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Economics of Crime: Panel Data Analysis of Bank Robbery in the United States

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Abstract

This paper examines the determinants of bank robbery in the United States using a rational choice model. Panel data estimation techniques were used to analyze the data for all 50 states and the District of Columbia from 1990 through 2000. A random-effects model emerged as the most appropriate estimating model for costs and benefits of bank robbery. Among the significant determinants of the rate of bank robbery were the unemployment rate and amount of loot. The findings suggest that the rational choice model is a suitable framework for examining bank robbery. However, if we are to draw useful policy conclusions, better data are needed to accurately measure the opportunity costs of bank robbery. (JEL C23, K42)

Keywords: bank robbery, economics of crime, panel data analysis

Introduction

According to a recent FBI report, in 2001 the rate of bank robbery was one every 52 min. Over the five year period, from 1996 through 2000, nearly half a billion dollars were robbed from banks, only 20 percent of which was recovered. Between 2000 and 2002 alone, the banks' loss of funds to bank robbery increased by an alarming 22.8 percent [Federal Bureau of Investigation, 2002a].

Few crimes garner as much public attention as bank robberies. The bravado of early bank robbers in the US, such as Jesse James, John Dillinger, Bonnie Parker, and Clyde Barrow, created a mystique which has been capitalized upon in several Hollywood movies (e.g., *Bandits* and *Butch Cassidy and the Sundance Kid*).

The first bank robbery in the United States occurred on March 19, 1831 when Edward Smith robbed the City Bank on Wall Street in New York City for $245,000. Today, the average amount of money taken in a bank robbery is about $5,000. Yet, the considerable frequency with which bank robberies occur, 10,262 in 2001 and 9,689 in 2002, impose a substantial cost upon the banking industry [Federal Bureau of Investigation, 2002b]. These costs include loss of funds, disruption of the bank's business, potential injury to the employees and customers, and destruction of bank's physical property. In addition, the rise in the incidents of bank robbery creates increasing pressure to invest in state of the art security devices over and above that which is required by the 1968 Bank Protection Act.[1] Furthermore, the fear of possible violence (death, injury, and hostage taking) bank robbery engenders, renders this crime a significant social and economic problem. The paucity of literature based on systematic

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academic investigation of bank robbery suggests that other preventative measures and policies may yet to be discovered.

The purpose of this paper is to examine bank robbery in the United States between 1990 and 2000. Bank robbery is classified as one of the violent crimes (murder, rape, and assault are other ones), even though it is a crime against property. In addition to the costs imposed on the banks that fall victim to this crime, it imposes increasing costs on all of the taxpayers in a community by adding to the costs of law enforcement and police protection. Bank robbery is not an inevitable fact of life, yet its consequences on economic activity are inevitably pernicious. A better understanding of the determinants of this crime can help to shape national and local policies in order to deter bank robberies and thus, reduce the costs of this crime.

Literature Review

Criminologists, sociologists, and psychologists have sought to understand criminal activity in general, and bank robbery in particular, through examination of offender's characteristics, environment, psyche, and motivations. Some sociologists question the efficacy of the rational choice model to be applied to the crime of robbery. For example, Katz [1991] suggested that, "Nonrational violence makes sense as a way of committing oneself to persist in robbery in the face of the risks and chaos inherent in the criminal event" [Katz, 1991, p. 289]. To understand robbery, he advocates biographical research which is a method of analysis that uses life-history material to trace the offender as he enters into a life of crime. Another method used by scientists is situational analysis which focuses on the offender–victim interaction, and yet there are others that combine elements of these two methods [Katz, 1991].

Economists, however, try to understand criminal activity within the framework of economics of crime first espoused by Gary Becker [1968]. Richard Posner summarized the economists' view of criminal activity:

> The notion of the criminal as a rational calculator will strike many as highly unrealistic, especially when applied to criminals having little education or to crimes not committed for pecuniary gain. But as emphasized (elsewhere), the test of a theory is not the realism of its assumptions but its predictive power. A growing empirical literature on crime has shown that criminals respond to changes in opportunity costs, in the probability of apprehension, in the severity of punishment and in other relevant variables as if they were indeed the rational calculators of the economic model – and this regardless of whether the crime is committed for pecuniary gain or out of passion, or by well educated or poorly educated people [Posner, 1986, p. 206].

However, other scholars have different perspectives on the crime of bank robbery. There are several sociological and psychological studies regarding bank robbery perpetrators [e.g., Haran, 1982; Johnston, 1978; Tiffany and Ketchel, 1978; West, 1978]. To date, the existing literature concerning bank robbery has sought to understand the phenomenon where the unit of analysis has either been the offender or the financial institution [Camp, 1968; Servay and Rehm, 1988; Wise and Wise, 1984; Baumer et al., 1986; Samavati, 2004]. Findings of these studies revealed certain characteristics of offenders such as their gender, age, employment status, and means of get away. In addition, a number of variables were found to predict the probability that a bank will fall victim to robbery. Some of those variables were the proximity of a bank to a highway or arterial routes, closeness to a police station, number of entrances, number of tellers, distance between any two tellers, and visibility from within or outside of the bank. These findings are most useful to the law enforcement authorities who are charged with solving these crimes and the banking industry officials who may use the information to create a safer bank. While extremely helpful at a micro level, these studies fail to provide knowledge that can assist in decision making at a macro level. In other words, information that leads to the improvement and design of policies at the state or national level that aim to reduce bank robberies.

Because economic studies of bank robbery are almost non-existent, it is the goal of current study to fill the gap that exists in the literature. After all, money, credit and banking are all affected by illegitimate "runs" on banks. The next section discusses the theory and variables used in the study.

Theory and the Model

The aim of the paper is to analyze the determinants of bank robbery. That is, examine those factors that can explain variations in the rate of bank robbery in the United States. After discussion of the theory, a reduced form model will emerge that will be used to estimate the criminal expectations concerning the costs and benefits of bank robbery.

Becker's [1968] work applied the Rational Choice Model to the understanding of crime. This approach, economics of crime, seeks to explain criminal behavior as a "rational" decision process and thus, subject to cost and benefit analysis. In this paper, crime of bank robbery is studied within the framework of the Rational Choice Model along with consideration of findings of other social scientists such as psychologists, sociologists, and criminologists in this arena. The main approach, however, is that of economics of crime.

Total benefits (TB) from bank robbery consists of financial benefits of the loot (FB) and any psychological benefits (PSB) derived from the act.

$$TB = FB + PSB \tag{1}$$

Benefits derived from bank robbery, however, are not certainty. There is a probability that the offender will get caught. In fact, bank robbery is an offence which has one of the highest arrest and conviction rates. In 2001 the clearance rate for bank robbery was 57.7 percent, second only to murder at 62.4 percent [Federal Bureau of Investigation, 2002a]. As long as a bank robber understands that there is a chance of being caught, and assuming the probability of being arrested is represented by p, then the expected total benefit, $E(TB)$, from bank robbery is:

$$E(TB) = (1 - p)FB + PSB \tag{2}$$

Equation 2 suggests that even if expected financial benefit is about zero, when probability of being caught is near one, as long as a bank robber derives some psychological benefit from his offense, his expected total benefit can still have a positive value.

Having worked with groups of convicted bank robbers, some psychologists and sociologists insist that bank robbery is not an endeavor for strictly material reasons [Johnston, 1978; Katz, 1991]. Instead, they suggest a bank might become an arena where psychological pressures are acted out. Rage emanating from previous failed experiences may be driving a bank robber who might feel "in charge" and feel "he is somebody" when committing the crime of bank robbery.

Total costs (*TC*) of bank robbery consists of costs imposed by law enforcement authorities, jail time and fines (*C*), and opportunity costs of engaging in bank robbery (*OC*).

$$TC = C + OC \tag{3}$$

Costs of punishment by law enforcement authority are not certainty. These costs will be incurred only if the bank robber is arrested.[2] Assuming the probability of being arrested is represented by p, expected costs from bank robbery are:

$$E(TC) = p(C) + OC \tag{4}$$

Costs to the bank robbers increase when probability of arrest and conviction goes up, when punishments imposed become more severe, larger fines and longer jail sentences, and when the values foregone due to engagement in bank robbery increase.

Expected net benefit from bank robbery $E(NB)$ is:

$$E(NB) = E(TB) - E(TC) \tag{5}$$

When expected net benefit from bank robbery is positive (i.e., when expected total benefits exceed expected total costs), the model predicts that episodes of bank robbery will be on the rise. In other words, Eq. 5 suggests that the rate of bank robbery (*BNK-ROB*) increases when the size of loot (*LOOT*) increases; when probability of arrest (p) decreases (expected benefit increases and expected cost decreases); when severity of punishment in terms of fines and jail time decrease; and when opportunity costs decrease. Among others, opportunity costs are affected by the earning opportunities in the legal labor market. When unemployment rate is higher, there are fewer alternatives to legally earn income. All other things equal, those who are unemployed have lower opportunity costs to engage in a criminal act. Similarly, the poverty rate (*POV*) is a variable that affects the opportunity cost of crime in the same manner as unemployment rate. Furthermore, level of educational attainment affects one's opportunity costs to engage in an illegal activity. The higher the education level, the higher is the earning possibility in the legal sector and thus, the higher is the opportunity cost of committing a bank robbery, *ceteris paribus*.

The reduced form model derived from the above analysis is as follows:

$$BNK - ROB = \beta_0 + \beta_1 LOOT + \beta_2 POLICE + \beta_3 UR + \beta_4 POV + \beta_5 EDUC + \varepsilon \tag{6}$$

The dependent variable (*BNK-ROB*) is the rate of bank robbery. The variable *LOOT* is the dollar amount stolen from the banks and is expected to be positively correlated with the rate of bank robbery. The variable *POLICE*, total number of officers per 10,000 residents, is included in the model to serve as a proxy for the probability of being caught, hence receiving punishment. Of course, it would have been more desirable to include either clearance rate or incarceration rate for bank robbery. Unfortunately, annual data for each of 50 states, over the study period, for this specific category of robbery does not exist. The coefficient of *POLICE* is expected to be negative. The larger the proportion of full time police officers relative to population, the higher the probability of apprehension of all criminals, including bank robbers.

The expected sign for the coefficients of *UR* and *POV* are hypothesized to be positive. The higher the unemployment rate (*UR*) and poverty rate (*POV*), the lower the opportunity cost of committing a bank robbery and thus, the higher the expected net benefit. On the other hand, the variable *EDUC* which measures the level of education is expected to enter the model with a negative sign. Ceteris paribus, higher educational attainment of the population raises the opportunity cost of engaging in the crime of bank robbery reducing the net expected benefit of such activity and is expected to be negatively associated with the incidences of bank robbery. The next section discusses the data and the statistical method.

Data and Method

The panel data collected for this study contain 11 years of data, from 1990 through 2000, for each of 50 states and the District of Columbia for a total of 561 observations. The number of bank robberies for each state were obtained from the U.S. Department of Justice, Federal Bureau of Investigation, *Bank Crime Statistics, Federally Insured Financial Institutions*, issues 1990 through 2000. Total population data for each state were collected from the Bureau of Economic Analysis web site. The rate of bank robbery (*BNK-ROB*) was then calculated as the number of bank robberies per 100,000 residents. The data for unemployment rate (*UR*) were obtained from the U.S. Bureau of Labor Statistics web site, Geographic Profile of Employment and Unemployment, 1990–2000. The poverty rate data (*POV*) came from the U.S. Census Bureau web site, Historical Poverty Tables. The poverty rate is reported as the percentage of population living at or below the poverty level. Data for the number of law enforcement officers were taken from the Federal Bureau of Investigation web site, Law Enforcement Personnel, Section VI, Table 77. Given the population for each state, the number of police officers per 10,000 of population (*POLICE*) were then calculated. Data for the education variable (*EDUC*) is the percent of population 25 years old and over with high school degree or more. Educational attainment data for the years 1990, and 1997 through 2000 were taken from U.S. Bureau of Census, *Statistical Abstract of the United States 1998 through 2001*. For the years 1991 through 1996, data source was U.S. Census Bureau web site, Educational Attainment: Historical Reports 1990 to 1998 Detailed Tables. The data for dollar amount of stolen money (*LOOT*) were extracted from the printout provided by the *Communication Unit, Criminal Justice Information Services Division, Federal Bureau of Investigation*.

A linear relationship between the rate of bank robbery in each state, the dependent variable, and the explanatory variables, discussed above, was assumed. The model was initially estimated using the Ordinary Least Squares (OLS) method. However, because the patterns of bank robbery, unemployment rate, and poverty rate are different for each state, it may be more appropriate to use the panel data estimation methods that control for heterogeneity due to the state variable. The rate of bank robbery varies from state to state and from one year to another. This double dependence is shown by using two indices i and t.

Using panel data methods, depending on statistical results, a fixed-effects or a random-effects model may emerge as the appropriate empirical model. The model to be estimated is specified as follows:

$$BNK-ROB_{it} = \beta_0 + \beta_1 LOOT_{it} + \beta_2 POLICE_{it} + \beta_3 UR_{it} + \beta_4 POV_{it} + \beta_5 EDUC_{it} + \varepsilon_{it} \quad (7)$$
$$\varepsilon_{it} = \mu_i + \upsilon_{it}$$

If the model is estimated using a fixed-effects or covariance model, then μ_i denotes the constant state-specific effect that is time-invariant and unobservable and υ_{it} denotes the remainder disturbance where $\upsilon_{it} \sim i.i.d.(0, \sigma_{\upsilon}^2)$, [Frees, 2004].

TABLE 1
Coefficient Estimates for Determinants of Bank Robbery in the United States: 1990–2000

Explanatory Model	Classic OLS Model	Fixed-Effects Model	Random-Effects Model
Constant	0.877**		0.67
	(.035)		(.246)
LOOT	0.47E−06*	0.31E−06*	0.34E−06*
	(.000)	(.000)	(.000)
UR	0.85E−01***	0.100*	0.99E−01*
	(.083)	(.003)	(.002)
POLICE	−0.32E−01**	−0.44E−01***	−0.42E−01***
	(.040)	(.071)	(.052)
EDUC	0.17E−04	0.99E−04	0.97E−04
	(.914)	(.182)	(.191)
R^2	0.1890	0.8485	0.1890

The numbers in the parentheses are *p* values.
*Statistically significant at one percent.
**Statistically significant at five percent.
***Statistically significant at 10 percent.

If the model is estimated as a random-effects or an error components model, then μ_i denotes the random state-specific effect and is assumed to be independent of the remainder disturbance υ_{it}. Furthermore, the two components μ_i and υ_{it} are assumed to be i.i.d. with mean zero and variance σ_μ^2 and σ_υ^2, respectively [Arellano, 2003]. As suggested by Mátyás [1992, p. 47], "In the error components model the individual and time specificities are introduced in the model by error terms. This means that the heterogeneity is not incorporated into the model by the expected value of the endogenous variable (which is the case for fixed-effects model) but via its variance."

The panel data used to estimate the model consist of i cross-sectional units, where i=1, 2,..., 51 for the 50 states and the District of Columbia observed at each of t-time periods, t=1, 2,..., 11 (1990 through 2000). The results of statistical analysis are reported in the following section.

Empirical Results

The empirical model was estimated using ordinary least squares, the fixed, and the random-effects models. Given that there were 11 years of time-series data for each state, potential for the presence of serial correlation was of concern. The estimated Durbin–Watson statistic for the fixed-effects model was 1.36. For a one percent significance level, n=100, and k=5 independent variables, d_L=1.44 and d_U=1.65. Because the estimated D-W statistic was less than d_L, the null hypothesis of no autocorrelation was rejected. The Box

TABLE 2
Estimated Fixed Effects

Group	Coefficient	Standard Error	*t*-ratio
1. AL	0.109	0.670	0.163
2. AK	0.599	0.618	0.969
3. AZ	3.553	0.629	5.646
4. AR	−0.396	0.583	−0.679
5. CA	2.233	0.954	2.339
6. CO	1.158	0.676	1.714
7. CT	0.030	0.673	0.044
8. DE	0.787	0.702	1.121
9. FL	2.384	0.711	3.355
10. GA	0.193	0.751	0.257
11. HI	2.012	0.676	2.974
12. ID	−0.545	0.594	−0.917
13. IL	−0.473	0.782	−0.604
14. IN	0.637	0.527	0.209
15. IA	0.138	0.514	−0.268
16. KS	0.001	0.680	0.002
17. KY	0.002	0.584	0.004
18. LA	−0.562	0.894	−0.628
19. ME	−0.812	0.555	−1.462
20. MD	2.927	0.762	3.825
21. MA	1.003	0.734	1.366
22. MI	1.107	0.642	1.725
23. MN	0.364	0.498	0.732
24. MS	0.167	0.558	0.300
25. MO	0.004	0.617	0.006
26. MT	−0.929	0.562	−1.655
27. NE	0.592	0.540	1.096
28. NV	6.290	0.703	8.945
29. NH	−0.338	0.554	−0.610
30. NJ	−1.029	0.975	−1.055

TABLE 2 Continued

Group	Coefficient	Standard Error	*t*-ratio
31. NM	1.411	0.668	2.112
32. NY	−0.381	0.910	−0.419
33. NC	1.491	0.673	2.217
34. ND	−0.813	0.510	−1.594
35. OH	1.203	0.579	2.077
36. OK	−0.549	0.616	−0.890
37. OR	5.325	0.553	9.633
38. PA	0.311	0.597	0.522
39. RI	−0.471	0.719	−0.655
40. SC	0.824	0.654	1.259
41. SD	−0.527	0.468	−1.126
42. TN	1.055	0.628	1.681
43. TX	−1.002	0.688	−1.456
44. UT	0.661	0.569	1.162
45. VT	−0.629	0.500	−1.258
46. VA	0.791	0.630	1.255
47. WA	3.861	0.551	7.000
48. WV	−1.029	0.600	−1.714
49. WI	0.358	0.656	0.545
50. WY	−1.129	0.734	−1.539
51. DC	1.429	0.675	2.116

and Pierce Q test was carried out for up to third degree autoregression. The presence of higher degree autocorrelation was rejected, however.

In the presence of first-order autocorrelation ordinary least squares, estimates will be inefficient [Greene, 2000, p. 534]. In addition, Greene [2000, p. 539] suggested that, “Failing to account for autocorrelation when it is present is almost surely worse than accounting for it when it is not.” Therefore, the models were re-estimated using the Cochran–Orcutt transformation.[3]

Tables 1 and 2 present the estimation results when OLS, fixed-effects, and random-effects regressions were used. These results are remarkably similar across all three estimation methods: classic OLS, fixed-effects, and error components models. The robustness of the findings across all three estimation methods may suggest that the results reported in Tables 1 and 2 permit the identification of determinants of rate of bank robbery and are suitable for exploring broad policy implications.[4] The variable *POV* is not reported in Table 1 because it was not significant. Therefore, it was dropped from the model in the last round of estimations. Coefficients of all other variables are significant and of the right sign except for the coefficient of *EDUC* which is not significant. The joint significance of fixed-effects was tested using the *F* test discussed in Greene [2000, p. 562].[5] The joint fixed-effects were significant at better than the one percent significance level. This result suggests that a fixed-effects model is superior to a least squares model.

To test for the appropriateness of the error components model (i.e., to test for individual effects in the random-effects model), the null hypothesis $H_o : \sigma_\mu^2 = 0$ against the alternative, $H_a : \sigma_\mu^2 \neq 0$ was tested. Under the null hypothesis the Lagrange Multiplier test devised by Breusch and Pagan [1980] is distributed as a χ^2 with one degree-of-freedom. The calculated value of LM statistic was 1761.53 and the critical value for a one percent significance level was 6.635. The null hypothesis is rejected with a conclusion that the random-effects are significant. It needs to be determined if the fixed-effects or the random-effects model is appropriate, however. The Hausman test for fixed- vs. random-effects was carried out. Under the null hypothesis of no correlation between the random-effects and the regressors, the test-statistic is a chi-squared with four degrees-of-freedom. Calculated value of the test-statistic was 1.81 and the critical value for a chi-squared with four degrees-of-freedom and one percent significance level was 13.277 thus, the null hypothesis is not rejected. Because the LM test results are decisive that there are state effects and the Hausman test suggests that these effects are uncorrelated with the other explanatory variables in the model, the random-effects model is concluded to be the appropriate model here. All the statistical results were obtained by using the econometric software program LIMDEP – versions 7.0 and 8.0.

Conclusions and Policy Implications

The United States is currently facing a crisis of sorts. Criminal activity, including bank robbery has not disappeared from the scene, yet the nation's law enforcement resources are increasingly diverted to anti-terrorist activities. If the determinants of bank robbery can be identified, such information will be useful to policy makers in fashioning measures which may help to ameliorate the economic atmosphere and, hence, free resources for other law enforcement and security concerns.

The finding that poverty rate was not a significant explanatory variable for the rate of bank robbery may be due to the fact that women, children, and elderly constitute a large portion of the poor. However, according to the F.B.I., 76.56 percent of bank robbers were male and especially those in the 18–29 years age group [Federal Bureau of Investigation, 2002a, p. 310]. From the published data sources, it was not possible to identify the poverty rate for the group prone to committing this crime. Instead, the poverty rate for the entire population was used. Not surprisingly, lack of significant explanatory power was discovered. Similarly, in this framework, for the variable education (EDUC) to reflect the opportunity cost to those who engage in this type of criminal activity, the education level of the 18 to 29 year males would have been a more appropriate predictor. Again, because of data limitation the educational attainment of the entire population for those 24 years and older were used. Perhaps, the correlation between these two data series was not high enough to allow testing this important element of economic cost to the perpetrators. Understanding the significance of this variable helps in advocating social and economic policies that are geared toward this segment of population in order to reduce incidences of bank robbery. Therefore, because of its theoretical significance and the possible policy implication, the variable EDUC was not dropped out of the reported models. Improved databases may allow future studies to test the significance of this variable.

The findings indicate that the unemployment rate is a significant determinant of bank robbery. As hypothesized, an increase in the unemployment rate increases the rate of bank robbery. The standard economics of crime interpretation for this result is that as there is diminution of legitimate sources of income, the opportunity cost of illegitimate pecuniary gains declines. Hence, as unemployment increases, then bank robbery becomes less costly to potential offenders. An economic policy that aims to lower the unemployment rate has the positive externality of reducing the crime of bank robbery.

The results also show that the variable *POLICE*, police to population ratio, is significant and negatively associated with bank robbery. Again, the economics of crime literature suggests that as resources devoted to police protection increase, crime should diminish. Raising the costs of crime by increasing the probability of punishment through strengthening the ranks of law enforcement officers, can serve as a significant deterrent.

Gaining access to the loot as a result of bank robbery is at least one significant motivation for the bank robbers. While psychological impulses might drive some bank robbers or be part of the reason for most bank robbers who commit this crime, those impulses, however, are not measurable. In the absence of such systematic means of data gathering, economic incentives provide the best estimate of determinants of bank robbery in the US for this time period.

In sum, the findings of this study lend support to the basic premises of the rational choice model when analyzing crime of bank robbery. The fact that all the variables representing the costs and benefits associated with bank robbery entered the estimated model with the theoretically expected signs verifies the applicability of the model to this problem. The most serious hurdle in this analysis, however, is data limitations. Improvement in availability of state-wide data from demographic to economic and crime statistics is necessary if reducing incidents of bank robbery is to be achieved.

Footnotes

[1] Minimum security requirement standards require (1) an alarm in all offices, (2) bait money (Federal Reserve notes with serial numbers and years recorded), (3) bullet resistant glass in walk-up and drive-up windows, (4) a designated security officer, (5) a security program, (6) inspection of the bank prior to opening and closing, and (7) minimum currency requirements.

[2] Bank robbery is a federal crime, US Bank Robbery Act, 48 Stat. 783 et seq. which results in the punishments for the crime being the same across all of the 50 states due to Federal Sentencing Guidelines, see 18 Title 2113 for further discussion.

[3] $Y_{it} - \rho Y_{it-1} = \beta'(X_{it} - \rho X_{it-1}) + \mu_i(1-\rho)\eta_{it}$

where

$$\varepsilon_{it} = \rho\varepsilon_{it-1} + \eta_{it}$$

[4] It can be conjectured that log transformation of the data can alleviate a possible heteroskedasticity problem. Therefore, in addition to estimating the models using level data, the models were estimated using the natural logarithms of the data. However, the results remained robust to this data transformation as well. That is, all of the variables that were found to be

significant (not significant), with the appropriate signs, remained significant (not significant) in these estimations.

[5] The F ratio test statistic is:

$$F(n-1, nt-n-K) = \frac{\left(R_u^2 - R_p^2\right)/(n-1)}{\left(1-R_u^2\right)/(nt-n-K)}$$

where u indicates unrestricted model and p for pooled or restricted model with a single overall constant term. Also, n represents number of cross-sectional units, t time periods, and K the number of regressors.

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