                      Prob > F          =
0.0000
                                                      R-squared         =
0.8983
                                                      Root MSE          =
.20599

                                    (Std. Err. adjusted for 51 clusters
in stateid)
------------------------------------------------------------------------
------------
             |               Robust
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
-------------+----------------------------------------------------------
------------
  lnincarc_rate |   .3308061   .0590076     5.61   0.000     .2122859
.4493262
       shall |  -.0589598    .040524    -1.45   0.152    -.1403546
.022435
     lnpb1064 |  -.1386792   .0614845    -2.26   0.029    -.2621745
-.0151839
      pm1029 |   .0186458   .0180098     1.04   0.306    -.0175279
.0548195
       lnpop |  -.0579515   .0555871    -1.04   0.302    -.1696014
.0536985
       lnden |  -.0996981   .0901016    -1.11   0.274    -.2806724
.0812763
       lnmur |   .1535501   .0700273     2.19   0.033     .0128961
.294204
       lnrob |   .5402218   .0595007     9.08   0.000     .4207111
.6597324
     lnavginc |   -.009638   .1983124    -0.05   0.961    -.4079602
.3886841
       _cons |   1.533443   .7603481     2.02   0.049     .0062389
3.060647
------------------------------------------------------------------------
------------

    40 . estat ic

      Akaike's information criterion and Bayesian information criterion

------------------------------------------------------------------------
----------
       Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
-------------+----------------------------------------------------------
----------
           . |      1,173 -1146.721   193.8481      10   -367.6963
-317.0231
------------------------------------------------------------------------
----------
                  Note: N=Obs used in calculating BIC; see [R] BIC
note.
```

```
    41 . *BIC: -317.0231
    42 . *We see that coefficients are same but for most of the variables
the satndard errors and p values changed thus proceeding with robust
standard error method
    43 .
    44 . *MODEL1.3 : AFTER REMOVING INSIGNIFICANT VARIABLES
    45 . reg lnvio lnincarc_rate lnpb1064 lnmur lnrob , vce (cluster
stateid)

      Linear regression                               Number of obs     =
1,173
                                                      F(4, 50)          =
221.88
                                                      Prob > F          =
0.0000
                                                      R-squared         =
0.8917
                                                      Root MSE          =
.21216

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
------------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
      lnincarc_rate |   .2667581    .033209     8.03   0.000     .2000558
.3334604
           lnpb1064 |  -.1142494   .0572693    -1.99   0.052    -.2292782
.0007794
              lnmur |   .2097734   .0712679     2.94   0.005     .0666277
.3529191
              lnrob |   .4853906   .0447206    10.85   0.000     .3955666
.5752146
              _cons |   2.131169   .1590711    13.40   0.000     1.811665
2.450672
      ------------------------------------------------------------------
------------

    46 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173 -1146.721   156.7437       5   -303.4874
-278.1508
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

    47 . *BIC: -278
```

```
    48 .
    49 . *MODEL1.4 : AFTER REMOVING INSIGNIFICANT VARIABLES BUT WITH
SHALL SINCE WE HAVE TO ANALYZE ITS EFFECT
    50 . reg lnvio shall lnincarc_rate lnpb1064 lnmur lnrob , vce
(cluster stateid)

      Linear regression                               Number of obs     =
1,173
                                                      F(5, 50)          =
200.14
                                                      Prob > F          =
0.0000
                                                      R-squared         =
0.8935
                                                      Root MSE          =
.2104

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
------------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
             shall |  -.0730479   .0421675    -1.73   0.089    -.1577439
.0116481
      lnincarc_rate |   .2849197   .0358874     7.94   0.000     .2128377
.3570017
           lnpb1064 |  -.1235419   .0563633    -2.19   0.033    -.2367509
-.010333
             lnmur |   .2039502   .0699567     2.92   0.005     .0634381
.3444624
             lnrob |   .4747866   .0448453    10.59   0.000     .3847121
.564861
             _cons |   2.130693   .1592686    13.38   0.000     1.810793
2.450593
      ------------------------------------------------------------------
------------

    51 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173 -1146.721   167.0179       6   -322.0359
-291.6319
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

    52 . *BIC: -291
    53 .
```

```
    54 . *MODEL1.5 : AFTER REMOVING INSIGNIFICANT VARIABLES BUT WITH
SHALL and pm1029
    55 . reg lnvio shall lnincarc_rate lnpb1064 pm1029 lnmur lnrob , vce
(cluster stateid)

      Linear regression                               Number of obs     =
1,173
                                                      F(6, 50)          =
191.47
                                                      Prob > F          =
0.0000
                                                      R-squared         =
0.8956
                                                      Root MSE          =
.20847

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
------------
                    |               Robust
              lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      --------------+---------------------------------------------------
------------
              shall |  -.0612149   .0418397    -1.46   0.150    -.1452524
.0228226
      lnincarc_rate |   .3457508    .058657     5.89   0.000     .2279346
.4635669
           lnpb1064 |  -.1409729   .0519474    -2.71   0.009    -.2453123
-.0366335
             pm1029 |    .026163   .0162799     1.61   0.114    -.0065362
.0588622
              lnmur |   .1545301   .0706948     2.19   0.034     .0125354
.2965248
              lnrob |    .491212   .0409129    12.01   0.000     .4090361
.5733879
              _cons |   1.438613   .4729632     3.04   0.004     .4886388
2.388588
      ------------------------------------------------------------------
------------

    56 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173 -1146.721    178.339       7    -342.678
-307.2067
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

    57 . *BIC:-307 *lowest bic
```

```
    58 .
    59 . *MODEL1.6: AFTER REMOVING INSIGNIFICANT VARIABLES BUT WITH SHALL
and pm1029 and lndren
    60 . reg lnvio shall lnincarc_rate lnpb1064 pm1029 lnmur lnrob lnden,
vce (cluster stateid)

      Linear regression                               Number of obs     =
1,173
                                                      F(7, 50)          =
292.41
                                                      Prob > F          =
0.0000
                                                      R-squared         =
0.8961
                                                      Root MSE          =
.20798

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
------------
                    |               Robust
              lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      --------------+---------------------------------------------------
------------
              shall |  -.0624175   .0412774    -1.51   0.137    -.1453256
.0204906
      lnincarc_rate |   .3426591   .0590682     5.80   0.000     .2240171
.461301
           lnpb1064 |  -.1374528   .0537825    -2.56   0.014    -.2454781
-.0294275
             pm1029 |   .0242604   .0159325     1.52   0.134    -.0077409
.0562617
              lnmur |   .1585339   .0708759     2.24   0.030     .0161755
.3008922
              lnrob |   .4974592    .040418    12.31   0.000     .4162772
.5786411
              lnden |   -.050778   .0511238    -0.99   0.325    -.1534632
.0519072
              _cons |   1.451794   .4706618     3.08   0.003     .5064417
2.397146
      ------------------------------------------------------------------
------------

    61 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173 -1146.721    181.553       8    -347.106
-306.5674
      ------------------------------------------------------------------
----------
```

```
                    Note: N=Obs used in calculating BIC; see [R] BIC
note.

    62 . *BIC:-306 *BIC increased
    63 .
    64 . *MODEL1.7: AFTER REMOVING INSIGNIFICANT VARIABLES BUT WITH SHALL
and pm1029
    65 . reg lnvio shall lnincarc_rate lnpb1064 pm1029 lnmur lnrob lnden
lnpop, vce (cluster stateid)

      Linear regression                               Number of obs     =
1,173
                                                      F(8, 50)          =
213.34
                                                      Prob > F          =
0.0000
                                                      R-squared         =
0.8983
                                                      Root MSE          =
.20591

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
------------
                    |               Robust
              lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      --------------+---------------------------------------------------
------------
             shall |  -.0590532   .0403381    -1.46   0.149    -.1400745
.0219682
      lnincarc_rate |   .3302438   .0601298     5.49   0.000     .2094695
.4510182
           lnpb1064 |  -.1388187   .0612444    -2.27   0.028    -.2618318
-.0158057
            pm1029 |   .0189029   .0162186     1.17   0.249    -.0136732
.0514789
             lnmur |   .1552896   .0688229     2.26   0.028     .0170547
.2935245
             lnrob |   .5391388   .0576843     9.35   0.000     .4232765
.655001
             lnden |  -.1008833   .0875875    -1.15   0.255    -.2768081
.0750414
             lnpop |  -.0577938   .0557736    -1.04   0.305    -.1698183
.0542307
             _cons |    1.50835   .4679348     3.22   0.002     .5684755
2.448225
      ------------------------------------------------------------------
------------

    66 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
```

```
      -------------+----------------------------------------------------
----------
                 . |      1,173 -1146.721   193.8318       9   -369.6637
-324.0578
      -------------------------------------------------------------------
----------
                       Note: N=Obs used in calculating BIC; see [R] BIC
note.

    67 . *BIC:-324 *BIC lower than model 5 *BEST MODEL FOR POOLED
    68 .
    69 . ***********************************FIXED
EFFECT***********************************************
    70 . *MODEL2.1: FIXED AFFECT MODEL ON ALL THE VRIABLES(TO CAPTURE THE
EFECTS OF DIFFERENT STATES)
    71 . xtreg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden
lnmur lnrob lnavginc, fe

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

      R-sq:                                           Obs per group:
           within  = 0.6179                                         min =
23
           between = 0.7955                                         avg =
23.0
           overall = 0.7810                                         max =
23

                                                      F(9,1113)         =
200.01
      corr(u_i, Xb)  = 0.2567                         Prob > F          =
0.0000

      ------------------------------------------------------------------
------------
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
      lnincarc_rate |   .0617937   .0198174     3.12   0.002     .0229101
.1006773
             shall |  -.0010026    .012471    -0.08   0.936     -.025472
.0234668
           lnpb1064 |   .1759719   .0681901     2.58   0.010     .0421763
.3097675
            pm1029 |  -.0373956   .0056321    -6.64   0.000    -.0484464
-.0263448
             lnpop |  -.2702397   .0842294    -3.21   0.001     -.435506
-.1049734
             lnden |  -.5513626   .3402211    -1.62   0.105     -1.21891
.1161843
             lnmur |   .0790516   .0220294     3.59   0.000     .0358277
.1222754
             lnrob |   .5430485   .0179961    30.18   0.000     .5077383
.5783586
           lnavginc |   .0509784   .0657195     0.78   0.438    -.0779697
.1799265
```

```
              _cons |   3.675818   .2790747    13.17   0.000     3.128246
4.22339
      --------------+----------------------------------------------------
------------
            sigma_u |  .29314285
            sigma_e |   .1120213
                rho |  .87257737   (fraction of variance due to u_i)
      ------------------------------------------------------------------
------------
      F test that all u_i=0: F(50, 1113) = 56.39                     Prob >
F = 0.0000

    72 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   934.1542      10   -1848.308
-1797.635
      ------------------------------------------------------------------
----------
                       Note: N=Obs used in calculating BIC; see [R] BIC
note.

    73 . * bic : -1797.635
    74 . estimates store fixed2_1

    75 . *INSIGNIFICANT VARIABLES: shall lnden lnavginc
    76 .
    77 . *MODEL 2.2 : with robust standard error
    78 . xtreg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden
lnmur lnrob lnavginc, fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6179                                         min =
23
           between = 0.7955                                         avg =
23.0
           overall = 0.7810                                         max =
23

                                                      F(9,50)           =
59.65
      corr(u_i, Xb)  = 0.2567                         Prob > F          =
0.0000

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

```
                    |               Robust
               lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      --------------+----------------------------------------------------
------------
      lnincarc_rate |   .0617937   .0503234     1.23   0.225    -.0392838
.1628712
              shall |  -.0010026   .0302662    -0.03   0.974     -.061794
.0597888
            lnpb1064 |   .1759719   .1618315     1.09   0.282    -.1490762
.50102
             pm1029 |  -.0373956   .0140429    -2.66   0.010    -.0656016
-.0091895
              lnpop |  -.2702397   .1885807    -1.43   0.158    -.6490152
.1085359
              lnden |  -.5513626   .6489013    -0.85   0.400    -1.854719
.751994
              lnmur |   .0790516     .02856     2.77   0.008     .0216871
.136416
              lnrob |   .5430485    .034028    15.96   0.000     .4747013
.6113956
            lnavginc |   .0509784    .149821     0.34   0.735    -.2499458
.3519027
              _cons |   3.675818   .6466882     5.68   0.000     2.376906
4.974729
      --------------+----------------------------------------------------
------------
            sigma_u |  .29314285
            sigma_e |   .1120213
                rho |  .87257737   (fraction of variance due to u_i)
      ------------------------------------------------------------------
------------

    79 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   934.1542       9   -1850.308
-1804.703
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

    80 . *bic: -1804.703
    81 . estimates store fixed2_2

    82 . *insignificant variables: shall lnpb1064 lnincarc_rate lnpop
lnden lnavginc
    83 .
    84 . *MODEL 2.3 : REMOVING ALL INSIGNIFICANT VARIABLES
    85 . xtreg lnvio pm1029 lnmur lnrob , fe vce (cluster stateid)
```

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

      R-sq:                                           Obs per group:
           within  = 0.6033                                         min =
23
           between = 0.8619                                         avg =
23.0
           overall = 0.8421                                         max =
23

                                                      F(3,50)           =
122.63
      corr(u_i, Xb)  = 0.1920                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
-----------
            pm1029 |  -.0559896    .006579    -8.51   0.000    -.0692039
-.0427753
             lnmur |   .1049331   .0259134     4.05   0.000     .0528846
.1569816
             lnrob |    .515525   .0381998    13.50   0.000     .4387983
.5922516
             _cons |   4.300789   .2061364    20.86   0.000     3.886752
4.714826
      -------------+----------------------------------------------------
-----------
           sigma_u |  .23679004
           sigma_e |  .11384407
               rho |  .81224869   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

    86 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   912.0681       3   -1818.136
-1802.934
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.
```

```
    87 . *BIC: -1802.934
    88 . estimates store fixed2_3

    89 .
    90 . *MODEL 2.4: Using shall and REMOVING ALL other INSIGNIFICANT
VARIABLES
    91 . xtreg lnvio shall pm1029 lnmur lnrob , fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6033                                         min =
23
           between = 0.8620                                         avg =
23.0
           overall = 0.8421                                         max =
23

                                                      F(4,50)           =
94.12
      corr(u_i, Xb)  = 0.1923                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
-----------
             shall |   .0003409   .0287628     0.01   0.991    -.0574309
.0581128
            pm1029 |  -.0559623   .0067207    -8.33   0.000    -.0694613
-.0424634
             lnmur |   .1050031   .0261169     4.02   0.000     .0525458
.1574604
             lnrob |   .5154802   .0390518    13.20   0.000     .4370423
.593918
             _cons |    4.30034   .2008906    21.41   0.000      3.89684
4.703841
      -------------+----------------------------------------------------
-----------
           sigma_u |  .23679539
           sigma_e |  .11389493
               rho |  .81211932   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

    92 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
```

```
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   912.0685       4   -1816.137
-1795.868
      ------------------------------------------------------------------
----------
                       Note: N=Obs used in calculating BIC; see [R] BIC
note.

    93 . *BIC: -1795.868
    94 .
    95 . *MODEL 2.5: Using shall, lnpb1064 as INSIGNIFICANT VARIABLES
    96 . xtreg lnvio shall pm1029 lnmur lnrob lnpb1064 , fe vce (cluster
stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6058                                         min =
23
           between = 0.8618                                         avg =
23.0
           overall = 0.8423                                         max =
23

                                                      F(5,50)           =
79.70
      corr(u_i, Xb)  = -0.1421                        Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
-----------
             shall |  -.0018249   .0289038    -0.06   0.950    -.0598799
.0562301
            pm1029 |  -.0488951   .0071084    -6.88   0.000    -.0631728
-.0346174
             lnmur |   .1063104   .0278723     3.81   0.000     .0503273
.1622934
             lnrob |   .5189347   .0368948    14.07   0.000     .4448293
.59304
          lnpb1064 |   .1609463   .1304166     1.23   0.223    -.1010033
.4228958
             _cons |   3.907315   .2852123    13.70   0.000     3.334449
4.48018
      -------------+----------------------------------------------------
-----------
           sigma_u |  .23474761
           sigma_e |  .11358308
```

```
               rho |   .8102988   (fraction of variance due to u_i)
      ------------------------------------------------------------------------------
----------

    97 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------------------
----------
                 . |      1,173  369.8453   915.8095       5   -1821.619
-1796.282
      ------------------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

    98 . *BIC: -1796.282
    99 .
   100 . *MODEL 2.6: Using shall, lnpb1064, lnden as INSIGNIFICANT
VARIABLES
   101 . xtreg lnvio shall pm1029 lnmur lnrob lnpb1064 lnden , fe vce
(cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6102                                         min =
23
           between = 0.5795                                         avg =
23.0
           overall = 0.5806                                         max =
23

                                                      F(6,50)           =
78.55
      corr(u_i, Xb)  = -0.2255                        Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------------------
----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------------------
----------
             shall |  -.0023498   .0288505    -0.08   0.935    -.0602978
.0555981
            pm1029 |  -.0473553    .007159    -6.61   0.000    -.0617346
-.0329759
```

```
            lnmur |   .0816994   .0287213     2.84   0.006      .024011
.1393879
            lnrob |   .5352131   .0356357    15.02   0.000     .4636367
.6067895
          lnpb1064 |   .2463781    .150595     1.64   0.108    -.0561008
.5488571
            lnden |  -1.110782   .6933656    -1.60   0.115    -2.503448
.2818838
            _cons |   3.916171   .3064399    12.78   0.000     3.300668
4.531673
      -------------+----------------------------------------------------
-----------
           sigma_u |  .41640973
           sigma_e |   .1129988
               rho |  .93141206   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

   102 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   922.3844       6   -1832.769
-1802.365
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   103 . *BIC: -1802.365
   104 . estimates store fixed2_6

   105 .
   106 . *MODEL 2.7: Using shall, lnpb1064,lnavginc,lnden as
INSIGNIFICANT VARIABLES
   107 . xtreg lnvio shall pm1029 lnmur lnrob lnpb1064 lnden lnavginc ,
fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6108                                         min =
23
           between = 0.5686                                         avg =
23.0
           overall = 0.5706                                         max =
23

                                                      F(7,50)           =
66.47
```

```
      corr(u_i, Xb)  = -0.2154                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
-----------
             shall |  -.0050984   .0290937    -0.18   0.862    -.0635349
.053338
            pm1029 |  -.0439012   .0085254    -5.15   0.000    -.0610249
-.0267775
             lnmur |   .0783701   .0288227     2.72   0.009      .020478
.1362622
             lnrob |   .5352203   .0360567    14.84   0.000     .4627982
.6076423
          lnpb1064 |   .2243957   .1652018     1.36   0.180    -.1074218
.5562133
             lnden |  -1.130886   .7198929    -1.57   0.123    -2.576834
.3150612
          lnavginc |   .0848814   .1460449     0.58   0.564    -.2084584
.3782211
             _cons |   3.680035   .4896948     7.51   0.000     2.696454
4.663616
      -------------+----------------------------------------------------
-----------
           sigma_u |  .42075342
           sigma_e |  .11295925
               rho |  .93277003   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

   108 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   923.3207       7   -1832.641
-1797.17
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   109 . *BIC: -1797.17
   110 . estimates store fixed2_7

   111 .
   112 . *MODEL 2.8: Using shall, lnpb1064, lnpop,lnden as INSIGNIFICANT
VARIABLES
```

```
   113 . xtreg lnvio shall pm1029 lnmur lnrob lnpb1064 lnden lnpop , fe
vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6136                                         min =
23
           between = 0.7339                                         avg =
23.0
           overall = 0.7243                                         max =
23

                                                      F(7,50)           =
70.33
      corr(u_i, Xb)  = 0.1638                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
-----------
             shall |   .0058435   .0293167     0.20   0.843    -.0530408
.0647278
            pm1029 |  -.0518392   .0082553    -6.28   0.000    -.0684206
-.0352578
             lnmur |   .0749588    .029398     2.55   0.014     .0159112
.1340063
             lnrob |   .5412995   .0349555    15.49   0.000     .4710895
.6115096
          lnpb1064 |    .255527   .1503505     1.70   0.095     -.046461
.5575149
             lnden |    -.69551     .61289    -1.13   0.262    -1.926536
.5355157
             lnpop |  -.2659327   .1947073    -1.37   0.178    -.6570137
.1251484
             _cons |   4.271589    .397308    10.75   0.000     3.473573
5.069606
      -------------+----------------------------------------------------
-----------
           sigma_u |  .32697845
           sigma_e |   .1125468
               rho |  .89407423   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

   114 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
```

```
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   927.6115       7   -1841.223
-1805.752
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   115 . *BIC: -1805.752
   116 . estimates store fixed2_8

   117 .
   118 . *MODEL 2.9: Using shall, lnpb1064, lnpop,lnden, lnincarc_rate as
INSIGNIFICANT VARIABLES
   119 . xtreg lnvio shall pm1029 lnmur lnrob lnpb1064 lnden lnpop
lnincarc_rate, fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6177                                         min =
23
           between = 0.7996                                         avg =
23.0
           overall = 0.7850                                         max =
23

                                                      F(8,50)           =
66.87
      corr(u_i, Xb)  = 0.2397                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
------------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
             shall |   .0000894   .0303625     0.00   0.998    -.0608954
.0610742
            pm1029 |  -.0385358   .0140708    -2.74   0.009    -.0667978
-.0102737
             lnmur |   .0816308    .028107     2.90   0.005     .0251761
.1380854
             lnrob |   .5429988   .0337221    16.10   0.000     .4752659
.6107316
          lnpb1064 |   .1845555   .1569155     1.18   0.245    -.1306185
.4997296
             lnden |   -.539933   .6329484    -0.85   0.398    -1.811247
.7313813
```

```
              lnpop |   -.263511   .1892361    -1.39   0.170    -.6436029
.1165808
      lnincarc_rate |   .0658703   .0471004     1.40   0.168    -.0287335
.1604742
              _cons |   3.778317   .5884176     6.42   0.000     2.596445
4.960188
      --------------+----------------------------------------------------
------------
            sigma_u |  .28873478
            sigma_e |  .11200128
                rho |  .86921054   (fraction of variance due to u_i)
      ------------------------------------------------------------------
------------

   120 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   933.8372       8   -1851.674
-1811.136
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   121 . *BIC: -1811.136. This is the best model as per BIC.
   122 . estimates store fixed2_9

   123 .
   124 . **************************FIXED TIME
EFFECT****************************************************
   125 .
   126 . *MODEL 3.1: MODEL WITH ENTITY AND TIME FIXED EFFECT
   127 . xtreg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden
lnmur lnrob lnavginc i.year, fe

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

      R-sq:                                           Obs per group:
           within  = 0.6758                                         min =
23
           between = 0.5718                                         avg =
23.0
           overall = 0.5619                                         max =
23

                                                      F(31,1091)        =
73.37
      corr(u_i, Xb)  = 0.3719                         Prob > F          =
0.0000
```

```
------------------------------------------------------------------------------
       lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lnincarc_rate |  -.0041201   .0213632    -0.19   0.847    -.0460378    .0377976
       shall |  -.0299454   .0129191    -2.32   0.021    -.0552945   -.0045962
     lnpb1064 |   -.027411   .0703291    -0.39   0.697    -.1654067    .1105847
      pm1029 |   .0384271   .0084945     4.52   0.000     .0217598    .0550944
       lnpop |  -.2997561   .0808331    -3.71   0.000    -.4583621   -.1411501
       lnden |  -.5725517   .3237413    -1.77   0.077    -1.207778    .0626744
       lnmur |    .049223   .0217153     2.27   0.024     .0066146    .0918315
       lnrob |   .4768532   .0185334    25.73   0.000     .4404881    .5132183
     lnavginc |  -.1177747   .0790452    -1.49   0.137    -.2728726    .0373231
              |
        year |
         78  |   .0496742   .0209807     2.37   0.018     .0085072    .0908412
         79  |   .1089603   .0214643     5.08   0.000     .0668442    .1510763
         80  |   .1149285   .0221724     5.18   0.000     .0714231    .1584339
         81  |   .1073847   .0229755     4.67   0.000     .0623037    .1524658
         82  |   .1204283   .0242418     4.97   0.000     .0728626    .1679941
         83  |   .1373779   .0259963     5.28   0.000     .0863695    .1883863
         84  |   .2010825   .0286676     7.01   0.000     .1448326    .2573323
         85  |   .2393366   .0311602     7.68   0.000     .1781959    .3004774
         86  |   .2840803   .0342508     8.29   0.000     .2168755    .3512851
         87  |   .3056825   .0370628     8.25   0.000     .2329602    .3784049
         88  |   .3563915   .0401949     8.87   0.000     .2775235    .4352594
         89  |   .3903557    .043303     9.01   0.000      .305389    .4753223
         90  |    .474207   .0464222    10.22   0.000     .3831201    .5652939
         91  |   .4773074   .0490521     9.73   0.000     .3810603    .5735544
         92  |   .5182075   .0518277    10.00   0.000     .4165142    .6199008
         93  |   .5359566    .053665     9.99   0.000     .4306582    .6412549
         94  |   .5256749   .0560422     9.38   0.000     .4157121    .6356376
```

```
                95  |    .525475   .0584041     9.00   0.000     .4108779
.6400722
                96  |   .5060943   .0606338     8.35   0.000     .3871224
.6250663
                97  |   .5256931   .0627149     8.38   0.000     .4026375
.6487486
                98  |   .5234356   .0648452     8.07   0.000     .3962001
.6506711
                99  |   .5092141   .0665215     7.65   0.000     .3786896
.6397386
                    |
              _cons |   3.677631   .2877893    12.78   0.000     3.112948
4.242314
      --------------+----------------------------------------------------
------------
            sigma_u |   .4500464
            sigma_e |  .10421916
                rho |   .9491028   (fraction of variance due to u_i)
      ------------------------------------------------------------------
------------
      F test that all u_i=0: F(50, 1091) = 64.81                     Prob >
F = 0.0000

   128 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   1030.546      32   -1997.092
-1834.937
      ------------------------------------------------------------------
----------
                      Note: N=Obs used in calculating BIC; see [R] BIC
note.

   129 . *BIC: -1834.937
   130 . estimates store fixed3_1

   131 . *insignificant variables: lnincarc_rate lnpb1064 lnavginc
   132 .
   133 . *FTEST TO CHECK THE SIGNIFICANCE OF YEAR
   134 . 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,  1091) =    8.86
                  Prob > F =    0.0000

   135 . *yes significant
   136 .
   137 . *MODEL 3.2: MODEL WITH ENTITY AND TIME FIXED EFFECT with robust
standard error
   138 . xtreg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden
lnmur lnrob lnavginc i.year, fe vce(cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6758                                         min =
23
           between = 0.5718                                         avg =
23.0
           overall = 0.5619                                         max =
23

                                                      F(31,50)          =
110.96
      corr(u_i, Xb)  = 0.3719                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
------------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
      lnincarc_rate |  -.0041201   .0592242    -0.07   0.945    -.1230755
.1148353
             shall |  -.0299454   .0288532    -1.04   0.304    -.0878987
.028008
           lnpb1064 |   -.027411   .1836866    -0.15   0.882    -.3963563
.3415344
            pm1029 |   .0384271   .0192401     2.00   0.051    -.0002177
.077072
             lnpop |  -.2997561   .1685498    -1.78   0.081    -.6382983
.0387861
             lnden |  -.5725517   .4087528    -1.40   0.167    -1.393556
.2484525
```

```
              lnmur |    .049223    .028407     1.73   0.089    -.0078342
.1062802
              lnrob |   .4768532   .0372789    12.79   0.000     .4019764
.55173
            lnavginc |  -.1177747   .2006829    -0.59   0.560    -.5208582
.2853087
                     |
                year |
                  78 |   .0496742   .0130306     3.81   0.000     .0235015
.0758468
                  79 |   .1089603   .0197485     5.52   0.000     .0692942
.1486263
                  80 |   .1149285   .0258125     4.45   0.000     .0630826
.1667744
                  81 |   .1073847   .0306315     3.51   0.001     .0458595
.16891
                  82 |   .1204283   .0386741     3.11   0.003     .0427492
.1981075
                  83 |   .1373779   .0452062     3.04   0.004     .0465786
.2281772
                  84 |   .2010825   .0539679     3.73   0.000     .0926848
.3094802
                  85 |   .2393366   .0618038     3.87   0.000        .1152
.3634732
                  86 |   .2840803   .0735775     3.86   0.000     .1362955
.431865
                  87 |   .3056825   .0819664     3.73   0.000     .1410483
.4703168
                  88 |   .3563915   .0920065     3.87   0.000      .171591
.541192
                  89 |   .3903557   .1023984     3.81   0.000     .1846824
.596029
                  90 |    .474207   .1102501     4.30   0.000     .2527631
.6956509
                  91 |   .4773074   .1148394     4.16   0.000     .2466457
.7079691
                  92 |   .5182075   .1213541     4.27   0.000     .2744606
.7619544
                  93 |   .5359566    .126554     4.24   0.000     .2817653
.7901478
                  94 |   .5256749   .1321586     3.98   0.000     .2602266
.7911232
                  95 |    .525475   .1376786     3.82   0.000     .2489394
.8020107
                  96 |   .5060943   .1433813     3.53   0.001     .2181044
.7940843
                  97 |   .5256931   .1474582     3.57   0.001     .2295147
.8218715
                  98 |   .5234356   .1528947     3.42   0.001     .2163375
.8305337
                  99 |   .5092141   .1566451     3.25   0.002     .1945832
.823845
                     |
               _cons |   3.677631   .6469638     5.68   0.000     2.378166
4.977097
      --------------+----------------------------------------------------
------------
             sigma_u |   .4500464
             sigma_e |  .10421916
                 rho |   .9491028   (fraction of variance due to u_i)
```

```
      ------------------------------------------------------------------------------
------------

   139 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------------------
----------
                 . |      1,173  369.8453   1030.546      31   -1999.092
-1842.005
      ------------------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   140 . *BIC: -1842.005
   141 . estimates store fixed3_2

   142 . *insignificant variables: lnincarc_rate shall lnpb1064 lnpop
lnden lnmur  lnavginc
   143 .
   144 . *MODEL 3.3: MODEL WITH ENTITY AND TIME FIXED EFFECT and removing
insignificant variables
   145 . xtreg lnvio pm1029 lnrob i.year, fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6597                                         min =
23
           between = 0.8659                                         avg =
23.0
           overall = 0.8454                                         max =
23

                                                      F(24,50)          =
83.96
      corr(u_i, Xb)  = 0.5091                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------------------
-----------
            pm1029 |   .0318918   .0179875     1.77   0.082    -.0042373
.0680208
```

```
            lnrob |   .4774416   .0409467    11.66   0.000     .3951977
.5596856
                  |
             year |
              78  |   .0415357   .0105228     3.95   0.000        .0204
.0626714
              79  |   .0988504   .0141902     6.97   0.000     .0703484
.1273523
              80  |   .1047676   .0189809     5.52   0.000     .0666433
.1428919
              81  |   .0921284   .0223929     4.11   0.000     .0471509
.1371058
              82  |   .0968253   .0245419     3.95   0.000     .0475315
.1461191
              83  |   .1038185   .0249332     4.16   0.000     .0537386
.1538983
              84  |   .1537424   .0294401     5.22   0.000     .0946102
.2128746
              85  |   .1863018   .0334566     5.57   0.000     .1191023
.2535013
              86  |   .2252699      .0413     5.45   0.000     .1423165
.3082234
              87  |   .2384964   .0451573     5.28   0.000     .1477953
.3291974
              88  |   .2820228   .0491108     5.74   0.000     .1833808
.3806648
              89  |   .3097034   .0570113     5.43   0.000     .1951928
.4242141
              90  |   .3886641   .0621383     6.25   0.000     .2638556
.5134727
              91  |   .3873254   .0660386     5.87   0.000     .2546829
.5199679
              92  |   .4186766   .0689349     6.07   0.000     .2802167
.5571365
              93  |   .4341813   .0719453     6.03   0.000     .2896749
.5786878
              94  |   .4146717   .0739138     5.61   0.000     .2662115
.5631319
              95  |   .4064305   .0758718     5.36   0.000     .2540375
.5588236
              96  |    .376234    .076572     4.91   0.000     .2224347
.5300333
              97  |   .3850107   .0763449     5.04   0.000     .2316674
.5383539
              98  |   .3740918   .0769566     4.86   0.000       .21952
.5286636
              99  |   .3522206   .0806486     4.37   0.000     .1902331
.5142081
                  |
            _cons |   3.018026   .3543974     8.52   0.000     2.306198
3.729854
      ------------+----------------------------------------------------
-----------
          sigma_u |  .27102156
          sigma_e |  .10643873
              rho |  .86637237   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

   146 . estat ic
```

```
      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------------------
             Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
      -------------+----------------------------------------------------------------
                 . |      1,173  369.8453   1002.076      24   -1956.151   -1834.535
      ------------------------------------------------------------------------------
                       Note: N=Obs used in calculating BIC; see [R] BIC note.

   147 . * BIC: -1834.535
   148 . estimates store fixed3_3

   149 .
   150 . *MODEL 3.4: MODEL WITH ENTITY AND TIME FIXED EFFECT with shall and removing other insignificant variables
   151 . xtreg lnvio pm1029 lnrob shall i.year, fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6619                                         min =         23
           between = 0.8671                                         avg =       23.0
           overall = 0.8471                                         max =         23

                                                      F(25,50)          =      89.09
      corr(u_i, Xb)  = 0.4988                         Prob > F          =     0.0000

                                          (Std. Err. adjusted for 51 clusters in stateid)
      ------------------------------------------------------------------------------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
      -------------+----------------------------------------------------------------
            pm1029 |   .0372361   .0188774     1.97   0.054    -.0006803    .0751525
             lnrob |   .4781172   .0409484    11.68   0.000       .39587    .5603644
             shall |   -.033981    .030321    -1.12   0.268    -.0948826    .0269206
                   |
              year |
```

```
              78  |   .0423811    .010706     3.96   0.000     .0208776
.0638847
              79  |   .1004627   .0146716     6.85   0.000      .070994
.1299314
              80  |   .1070769   .0193244     5.54   0.000     .0682626
.1458912
              81  |   .0952499   .0228903     4.16   0.000     .0492734
.1412265
              82  |   .1020162   .0255809     3.99   0.000     .0506355
.1533969
              83  |   .1106458   .0266807     4.15   0.000     .0570561
.1642355
              84  |   .1623012    .031616     5.13   0.000     .0987985
.2258039
              85  |   .1965425   .0364524     5.39   0.000     .1233257
.2697593
              86  |   .2385356   .0433824     5.50   0.000     .1513994
.3256717
              87  |   .2541522   .0477238     5.33   0.000     .1582961
.3500083
              88  |   .2999561   .0519309     5.78   0.000     .1956499
.4042624
              89  |   .3290774   .0598379     5.50   0.000     .2088895
.4492653
              90  |   .4112856   .0663156     6.20   0.000     .2780867
.5444845
              91  |   .4131906    .070986     5.82   0.000     .2706109
.5557702
              92  |   .4469033   .0742034     6.02   0.000     .2978615
.5959452
              93  |   .4633299   .0768905     6.03   0.000     .3088909
.617769
              94  |   .4447152   .0796016     5.59   0.000     .2848307
.6045998
              95  |    .439747   .0821181     5.36   0.000      .274808
.604686
              96  |   .4133412   .0845065     4.89   0.000     .2436049
.5830775
              97  |   .4244504   .0847346     5.01   0.000      .254256
.5946448
              98  |   .4137998   .0859516     4.81   0.000     .2411609
.5864387
              99  |   .3922094   .0901345     4.35   0.000     .2111688
.5732499
                  |
            _cons |    2.91845   .3723638     7.84   0.000     2.170536
3.666365
      ------------+----------------------------------------------------
-----------
          sigma_u |  .26751764
          sigma_e |  .10613908
              rho |  .86399442   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

   152 . estat ic

      Akaike's information criterion and Bayesian information criterion
```

```
      -----------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+---------------------------------------------------------
----------
                 . |      1,173  369.8453   1005.917      25   -1961.834
-1835.151
      -----------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   153 . * BIC: -1835.151
   154 . estimates store fixed3_4

   155 .
   156 . *MODEL 3.5: MODEL WITH ENTITY AND TIME FIXED EFFECT with shall,
lnpb1064 as insignificant variables
   157 . xtreg lnvio pm1029 lnrob shall lnpb1064 i.year, fe vce (cluster
stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6627                                         min =
23
           between = 0.8501                                         avg =
23.0
           overall = 0.8261                                         max =
23

                                                      F(26,50)          =
90.10
      corr(u_i, Xb)  = 0.5704                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      -----------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+---------------------------------------------------------
-----------
            pm1029 |    .039862   .0196712     2.03   0.048     .0003512
.0793728
             lnrob |   .4733831    .039575    11.96   0.000     .3938944
.5528718
             shall |  -.0375786    .029877    -1.26   0.214    -.0975883
.0224311
           lnpb1064 |  -.1054846   .1847552    -0.57   0.571    -.4765764
.2656072
                   |
              year |
```

```
              78  |   .0440848   .0112558     3.92   0.000     .0214769
.0666927
              79  |   .1041281   .0154255     6.75   0.000      .073145
.1351113
              80  |   .1135976   .0218924     5.19   0.000     .0696254
.1575697
              81  |   .1035377   .0268883     3.85   0.000     .0495309
.1575444
              82  |   .1118319   .0307177     3.64   0.001     .0501336
.1735302
              83  |   .1217269   .0342375     3.56   0.001     .0529589
.1904949
              84  |   .1750141   .0397801     4.40   0.000     .0951133
.2549149
              85  |   .2112904    .046027     4.59   0.000     .1188424
.3037385
              86  |   .2556514   .0523369     4.88   0.000     .1505297
.3607732
              87  |     .27312   .0584218     4.67   0.000     .1557764
.3904637
              88  |   .3211822   .0641528     5.01   0.000     .1923276
.4500368
              89  |   .3525791    .073003     4.83   0.000     .2059482
.4992099
              90  |   .4373847   .0800108     5.47   0.000     .2766782
.5980911
              91  |   .4415649   .0852035     5.18   0.000     .2704286
.6127011
              92  |   .4771112    .089934     5.31   0.000     .2964734
.657749
              93  |   .4951386   .0936306     5.29   0.000     .3070761
.6832011
              94  |   .4779633   .0977465     4.89   0.000     .2816336
.674293
              95  |   .4746156   .1001432     4.74   0.000      .273472
.6757592
              96  |   .4496805   .1037209     4.34   0.000      .241351
.6580099
              97  |   .4619751   .1044321     4.42   0.000      .252217
.6717332
              98  |   .4521488   .1072504     4.22   0.000     .2367301
.6675675
              99  |   .4315642   .1144067     3.77   0.000     .2017714
.6613569
                  |
            _cons |   3.049359   .3831467     7.96   0.000     2.279786
3.818932
      -------------+----------------------------------------------------
-----------
          sigma_u |  .30477219
          sigma_e |  .10606426
              rho |  .89197148   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

   158 . estat ic

      Akaike's information criterion and Bayesian information criterion
```

```
      ------------------------------------------------------------------------------
             Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
      -------------+----------------------------------------------------------------
                 . |      1,173  369.8453   1007.279      26   -1962.558  -1830.807
      ------------------------------------------------------------------------------
                       Note: N=Obs used in calculating BIC; see [R] BIC note.

   159 . * BIC: -1830.807
   160 . estimates store fixed3_5

   161 .
   162 . *MODEL 3.6: MODEL WITH ENTITY AND TIME FIXED EFFECT with shall, lnpb1064, lnden as insignificant variables
   163 . xtreg lnvio pm1029 lnrob shall lnpb1064 lnden i.year, fe vce(cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6697                                         min =         23
           between = 0.2068                                         avg =       23.0
           overall = 0.2345                                         max =         23

                                                      F(27,50)          =      94.80
      corr(u_i, Xb)  = -0.3031                        Prob > F          =     0.0000

                                          (Std. Err. adjusted for 51 clusters in stateid)
      ------------------------------------------------------------------------------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
      -------------+----------------------------------------------------------------
            pm1029 |   .0385901   .0195552     1.97   0.054    -.0006878   .0778679
             lnrob |   .4857865   .0378731    12.83   0.000     .4097162   .5618568
             shall |  -.0341494    .029891    -1.14   0.259    -.0941872   .0258883
           lnpb1064 |   .0133737   .1895307     0.07   0.944      -.36731   .3940573
             lnden |  -1.330615   .4792874    -2.78   0.008    -2.293292  -.3679375
                   |
```

```
             year |
              78  |   .0427925   .0115105     3.72   0.001     .0196729
.0659121
              79  |   .1006459    .015487     6.50   0.000     .0695394
.1317525
              80  |   .1066256   .0215557     4.95   0.000     .0633298
.1499214
              81  |   .0956217   .0264191     3.62   0.001     .0425574
.148686
              82  |   .1038506   .0300858     3.45   0.001     .0434214
.1642798
              83  |   .1145085   .0336677     3.40   0.001     .0468849
.1821321
              84  |   .1680339   .0391227     4.30   0.000     .0894536
.2466142
              85  |    .203602     .04536     4.49   0.000     .1124937
.2947103
              86  |   .2468218   .0515899     4.78   0.000     .1432004
.3504433
              87  |   .2644289   .0575345     4.60   0.000     .1488675
.3799904
              88  |   .3114487   .0630971     4.94   0.000     .1847143
.438183
              89  |   .3414054   .0717375     4.76   0.000     .1973164
.4854943
              90  |   .4248889   .0787353     5.40   0.000     .2667444
.5830334
              91  |   .4270146   .0838344     5.09   0.000     .2586282
.595401
              92  |   .4617259   .0884502     5.22   0.000     .2840684
.6393834
              93  |   .4790912   .0919464     5.21   0.000     .2944113
.663771
              94  |   .4611878    .096069     4.80   0.000     .2682275
.6541482
              95  |   .4567965   .0983454     4.64   0.000     .2592639
.6543291
              96  |   .4313121   .1017523     4.24   0.000     .2269365
.6356877
              97  |   .4434946   .1025741     4.32   0.000     .2374685
.6495208
              98  |   .4341548   .1053793     4.12   0.000     .2224943
.6458153
              99  |   .4140245   .1124598     3.68   0.001     .1881423
.6399067
                  |
            _cons |   3.068598   .3726819     8.23   0.000     2.320045
3.817152
      ------------+----------------------------------------------------------
-----------
          sigma_u |  .58663053
          sigma_e |  .10501694
              rho |  .96894798   (fraction of variance due to u_i)
      ------------------------------------------------------------------------
-----------

   164 . estat ic

      Akaike's information criterion and Bayesian information criterion
```

```
      ------------------------------------------------------------------------------
             Model |        Obs  ll(null)  ll(model)      df         AIC        BIC
      -------------+----------------------------------------------------------------
                 . |      1,173  369.8453   1019.454      27   -1984.909  -1848.091
      ------------------------------------------------------------------------------
                        Note: N=Obs used in calculating BIC; see [R] BIC note.

   165 . * BIC: -1848.091
   166 . estimates store fixed3_6

   167 .
   168 . *MODEL 3.7: MODEL WITH ENTITY AND TIME FIXED EFFECT with shall, lnpb1064, lnpop, lnden as insignificant variables
   169 . xtreg lnvio pm1029 lnrob shall lnpb1064 lnden lnpop i.year, fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6740                                         min =         23
           between = 0.3874                                         avg =       23.0
           overall = 0.4045                                         max =         23

                                                      F(28,50)          =      96.60
      corr(u_i, Xb)  = 0.1744                         Prob > F          =     0.0000

                                          (Std. Err. adjusted for 51 clusters in stateid)
      ------------------------------------------------------------------------------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
      -------------+----------------------------------------------------------------
            pm1029 |    .037292   .0191589     1.95   0.057    -.0011897  .0757737
             lnrob |   .4894918   .0371094    13.19   0.000     .4149554  .5640282
             shall |  -.0286511   .0300385    -0.95   0.345    -.0889851  .031683
           lnpb1064 |  -.0067272   .1814566    -0.04   0.971    -.3711935  .357739
             lnden |  -.7967832   .4092568    -1.95   0.057      -1.6188  .0252332
```

```
            lnpop |  -.3062501   .1584566    -1.93   0.059    -.6245196
.0120195
                  |
             year |
              78  |   .0450831   .0114793     3.93   0.000     .0220263
.0681399
              79  |   .1051321   .0159612     6.59   0.000     .0730732
.1371911
              80  |   .1134354   .0218324     5.20   0.000     .0695837
.1572872
              81  |   .1041519    .026437     3.94   0.000     .0510517
.1572521
              82  |   .1141891   .0302669     3.77   0.000     .0533962
.174982
              83  |    .126602   .0334011     3.79   0.000     .0595139
.1936901
              84  |   .1814549   .0384078     4.72   0.000     .1043104
.2585993
              85  |   .2179403   .0443275     4.92   0.000     .1289059
.3069747
              86  |   .2615472   .0508026     5.15   0.000     .1595072
.3635873
              87  |   .2800558   .0564371     4.96   0.000     .1666986
.393413
              88  |   .3279556    .061823     5.30   0.000     .2037804
.4521308
              89  |   .3589758   .0710763     5.05   0.000     .2162148
.5017368
              90  |   .4431598   .0780969     5.67   0.000     .2862977
.6000219
              91  |   .4465117   .0829858     5.38   0.000       .27983
.6131935
              92  |   .4832675   .0876577     5.51   0.000     .3072018
.6593332
              93  |    .502804   .0909838     5.53   0.000     .3200575
.6855504
              94  |   .4870197   .0947501     5.14   0.000     .2967085
.6773308
              95  |    .484326   .0974396     4.97   0.000     .2886129
.6800391
              96  |   .4605056    .100676     4.57   0.000     .2582919
.6627192
              97  |   .4744865   .1017139     4.66   0.000      .270188
.6787849
              98  |   .4671973   .1041924     4.48   0.000     .2579206
.6764739
              99  |   .4489365   .1108072     4.05   0.000     .2263737
.6714992
                  |
            _cons |   3.439168   .3974521     8.65   0.000     2.640862
4.237474
      ------------+----------------------------------------------------
-----------
          sigma_u |  .49846196
          sigma_e |  .10436919
              rho |   .9580003   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

   170 . estat ic
```

```
      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------------
----------
                 . |      1,173  369.8453   1027.248      28   -1998.496
-1856.611
      ------------------------------------------------------------------------
----------
                       Note: N=Obs used in calculating BIC; see [R] BIC
note.

   171 . * BIC: -1856.611
   172 . estimates store fixed3_7

   173 .
   174 . *MODEL 3.8: MODEL WITH ENTITY AND TIME FIXED EFFECT with shall,
lnpb1064, lnpop, lnden, lnavginc as insignificant variables
   175 . xtreg lnvio pm1029 lnrob shall lnpb1064 lnden lnpop lnavginc
i.year, fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6743                                         min =
23
           between = 0.3862                                         avg =
23.0
           overall = 0.4035                                         max =
23

                                                      F(29,50)          =
92.48
      corr(u_i, Xb)  = 0.1723                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------------
-----------
            pm1029 |   .0384884   .0191643     2.01   0.050    -4.20e-06
.0769809
             lnrob |   .4919418    .037571    13.09   0.000     .4164782
.5674054
             shall |  -.0302281   .0298316    -1.01   0.316    -.0901466
.0296904
          lnpb1064 |  -.0052396   .1832161    -0.03   0.977    -.3732399
.3627607
```

```
             lnden |  -.7896372   .3951139    -2.00   0.051    -1.583247
.0039723
             lnpop |  -.3064545    .156771    -1.95   0.056    -.6213383
.0084293
          lnavginc |  -.0749538   .1913556    -0.39   0.697    -.4593028
.3093951
                   |
              year |
                78 |   .0480548   .0136295     3.53   0.001     .0206792
.0754304
                79 |   .1077555   .0174649     6.17   0.000     .0726762
.1428347
                80 |    .113719   .0219463     5.18   0.000     .0696386
.1577994
                81 |   .1050519   .0268224     3.92   0.000     .0511775
.1589263
                82 |   .1151763   .0306366     3.76   0.000     .0536409
.1767118
                83 |   .1294901   .0344793     3.76   0.000     .0602364
.1987438
                84 |   .1883821   .0422516     4.46   0.000     .1035173
.273247
                85 |   .2268528   .0504173     4.50   0.000     .1255867
.3281188
                86 |     .27244    .059251     4.60   0.000     .1534308
.3914491
                87 |   .2926669   .0669945     4.37   0.000     .1581045
.4272293
                88 |   .3423878   .0753057     4.55   0.000     .1911318
.4936438
                89 |   .3751012   .0840331     4.46   0.000     .2063158
.5438866
                90 |   .4597487   .0901136     5.10   0.000     .2787501
.6407472
                91 |   .4625193   .0931396     4.97   0.000      .275443
.6495956
                92 |   .5011161   .0991389     5.05   0.000     .3019897
.7002424
                93 |   .5211097   .1022312     5.10   0.000     .3157724
.726447
                94 |   .5067008   .1071087     4.73   0.000     .2915666
.721835
                95 |   .5050813   .1106536     4.56   0.000      .282827
.7273356
                96 |   .4827873   .1151746     4.19   0.000     .2514522
.7141224
                97 |   .4986949   .1187441     4.20   0.000     .2601903
.7371995
                98 |   .4942794   .1253134     3.94   0.000     .2425801
.7459787
                99 |    .477653   .1309381     3.65   0.001      .214656
.74065
                   |
             _cons |   3.593207   .5614292     6.40   0.000     2.465543
4.720871
-------------+----------------------------------------------------------
-----------
           sigma_u |   .4987377
           sigma_e |  .10437153
               rho |  .95804297   (fraction of variance due to u_i)
```

```
      ------------------------------------------------------------------------------
-----------

   176 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------------------
----------
                 . |      1,173  369.8453   1027.758      29   -1997.516
-1850.564
      ------------------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   177 . * BIC: -1850.564
   178 . estimates store fixed3_8

   179 .
   180 . *MODEL 3.9: MODEL WITH ENTITY AND TIME FIXED EFFECT with shall,
lnpb1064, lnpop, lnden,lnmur as insignificant variables
   181 . xtreg lnvio pm1029 lnrob shall lnpb1064 lnden lnpop lnmur
i.year, fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6752                                         min =
23
           between = 0.5545                                         avg =
23.0
           overall = 0.5475                                         max =
23

                                                      F(29,50)          =
102.81
      corr(u_i, Xb)  = 0.3527                         Prob > F          =
0.0000

                                    (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------------------
-----------
                   |               Robust
             lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------------------
-----------
            pm1029 |   .0366642   .0193594     1.89   0.064    -.0022203
.0755488
             lnrob |   .4759976   .0360411    13.21   0.000     .4036069
.5483883
```

shall	-.0274038	.0298807	-0.92	0.363	-.087421	.0326134
lnpb1064	-.0259579	.1818673	-0.14	0.887	-.3912492	.3393333
lnden	-.6154668	.4361356	-1.41	0.164	-1.491471	.2605373
lnpop	-.2986636	.1615274	-1.85	0.070	-.6231008	.0257737
lnmur	.0415796	.0271062	1.53	0.131	-.0128648	.096024
year						
78	.0448576	.0109285	4.10	0.000	.0229069	.0668082
79	.1044119	.0160144	6.52	0.000	.0722461	.1365777
80	.1137106	.0217082	5.24	0.000	.0701085	.1573127
81	.1049244	.0264332	3.97	0.000	.0518317	.1580172
82	.1170096	.0301387	3.88	0.000	.0564742	.1775451
83	.1303873	.0332947	3.92	0.000	.0635129	.1972617
84	.1871799	.0383289	4.88	0.000	.110194	.2641658
85	.2223392	.0442719	5.02	0.000	.1334165	.3112619
86	.2640099	.050999	5.18	0.000	.1615755	.3664443
87	.282653	.0564238	5.01	0.000	.1693224	.3959836
88	.3302933	.0617071	5.35	0.000	.206351	.4542356
89	.3613203	.0710524	5.09	0.000	.2186074	.5040332
90	.4441982	.0781508	5.68	0.000	.2872276	.6011687
91	.4478321	.0831759	5.38	0.000	.2807684	.6148958
92	.4854324	.0876229	5.54	0.000	.3094367	.6614281
93	.5026779	.091036	5.52	0.000	.3198266	.6855291
94	.489538	.0946751	5.17	0.000	.2993774	.6796985
95	.4872551	.0972396	5.01	0.000	.2919437	.6825665
96	.4649376	.100552	4.62	0.000	.2629729	.6669023
97	.4809319	.1013999	4.74	0.000	.2772643	.6845995
98	.4738971	.1038657	4.56	0.000	.2652766	.6825175
99	.4567346	.1104884	4.13	0.000	.2348122	.678657
_cons	3.415187	.4075031	8.38	0.000	2.596693	4.233681

```
      -------------+----------------------------------------------------
-----------
           sigma_u |  .45414947
           sigma_e |  .10423162
               rho |  .94996116   (fraction of variance due to u_i)
      ------------------------------------------------------------------
-----------

   182 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   1029.331      29   -2000.663
-1853.711
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   183 . * BIC: -1853.711
   184 . estimates store fixed3_9

   185 .
   186 . *MODEL 3.10: MODEL WITH ENTITY AND TIME FIXED EFFECT with shall,
lnpb1064, lnpop, lnden,lnmur, lnincarc_rate as insignificant variables
   187 . xtreg lnvio pm1029 lnrob shall lnpb1064 lnden lnpop lnmur
lnincarc_rate i.year, fe vce (cluster stateid)

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

      R-sq:                                           Obs per group:
           within  = 0.6752                                         min =
23
           between = 0.5444                                         avg =
23.0
           overall = 0.5384                                         max =
23

                                                      F(30,50)          =
118.35
      corr(u_i, Xb)  = 0.3452                         Prob > F          =
0.0000

                                        (Std. Err. adjusted for 51 clusters
in stateid)
      ------------------------------------------------------------------
------------
                     |               Robust
               lnvio |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
```

```
-------------+------------------------------------------------------------
             pm1029 |   .0366641   .0193943     1.89   0.065    -.0022906   .0756187
              lnrob |    .475487   .0376007    12.65   0.000     .3999636   .5510103
              shall |  -.0277153   .0293439    -0.94   0.349    -.0866543   .0312237
            lnpb1064 |  -.0261836    .181729    -0.14   0.886     -.391197   .3388297
              lnden |  -.6176105   .4427992    -1.39   0.169    -1.506999    .271778
              lnpop |  -.3009635   .1709125    -1.76   0.084    -.6442513   .0423244
              lnmur |   .0414854   .0270665     1.53   0.132    -.0128794   .0958501
      lnincarc_rate |  -.0043423   .0601336    -0.07   0.943    -.1251242   .1164396
                    |
               year |
                78  |   .0450568   .0110728     4.07   0.000     .0228164   .0672973
                79  |   .1050024   .0191439     5.48   0.000     .0665507   .1434541
                80  |   .1144706   .0259574     4.41   0.000     .0623336   .1666076
                81  |   .1058756   .0306786     3.45   0.001     .0442559   .1674953
                82  |    .118425   .0389273     3.04   0.004     .0402372   .1966129
                83  |   .1322302   .0455059     2.91   0.005     .0408289   .2236316
                84  |   .1892383   .0527025     3.59   0.001     .0833823   .2950943
                85  |   .2246316   .0588967     3.81   0.000     .1063341   .3429292
                86  |   .2666412   .0693807     3.84   0.000     .1272859   .4059965
                87  |    .285531   .0764171     3.74   0.000     .1320426   .4390193
                88  |   .3334406   .0843901     3.95   0.000     .1639381   .502943
                89  |   .3647578   .0956562     3.81   0.000     .1726267   .5568888
                90  |     .44815   .1049878     4.27   0.000     .2372759   .6590242
                91  |    .452129   .1113631     4.06   0.000     .2284498   .6758083
                92  |   .4899928   .1172623     4.18   0.000     .2544645   .7255211
                93  |    .507461   .1229052     4.13   0.000     .2605987   .7543234
                94  |   .4945375   .1276787     3.87   0.000     .2380872   .7509878
                95  |   .4925905    .132821     3.71   0.001     .2258117   .7593692
                96  |   .4705459   .1378395     3.41   0.001      .193687   .7474047
                97  |   .4867537   .1403439     3.47   0.001     .2048646   .7686428
```

```
                98  |    .479945   .1429273     3.36   0.002      .192867
.767023
                99  |   .4629602   .1477179     3.13   0.003     .1662601
.7596604
                    |
              _cons |    3.44139   .5521075     6.23   0.000      2.33245
4.550331
      --------------+----------------------------------------------------
------------
            sigma_u |  .45758745
            sigma_e |  .10427737
                rho |  .95063213   (fraction of variance due to u_i)
      ------------------------------------------------------------------
------------

   188 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173  369.8453   1029.354      30   -1998.707
-1846.688
      ------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   189 . * BIC: -1846.688
   190 .
   191 . **********************RANDOM
EFFECT*******************************
   192 . *MODEL 4.1: MODEL WITH RANDOM EFFECTS
   193 . xtreg lnvio lnincarc_rate shall lnpb1064 pm1029 lnpop lnden
lnmur lnrob lnavginc , re

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

      R-sq:                                           Obs per group:
           within  = 0.6144                                         min =
23
           between = 0.8929                                         avg =
23.0
           overall = 0.8717                                         max =
23

                                                      Wald chi2(9)      =
2261.92
      corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =
0.0000

      ------------------------------------------------------------------
------------
```

```
              lnvio |      Coef.   Std. Err.      z    P>|z|     [95%
Conf. Interval]
      --------------+----------------------------------------------------
------------
      lnincarc_rate |   .0945506   .0189998     4.98   0.000     .0573116
.1317895
              shall |  -.0081662   .0122065    -0.67   0.503    -.0320905
.0157581
           lnpb1064 |   .0777505   .0397477     1.96   0.050    -.0001536
.1556546
             pm1029 |  -.0318047   .0052591    -6.05   0.000    -.0421124
-.0214969
              lnpop |    -.10333   .0347689    -2.97   0.003    -.1714758
-.0351841
              lnden |  -.1490923   .0790706    -1.89   0.059    -.3040678
.0058833
              lnmur |   .1103124   .0203142     5.43   0.000     .0704974
.1501275
              lnrob |   .5381089   .0171298    31.41   0.000      .504535
.5716827
           lnavginc |   .0112977   .0616676     0.18   0.855    -.1095685
.132164
              _cons |   3.326692   .2402333    13.85   0.000     2.855844
3.797541
      --------------+----------------------------------------------------
------------
            sigma_u |  .18118924
            sigma_e |   .1120213
                rho |  .72346321   (fraction of variance due to u_i)
      ------------------------------------------------------------------
------------

   194 . estimates store random4_1

   195 .
   196 . *HAUSMAN TEST ON FIXED AND RANDOM MODEL FOR ALL THE VARIABLES
   197 . hausman fixed2_1 random4_1

                       ---- Coefficients ----
                    |      (b)          (B)            (b-B)
sqrt(diag(V_b-V_B))
                    |    fixed2_1    random4_1      Difference
S.E.
      --------------+----------------------------------------------------
-----------
      lnincarc_r~e |    .0617937     .0945506       -.0327568
.0056335
              shall |   -.0010026    -.0081662        .0071636
.002555
           lnpb1064 |    .1759719     .0777505        .0982214
.0554076
             pm1029 |   -.0373956    -.0318047       -.0055909
.0020155
              lnpop |   -.2702397      -.10333       -.1669097
.0767184
              lnden |   -.5513626    -.1490923       -.4022703
.3309051
              lnmur |    .0790516     .1103124       -.0312609
.0085224
```

```
            lnrob |    .5430485     .5381089        .0049396
.0055163
         lnavginc |    .0509784     .0112977        .0396807
.0227193
      ------------------------------------------------------------------
-----------
                                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(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                                =       32.99
                      Prob>chi2 =      0.0001
                      (V_b-V_B is not positive definite)

   198 . *significant (we reject the null hypothesis thus will use fixed
effect only)
   199 .
   200 . *HAUSMAN TEST ON FIXED TIME AND RANDOM MODEL FOR ALL THE
VARIABLES
   201 .
   202 . hausman fixed3_1 random4_1

                       ---- Coefficients ----
                    |      (b)          (B)            (b-B)
sqrt(diag(V_b-V_B))
                    |    fixed3_1    random4_1      Difference
S.E.
      -------------+----------------------------------------------------
-----------
      lnincarc_r~e |   -.0041201     .0945506       -.0986706
.0097671
             shall |   -.0299454    -.0081662       -.0217792
.0042315
         lnpb1064 |    -.027411     .0777505       -.1051615
.0580199
           pm1029 |    .0384271    -.0318047        .0702318
.0066706
            lnpop |   -.2997561      -.10333       -.1964261
.0729734
            lnden |   -.5725517    -.1490923       -.4234594
.3139368
            lnmur |     .049223     .1103124       -.0610894
.0076739
            lnrob |    .4768532     .5381089       -.0612556
.0070749
         lnavginc |   -.1177747     .0112977       -.1290725
.0494496
      ------------------------------------------------------------------
-----------
                                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(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                            =      240.65
                  Prob>chi2 =      0.0000
                  (V_b-V_B is not positive definite)

  203 . *significant (we reject the null hypothesis thus will use fixed
effect only)
  204 .
  205 . **************Effect of shall on robbery rate***************
  206 . *MODEL 5.1: MODEL WITH ENTITY AND TIME FIXED EFFECT
  207 . xtreg lnrob lnincarc_rate shall lnpb1064 pm1029 lnpop lnmur
lnden lnavginc i.year, fe

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

      R-sq:                                           Obs per group:
           within  = 0.3862                                         min =
23
           between = 0.1262                                         avg =
23.0
           overall = 0.1298                                         max =
23

                                                      F(30,1092)        =
22.91
      corr(u_i, Xb)  = -0.6628                        Prob > F          =
0.0000

      ------------------------------------------------------------------
------------
             lnrob |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      -------------+----------------------------------------------------
------------
      lnincarc_rate |  -.1566441   .0345584    -4.53   0.000    -.2244525
-.0888357
             shall |  -.0138187   .0210903    -0.66   0.512    -.0552007
.0275633
           lnpb1064 |  -.9202159   .1114062    -8.26   0.000     -1.13881
-.7016214
            pm1029 |   .0800614   .0136566     5.86   0.000     .0532653
.1068574
             lnpop |   .2167857   .1318216     1.64   0.100    -.0418666
.475438
             lnmur |   .4026039   .0332979    12.09   0.000     .3372688
.467939
             lnden |   3.340829   .5188487     6.44   0.000     2.322776
4.358882
           lnavginc |   .2110164   .1289074     1.64   0.102    -.0419178
.4639505
                    |
              year |
               78  |   .0373609   .0342387     1.09   0.275    -.0298201
.104542
               79  |   .1421364   .0347821     4.09   0.000      .073889
.2103837
```

```
                80  |   .2645959   .0353066     7.49   0.000     .1953194
.3338725
                81  |   .3073517   .0363432     8.46   0.000     .2360414
.3786621
                82  |   .3054505   .0384877     7.94   0.000     .2299323
.3809687
                83  |   .2582604   .0417212     6.19   0.000     .1763976
.3401231
                84  |   .2552461   .0461669     5.53   0.000     .1646602
.3458319
                85  |   .2875538   .0501289     5.74   0.000      .189194
.3859137
                86  |   .3542113    .054888     6.45   0.000     .2465135
.4619091
                87  |   .3465208   .0596008     5.81   0.000     .2295757
.4634659
                88  |   .3938068   .0645394     6.10   0.000     .2671716
.520442
                89  |   .4612815   .0693138     6.65   0.000     .3252783
.5972848
                90  |    .545515   .0739789     7.37   0.000     .4003581
.6906718
                91  |   .6663156   .0775127     8.60   0.000     .5142248
.8184064
                92  |   .6901816   .0820067     8.42   0.000     .5292731
.8510902
                93  |   .6963886   .0850527     8.19   0.000     .5295034
.8632737
                94  |   .7464904   .0886739     8.42   0.000     .5724999
.9204808
                95  |   .7710419    .092464     8.34   0.000     .5896147
.9524692
                96  |   .7554019   .0963279     7.84   0.000     .5663933
.9444105
                97  |   .7345574   .0999595     7.35   0.000     .5384229
.9306918
                98  |   .6694237   .1039236     6.44   0.000     .4655111
.8733362
                99  |   .6278357    .106942     5.87   0.000     .4180007
.8376708
                    |
              _cons |    2.99894    .461057     6.50   0.000     2.094282
3.903598
      --------------+----------------------------------------------------
------------
            sigma_u |  1.1580354
            sigma_e |  .17016956
                rho |  .97886307   (fraction of variance due to u_i)
      ------------------------------------------------------------------
------------
      F test that all u_i=0: F(50, 1092) = 88.98                     Prob >
F = 0.0000

   208 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
```

```
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+-----------------------------------------------------
----------
                 . |      1,173  168.6012   454.8874      31   -847.7747
-690.6878
      -------------------------------------------------------------------
----------
                     Note: N=Obs used in calculating BIC; see [R] BIC
note.

   209 . 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,  1092) =   11.19
                  Prob > F =    0.0000

   210 .
   211 . **************Effect of shall on murder rate***************
   212 . *MODEL 6.1: MODEL WITH ENTITY AND TIME FIXED EFFECT
   213 . xtreg lnmur lnincarc_rate shall lnpb1064 pm1029 lnpop lnden
lnrob  lnavginc i.year, fe

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

      R-sq:                                           Obs per group:
           within  = 0.4259                                         min =
23
           between = 0.0433                                         avg =
23.0
           overall = 0.0315                                         max =
23

                                                      F(30,1092)        =
27.00
```

```
      corr(u_i, Xb)  = -0.9321                         Prob > F          =
0.0000

      ------------------------------------------------------------------------
------------
              lnmur |      Coef.   Std. Err.      t    P>|t|     [95%
Conf. Interval]
      --------------+---------------------------------------------------------
------------
      lnincarc_rate |  -.0226387   .0297629    -0.76   0.447    -.0810377
.0357602
             shall |  -.0132913    .017999    -0.74   0.460    -.0486078
.0220252
           lnpb1064 |   .4438217   .0970828     4.57   0.000     .2533319
.6343116
             pm1029 |   .0011957   .0118374     0.10   0.920     -.022031
.0244224
             lnpop |  -.1919847   .1124953    -1.71   0.088    -.4127161
.0287467
             lnden |  -4.452737   .4305582   -10.34   0.000    -5.297552
-3.607922
             lnrob |   .2932622   .0242547    12.09   0.000     .2456712
.3408532
           lnavginc |   .8705185   .1069573     8.14   0.000     .6606533
1.080384
                    |
              year |
               78  |  -.0280543   .0292253    -0.96   0.337    -.0853985
.0292898
               79  |  -.0100755   .0299101    -0.34   0.736    -.0687632
.0486123
               80  |  -.0059463   .0308979    -0.19   0.847    -.0665722
.0546796
               81  |  -.0240646   .0320092    -0.75   0.452    -.0868711
.038742
               82  |  -.0718874   .0337121    -2.13   0.033    -.1380352
-.0057396
               83  |   -.114926   .0360599    -3.19   0.001    -.1856805
-.0441715
               84  |  -.2073431    .039454    -5.26   0.000    -.2847573
-.1299288
               85  |  -.1973026    .043011    -4.59   0.000    -.2816961
-.1129091
               86  |   -.171989   .0474456    -3.62   0.000    -.2650839
-.0788942
               87  |  -.1938961   .0513145    -3.78   0.000    -.2945824
-.0932099
               88  |  -.2074015   .0556609    -3.73   0.000    -.3166159
-.098187
               89  |  -.2257178   .0599572    -3.76   0.000    -.3433622
-.1080734
               90  |  -.1970216   .0644164    -3.06   0.002    -.3234156
-.0706276
               91  |  -.1952502   .0681008    -2.87   0.004    -.3288734
-.061627
               92  |   -.235559    .071872    -3.28   0.001    -.3765819
-.0945361
               93  |   -.184635    .074576    -2.48   0.013    -.3309635
-.0383064
```

```
               94  |  -.2630483   .0776911    -3.39   0.001    -.4154889
-.1106076
               95  |  -.2836493   .0809353    -3.50   0.000    -.4424556
-.1248429
               96  |  -.3360811    .083882    -4.01   0.000    -.5006693
-.1714929
               97  |  -.4057441   .0865298    -4.69   0.000    -.5755275
-.2359607
               98  |  -.4440551   .0893605    -4.97   0.000    -.6193928
-.2687173
               99  |  -.4885137   .0915148    -5.34   0.000    -.6680785
-.3089489
                   |
             _cons |  -1.075954   .3997255    -2.69   0.007    -1.860271
-.2916367
      -------------+----------------------------------------------------
------------
           sigma_u |  1.5479232
           sigma_e |  .14523488
               rho |  .99127357   (fraction of variance due to u_i)
      ------------------------------------------------------------------
------------
      F test that all u_i=0: F(50, 1092) = 49.75                     Prob >
F = 0.0000

   214 . estat ic

      Akaike's information criterion and Bayesian information criterion

      ------------------------------------------------------------------
----------
             Model |        Obs  ll(null)  ll(model)      df         AIC
BIC
      -------------+----------------------------------------------------
----------
                 . |      1,173    315.28    640.741      31   -1219.482
-1062.395
      ------------------------------------------------------------------
----------
                       Note: N=Obs used in calculating BIC; see [R] BIC
note.

   215 .
   216 . translate @Results stata_res2.txt
```