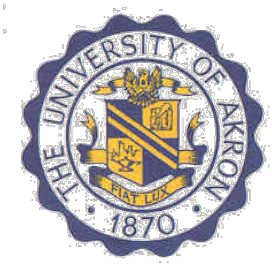
Senior Project
Department of Economics



The Relationship between Education and Crime in the U.S.

Tai Tan Huynh
May 2015

Advisor: *Francesco Renna*

Abstract

This paper looks at the relationship between education and crime in the United States. Additionally, the interaction between real GDP per capita and criminal activity is examined to specify whether real GDP per capita is positively correlated or negatively correlated to crime over the time period of 1999-2008. Using OLS regression, results are biased and inefficient. Yet, using fixed-effect models results in statistically and economically significant coefficients. However, there is not enough evidence to conclude that associate's degree graduation has a negative relationship with crime rates. In general, total crime rates are found to be negatively associated with education. Crime rates also show persistently over time by using difference-GMM estimator.

Keywords: Education, crime, two-way fixed-effect, GMM

*****I would like to thank Dr. Francesco Renna and Dr. Michael Nelson for reading my paper and making the necessary corrections along with guiding me in the right direction.*****

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I. Introduction, Hypothesis, and Motivation

According to the U.S. Census, the United States is the country that has highest crime rate per 100,000 population in the world (U.S. Statistical Abstract, 2014). Consequently, the imprisonment rate of the United States is also the highest in the world: more than 700 per 100,000 of the national population (Bureau of Justice Statistics, 2014). Every year the United States spends a tremendous amount of money on public expenditures to fight against crime. These expenditures fund a variety of criminal justice activities such as the costs of investigation, prosecution, detention and other necessary services. A study reported that the direct costs of crime in 2010 was roughly $261 billion (Kyckelhahn and Martin, 2013). Crime also creates physical and emotional costs for the subjects who are the victims of criminal activities. Criminal activities can impede economic growth and development not only by disrupting the production processes of many financial institutions but also by reducing significantly the productivity of workers. Generally, crime can be eliminated or diminished by appropriate methods of control and prevention. Education has been speculated as an important element in preventing individuals from engaging criminal activities. Therefore, it is important for policy-makers to identify the benefits of education in reducing crime. As mentioned above, crime and high imprisonment rates impose enormous costs on society; thus, decreasing of criminal activities associated with education may be economically vital.

For the concerns mentioned above, the main purpose of this paper is to answer the following research questions: Is there a negative causality between education and crime in the United States? Is the crime rate persistent from 1999 to 2008? (i.e. a higher crime rate today is associated with a higher crime rate tomorrow.)

II. Literature Review

Lochner and Moretti (2004) estimate the effects of education on participation in criminal activity using changes in state compulsory schooling laws over time to account for the endogeneity of schooling decisions. They use individual-level data on incarceration from the Census and "cohort-level" data on arrests by state from the FBI Uniform Crime Reports to analyze the effects of schooling on crime. They find that education plays a vital role in reducing the probability of incarceration and arrest. Specifically, by using two-stage least squares (2SLS), the authors' results suggest that an extra year of schooling lessens the probability of incarceration by about 0.14 percentage point for white individuals and 0.41 percentage points for black individuals respectively. In addition, they further estimate that the social savings from crime reduction associated with high school graduation is about 14-26 percent of the private return (benefits of education are not taken into account by individuals themselves) for men.

Moretti's paper (2005) is a continuation of the work in the former paper. In the paper, Lochner and Moretti use three different data sources: individual-data from the Census, state-level data from the Uniform Crime Reports, and self-report data from National Longitudinal Survey of Youth. The results of the empirical analysis unanimously suggest that criminal activities are significantly reduced by additional schoolings. By calculating social costs and social benefits per crime, Moretti concludes that a 1 percent increase in the high school completion rate of all men aged from 20 to 60 would save the United State roughly $1.4 billion per year from damage costs of crime to victims and society. However, the author also mentions that it is not an easy task to fully explain the estimated effects of education on crime due to the existences of unobserved characteristics of criminals and state policies.

Buonanno and Leonida (2006) examine the impact of education on criminal activity in Italy. By using data for 20 Italian regions over the period 1980-1995, a hypothesis is tested in order to clarify the effects of education and past criminal behaviors on criminal activity: “Is education negatively correlated to crime in Italy?”. For their econometrics model, they use a dynamic panel dataset. Therefore, the researchers use GMM (generalized method of moments) instead of using OLS (Ordinary Least Squares). Then a hypothesis is tested by using GMM-system estimator for the 20 Italian regions for the period 1980 to 1995. They also used fixed effect estimator in their econometrics model. From the results, the authors conclude that education, measured as the average years of schooling, has a negative and significant effect on crime rate and that crime rates display persistence over time; in other words, higher crime today is associated with higher crime tomorrow.

Groot and Maassen (2010) attempt to analyze the effects of different levels of educational attainment on offences and crimes committed using Dutch individual-level data. By estimating a probit equations for each type of crime, the results indicate that a year of education reduces the probability of shop lifting by 0.3 percent points, the probability of vandalism by 0.2 percent points and the probability of violent crime by 0.2 percent points. On the other hand, a year of education increases the probability of tax fraud by 0.4 percent points.

Interestingly, Deming (2011) estimates the impact of school quality and peer effects on crime by using data from school choice lotteries in the Charlotte-Mecklenburg school district. In detail, the author estimate the longer-term effect of winning an admissions lottery to attend a better middle or high school on adult crime. Seven years after random assignment, lottery winners had been arrested for fewer serious crimes and had spent fewer days incarcerated. Also, the results show that winning a lottery significantly reduces criminal activity for adults. The

author suggests that school quality explains more of the impact for high school, whereas peer effects are more important for middle school.

All previous papers are listed above result in the same conclusion: education has a negative relationship with crime. This study will use the latest-possible data in order to examine the relationship between education and crime and the United States. Nevertheless, the shadow economy size is included in the model as a regressor of estimating crime rates. The remainder of the paper is organized as follows: Section III provides theoretical model and economic approach of the study. Section IV describes the datasets are used in the paper and the methodology. Empirical results are presented in Section V, and Section VI is conclusion.

III. Theoretical Model

According to Gary Becker's analytical framework (1968), criminals rationally decide whether to commit a crime by measuring the expected costs and benefits of engaging in criminal activities. Particularly, if the probability of being caught is insignificant or the level of penalty is too low, then expected costs might be exceeded by the benefits. In such cases, committing crimes will result in net benefits and can be considered to be rational. However, it is necessary to understand that criminals, especially low-educated ones, usually believe the benefits of their crime outweigh the costs of apprehension, punishment, or even the possibility of death.

Becker's crime model further suggests that the wealthy are greatly attractive targets to criminals, which may lead to high victimization of the wealthy comparing to the poor. Since the United States is one of the countries with the most extreme income inequality, a higher GDP per capita will encourage the expansion of crime (Fajnzylber, Lederman and Loayza, 2002).

There are several reasons for expecting education to affect crime. Firstly, higher educated individuals are associated with higher economic returns in the labor market than lower educated ones. Thus, education increases the opportunity costs of criminal behavior, in other words, higher educated individuals will experience greater earning losses while in jail (Lochner and Moretti, 2004). Secondly, education may directly increase the psychic cost (i.e. anxiety, guilt, fear) of committing crime (Lochner and Moretti, 2004). Finally, education may alter individual preferences over time. For instance, well-educated youngsters are less likely to take risks, and more likely to behave morally reasonable. Educational attainment also reduces the time availability for criminal activities (Tauchen and Witte, 1994).

IV. Data and Methodology

The data used in this study are taken from four different sources: the FBI Uniform Crime Report, the Current Population Survey (CPS) on educational attainment, the Federal Trade Commission, and the Bureau of Labor Statistics (BLS). All data are collected from the time period of 1999-2008 (see table 1 and 2 in the appendix for more details). The econometric model is borrowed from the 2006 Buonanno-Leonida paper, which is mentioned in the literature review section. This study uses two-way fixed-effect models to examine the relationship between education and crime of 50 states of the United States. Additionally, difference-GMM estimator is applied to check the persistency of crime rate.

The two-way fixed-effect econometric model is presented as follows:

$$Log(Crime_{i,t}) = \alpha_i + \alpha_1 Educ_{i,t} + \alpha_2 shdw_{i,t} + \alpha_3 realWage_{i,t} + \eta_i + \eta_t + \varepsilon_{i,t}$$

Where:

- i and t represent region and time period

- η_i is a state fixed-effect
- η_t is a year fixed-effect
- $Crime_{i,t}$ is the number of crimes per state residents. Crime rates are categorized into two main groups: total crime rates, and total property crime rates. However, crime committed by unknown offenders, white-collar crime, and cybercrime are not included in these three categories.
- $Educ_{i,t}$ is the levels of education rates by state. The levels of educational attainment are divided into four main group: no high school graduation, high school graduation, associate's degree graduation, bachelor's degree and higher degrees graduation. No high school graduation is excluded from the models as a reference group. As mentioned above, many studies show that attaining to higher levels of education leads to reducing crime. Therefore, it is expected the education variables have negative sign.
- $shdw_{i,t}$ is the shadow economy size by state (% of GDP). Obviously, shadow economic activities and crime are positive correlated. In other words, higher shadow economic activities will lead to higher crime rates. Therefore, it is expected the shadow economy variable has a positive sign.
- $realWage_{i,t}$ is the annual average real wage by state (deflated by C.P.I.). The annual average real wage is expected to have a negative sign because the higher annual average wage a worker has, the more time that worker spent on labor, which means he has less available time for criminal activities. Workers with higher wages will have higher opportunity costs to commit crime as well.
- $\varepsilon_{i,t}$ is the error term.

In an attempt to check for the persistency of crime rate, a dynamic panel data econometric model is presented as follows:

$$Log(Crime_{i,t}) = \beta_0 + \beta_1 Crime_{i,t-1} + \beta_2 Educ_{i,t} + \beta_3 shdw_{i,t} + \beta_4 realWage_{i,t} + \eta_i + \eta_t + v_{i,t}$$

Where:

- $Crime_{i,t-1}$ is the lagged variable of $Crime_{i,t}$. The lagged variable is created to examine the persistency of crime. Theoretically, higher crime today is associated with higher crime tomorrow. Thus, the lagged variable is expected to have a positive sign.

- $v_{i,t}$ is the error term.

A list of variables used in this study is available in the appendix, as well as descriptive statistics for each variable.

V. Results

	Two-way fixed-effect		**Second stage difference-GMM estimator**	
Variable	**logtotalcrime**	**logpropcrime**	**logtotalcrime**	**logpropcrime**
Intercept	9.847 *** (34.04)	9.571*** (32.27)		
logtotalcrime _1			0.59*** (204.45)	
logpropcrime _1				0.610*** (166.41)
HSrate	-0.855*** (-3.13)	-0.854*** (-3.05)	-0.599*** (-100.06)	-0.666*** (-80.29)
somecollegerate	0.1897 (0.61)	0.1782 (0.56)	-0.054** (-2.37)	-0.17*** (-9.89)
bachormorerate	-0.979*** (-3.39)	-0.965*** (-3.26)	-0.273*** (-34.06)	-0.1731*** (-19.71)
shdw	0.0739*** (3.15)	0.099*** (4.13)	0.0098*** (25.21)	0.01297*** (31.80)
realwageink	-0.019 ** (-2.29)	-0.019** (-2.13)	-0.018*** (-52.75)	-0.020*** (-42.77)
R-Square	0.9978	0.9976		
Observation	500	500	450	450
F-Statistic	2055.03	1936.96		
Sargan test			2243.9	2288.19
Notes: T-values in parentheses. ***, ** and * indicate significance at 1 %, 5 %, and 10 % levels, respectively.				

Using Ordinary Least Square (OLS) regression for a panel data will result in biased and inefficient coefficients when unobserved state-specific effects are statistically significant and the regressors are correlated with these affects. The R-Squared values for the two-way fixed-effect models are above .99, meaning these models explain 99% of all variability of data. However, since the t-values of some regressors are low and high R-Squared values, the models may have multicollinearity issues. For dynamic panel data, it is also worth noting that the coefficients of two-way fixed-effect models with small sample size may be biased, but the biased effect is quite small. In general, the results suggest that one percent increase in high school graduation rate will cause a decrease in the total crime rates by 0.86 percentage point. Although high school graduation shows the expected signs, associate's degree graduation rate is insignificant. Nevertheless, bachelor's degree and higher degrees graduation rate show the expected sign for the total crime model, more specifically, one percent increase in bachelor's and higher degrees graduation rates will decrease the total crime rates by 0.98 percentage point.

For the total crime and total property crime rates, shadow economic activities expectedly show the predicted signs. More clearly, one percent increase in GDP associated with the shadow economy will increase the total crime rates by 0.07 percentage point and by 0.1 percentage point for the property crime rates respectively.

Annual average real wage overall has a smaller overall effect on crime relative to shadow economy size. For instance, an additional thousand dollar in real wage will lead to a decrease in the total crime rates by 0.02 percent and by 0.02 for the total property crime rates respectively.

For checking whether the crime rate is persistent, we look at the difference-GMM estimator results. The results indicate that there is a correlation between $\boldsymbol{crime_{i,t}}$ and $\boldsymbol{crime_{i,t-1}}$.

For the total crime rates, the probability of committing crime in time ***t*** is correlated with the probability of committing crime in time ***t - 1*** by roughly 0.59. Yet, this probability is larger for the total property crime rates, roughly by 0.61. However, statistic values from Sargan test suggest that the GMM models are unreliable models, which lead to bad estimations.

VI. Limitations and Conclusions

As the economic theories proposed in literature review section, the results for this paper show robust evidences there is a strong relationship between education and crime. However, it is important to know that the purpose of attaining in higher levels of education is to have higher legitimate returns in future by having financially better occupations. If well-educated individuals cannot find high income jobs as economic theories suggested, education do not necessarily lessen crime. From the GMM results, it is simply understood that the crime rates today is highly connected with the crime rates tomorrow, especially more convincing for property crimes. Furthermore, shadow economy is positive correlated with total crime rate, which means the larger shadow economy is the initial assumption is correct: for states with larger shadow economy will have higher crime rates. This would be an interesting research topic for me in the future. Higher annual average wage empirically results in lower crime rate.

One of the limitations of this paper is the missing of some special crime categories such as identity theft crime, white-collar crime, etc. The other limitations have to be mentioned is the sample size is not impressively large enough and some categories are not grouped by gender or race. Importantly, difference-GMM estimation has to be considered more carefully before applying to the study. These limitations will be improved in my next research paper.

VII. Appendix

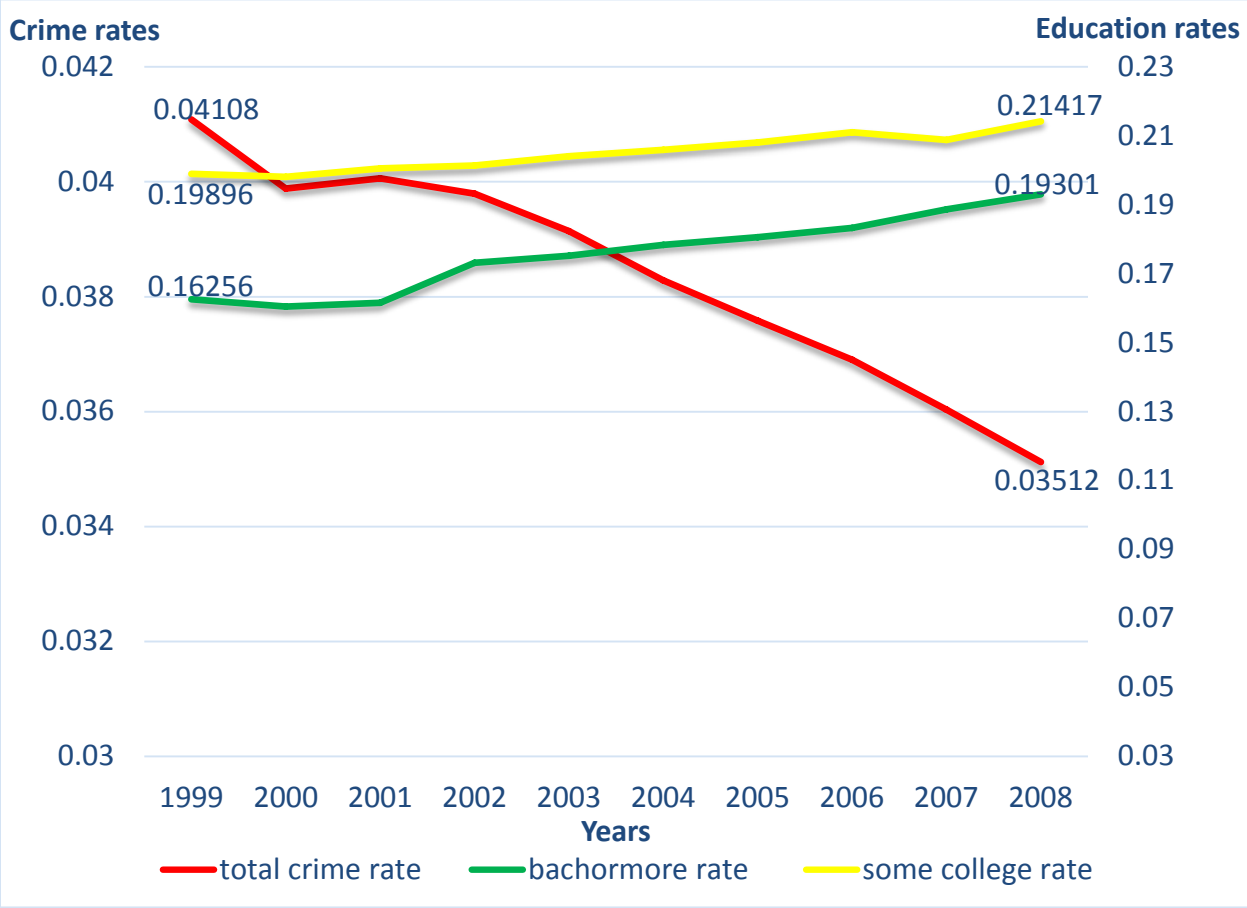
Table 1: Variable Descriptions and Sources

Variable	Description	Source
totalcrime	Total number of crime by state (from 1999 to 2008)	FBI Uniform Crime Reports
propertycrime	Total number of property crime by state (from 1999 to 2008)	FBI Uniform Crime Reports
Hsrate	High school graduation rate by state (from 1999 to 2008)	Current Population Survey (CPS).
somecollegerate	Associate's degree (or equivalent) graduation rate by state (from 1999 to 2008)	Current Population Survey (CPS).
bachormorerate	BA and post-BA graduation rate by state (from 1999 to 2008)	Current Population Survey (CPS).
shdw	Shadow economy size (% of GDP) by state (from 1999 to 2008)	Travis Wiseman's paper (2013).
annavewageink	Annual average wage (in thousands U.S. dollars).	Bureau of Labor Statistics (BLS).
CPI	Consumer Price Indexes (from 1999 to 2008)	Bureau of Labor Statistics (BLS).
realwageink	Annual average real wage (in thousands U.S. dollars).	Self-calculated.

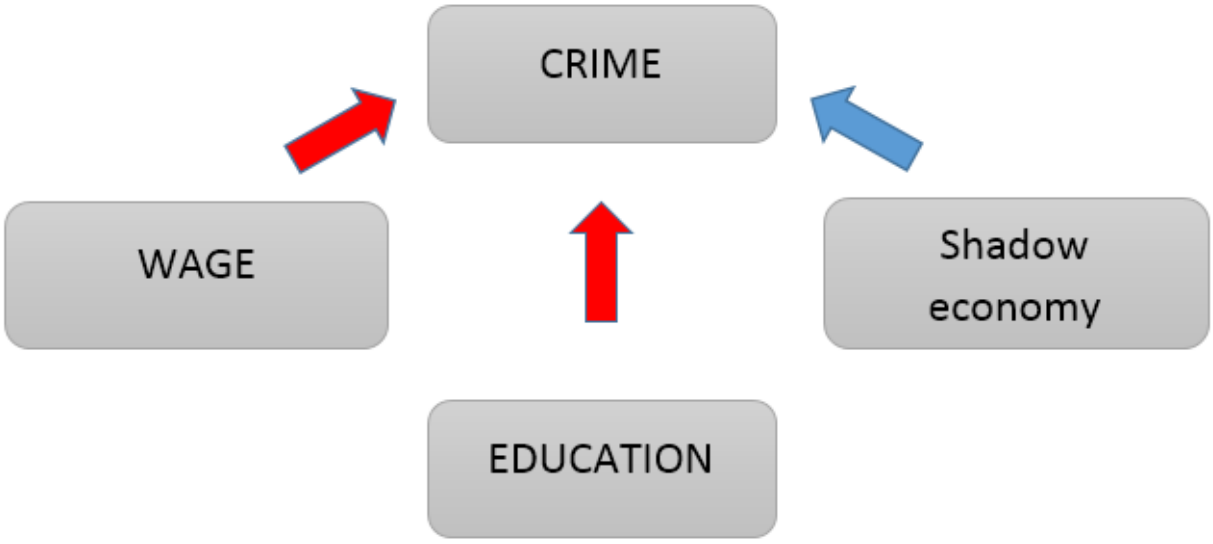
Table 2: Descriptive Statistics

Variable	Label	N	Mean	Std Dev	Minimum	Maximum
totalcrime		500	231204.34	262778.07	13051.00	1420637.00
Prop_tot		500	203172.60	226739.03	12493.00	1227194.00
logtotalcrime		500	11.7992597	1.1192647	9.4766200	14.1666159
logpropcrime		500	11.6864708	1.1019165	9.4329238	14.0202408
noHSrate		500	0.1063435	0.0262930	0.0523668	0.1830510
Hsrate		500	0.2417842	0.0320774	0.1637412	0.3600041
somecollegerate		500	0.2050737	0.0264560	0.1443581	0.2733451
bachormorerate		500	0.1756470	0.0360871	0.1064869	0.3079523
shdw	shdw	500	8.1585200	0.8051686	6.0500000	10.0000000
realwageink		500	19.0722637	3.0274853	13.9615846	28.6671297

Figure 1: Crime and education



Theoretical model:



= Negative effect

= Positive effect

SAS Code

```
libname mydata 'E:/sen_stuff';
OPTIONS INVALIDDATA='_';

proc import datafile='E:/sen_stuff/crime/latestcrimedata.csv'
            out=work.crimedata
            dbms=csv
            replace;
proc import datafile='E:/sen_stuff/educ/education9.csv'
            out=work.edudata
            dbms=csv
            replace;
proc import datafile='E:/sen_stuff/wage/realwage.csv'
            out=work.wage
            dbms=csv
            replace;
proc import datafile='E:/sen_stuff/shad/sh.xlsx'
            out=work.shdw
            dbms=xlsx
            replace;
run;

proc sort data=crimedata; by State Year; run;
proc sort data=edudata; by State Year; run;
proc sort data=wage; by State Year; run;
proc sort data=shdw; by State Year; run;

data finaldata;
merge crimedata edudata wage shdw; by State Year;
run;

/* exports data */
proc export data=finaldata
outfile='//Client/E$/sen_stuff/finaldata.csv'
dbms =csv
replace;
run;

/* removes observations with missing variables */
data finaldata;
set finaldata;
If Year = '1997' then delete;
If Year = '1998' then delete;
If Year = '2009' then delete;
If Year = '2010' then delete;
If Year = '2011' then delete;
If Year = '2012' then delete;
If State = 'District of Columbia' then delete;
run;

/* creates logged variables */
data finaldata;
```

```
set finaldata;
logtotalcrime = log(totalcrime);
logpropcrime = log(prop_tot);
run;

/* displays means between variables*/
proc means data=finaldata;
var totalcrime prop_tot logtotalcrime logpropcrime NoHSrate HSrate
somecollegerate bachormorerate shdw realwageink;
run;

/* two-way fixed-effect models */
proc panel data=finaldata;
id State Year;
model logtotalcrime = HSrate somecollegerate bachormorerate shdw realwageink
/ fixtwo;
model logpropcrime = HSrate somecollegerate bachormorerate shdw realwageink /
fixtwo;
run;

/* difference-GMM  */
proc panel data=finaldata;
id State Year;
lag logtotalcrime(1) / out=alpha1;
run;
proc panel data=finaldata;
id State Year;
lag logpropcrime(1) / out=alpha2;
run;

/* removes observetions with missing variables */
data beta1;
set alpha1;
if logtotalcrime_1 = '.' then delete;
data beta2;
set alpha2;
if logpropcrime_1 =     '.' then delete;
run;

proc panel data=beta1;
      inst depvar exog=(HSrate somecollegerate bachormorerate);
      model logtotalcrime = logtotalcrime_1 HSrate somecollegerate
bachormorerate shdw realwageink / GMM twostep nolevels maxband=4;
      id State Year;
run;
proc panel data=beta2;
      inst depvar exog=(HSrate somecollegerate bachormorerate);
      model logpropcrime = logpropcrime_1 HSrate somecollegerate
bachormorerate shdw realwageink / GMM twostep nolevels maxband=4;
      id State Year;
run;
```

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