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Steven D. Levitt: 2003 John Bates Clark Medalist

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Steven D. Levitt, winner of the 2003 John Bates Clark medal, writes papers that capture the reader's attention and never let it go. Who can resist reading about topics as varied and intriguing as how installing auto security systems affects the crime rate, whether some contests in professional sports are rigged, the extent to which teachers cheat by modifying their students' answers on standardized tests, and how drug gangs are organized? Steve's research tackles economic issues that appeal broadly to social scientists. It focuses on fundamental issues in economics, many of which overlap with other disciplines, and it exploits clever and often subtle identification strategies to tease important insights from changes in the economic environment. Even though Steve's research strategy is often complex and sophisticated, his conclusions, which are often strong and provocative, can usually be summarized in a few sentences. Steve's work expands the boundaries of economics, demonstrates the power of economic analysis and enhances our understanding of key economic issues.

Steve began his study of economics as an undergraduate at Harvard, where he displayed an early talent for independent research. His senior thesis, which tried to detect rational bubbles in the pricing of thoroughbred race horses, won a prize as the year's best. Another undergraduate research project, a term paper on why the party of the incumbent president tends to lose seats in the House of Representatives at the midterm election, became Steve's first publication. Steve spent two years after graduating from college working as an economic consultant. His experiences convinced him of the practical applicability of economic theory and econometrics and led him to pursue graduate study.

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Steven D. Levitt

Steve entered the Ph.D. program at MIT in the fall of 1991. He was involved in writing and publishing research papers from the start of his graduate school career. I met Steve a few weeks after he arrived at MIT, when he visited my office to ask for advice about responding to a referee's comments on his paper about congressional elections. I was intrigued by this first-year student who had already received a "revise and resubmit" from an academic journal. I have enjoyed and learned from every moment of our professional interaction since then.

When Steve started graduate school, he planned to specialize in economic theory. Although his undergraduate mathematical training was limited to a calculus course, Steve embarked on a crash program to acquire technical skills. By his second year at MIT, Steve had honed his theory skills, and he wrote a publishable contract theory paper. Yet Steve concluded that his comparative advantage lay in studying more applied problems. He therefore turned his research attention to a range of interesting and important empirical questions and never looked back. Steve's command of economic theory is nevertheless evident in much of his empirical research.

Steve wrote several interesting papers in the field of political economy during his first two years at MIT, and he completed his doctoral dissertation in only three years. After receiving his Ph.D., Steve spent three years as a postdoctoral fellow at Harvard University's Society of Fellows, a distinguished group of young scholars drawn from a wide range of disciplines. He developed interesting interdisciplinary contacts during this time. In 1997, when his postdoctoral fellowship came to an end, Steve joined the faculty at the University of Chicago, where with the exception of a one-year fellowship at the Center for Advanced Study in Behavioral Sciences at

Stanford, he has been ever since. Steve currently holds the Alvin H. Baum Professorship of Economics. He is also a Research Fellow of the American Bar Foundation and a Research Associate at the National Bureau of Economic Research.

Steve's Clark Medal citation mentions his path-breaking contributions to the economics of crime and to the political economy of campaign finance. This paper describes Steve's research in each of these areas, as well as his contributions on a range of other topics. It identifies the substantive themes as well as the methodological patterns that run through Steve's research, and it describes the economic issues that have been informed by his analysis.

This paper is divided into four sections. The first considers Steve's work on the economics of crime, including his work on how public policies affect criminal activity and on the explanation of changing crime rates over time. The second focuses on Steve's research in political economy, which explores the determinants of electoral success with particular emphasis on the role of campaign finance. The third section describes four studies that Steve has carried out on a range of other interesting topics, ranging from strategy choice in professional soccer to the fraction of drivers who drive drunk. There is a brief conclusion. For ease of reference, Table 1 lists the selected papers by Steve that are referenced in my discussion, and the discussion refers to those papers by number.

The Economics of Crime

Theoretical and empirical analysis of criminal activity has a long and distinguished history within the field of economics. In his careful survey on this subject, Ehrlich (1996) observes that Adam Smith, William Paley and Jeremy Bentham all wrote about the factors that lead to criminal activity and tried to understand the factors that determine the level of illegal activity. Many of the contemporary studies of the economics of crime were stimulated by Becker's (1968) neoclassical analysis of criminal behavior and by Stigler's (1970) study of optimal law enforcement.

Steve's contribution to our understanding of the economics of crime consists of a collection of careful empirical studies that tackle central questions about the determinants of criminal behavior. These studies often address long-standing difficulties in the assignment of causal patterns. Steve's work has catalyzed an empirical renaissance in the economic analysis of crime. One strand of Steve's work has focused on how public policies affect criminal activity. This research has advanced long-standing debates about the roles of incapacitation and deterrence. A second has explored the social and economic factors that lead individuals to engage in crime. A third strand of research has analyzed the determinants of corruption in various settings and raised new issues about the determinants of criminal behavior and the presence of law-breaking in nonstandard environments.

Deterrence, Incapacitation and the Effect of Law Enforcement on Criminal Activity

The impact of crime-prevention efforts, such as government spending on prisons and police and private spending on security systems, is a subject of long-

Table 1
Selected Papers by Steven D. Levitt

1. "The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation," *Quarterly Journal of Economics,* 111:2, pp. 319–52, May 1996.
2. "Using Sentence Enhancements to Distinguish Between Deterrence and Incapacitation," *Journal of Law and Economics,* 42, pp. 343–63, with Daniel Kessler, April 1999.
3. "Juvenile Crime and Punishment," *Journal of Political Economy,* 106:2, pp. 1156–185, December 1998.
4. "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime," *American Economic Review,* 87:3, pp. 270–90, June 1997.
5. "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime: Reply," *American Economic Review,* 92:4, pp. 1244–250, September 2002.
6. "Measuring the Positive Externalities from Unobservable Victim Precaution: An Empirical Analysis of Lojack," *Quarterly Journal of Economics,* 113:1, pp. 43–77, with Ian Ayres, 1998.
7. "The Exaggerated Role of Changing Age Structure in Explaining Aggregate Crime Changes," *Criminology,* 37, pp. 537–99, August 1999.
8. "Understanding Why Crime Fell in the 1990s: Four Factors That Explain the Decline and Six That Do Not," *Journal of Economic Perspectives,* 18:1, pp. 163–90, Winter 2004.
9. "The Impact of Legalized Abortion on Crime," *Quarterly Journal of Economics,* 116:2, pp. 379–420, with John Donohue, May 2001.
10. "Further Evidence that Legalized Abortion Lowered Crime: A Reply to Joyce," *Journal of Human Resources,* 39:1, pp. 29–49, with John Donohue, 2004.
11. "Winning Isn't Everything: Corruption in Sumo Wrestling," *American Economic Review,* 92:5, pp. 1594–605, with Mark Duggan, December 2002.
12. "Rotten Apples: An Investigation of the Prevalence and Predictors of Teacher Cheating," *Quarterly Journal of Economics,* 118:3, 843–77, with Brian Jacob, 2003.
13. "Catching Cheating Teachers: The Results of an Unusual Experiment in Implementing Theory," in W. Gale and J. Pack, eds., *Brookings-Wharton Papers on Urban Affairs 2003,* Washington: Brookings Institution, pp. 185–209, with Brian Jacob, 2003.
14. "An Empirical Test of Competing Explanations for the Midterm Gap in the U.S. House," *Economics and Politics,* 6:1, pp. 25–38, 1994.
15. "Decomposing the Sources of Incumbency Advantage in the U.S. House," *Legislative Studies Quarterly,* 22:1, pp. 45–60, with Catherine D. Wolfram, 1997.
16. "The Impact of Federal Spending on House Election Outcomes," *Journal of Political Economy,* 105: 1, pp. 30–53, with James Snyder, 1997.
17. "Using Repeat Challengers to Estimate the Effect of Campaign Spending on Election Outcomes in the U.S. House," *Journal of Political Economy,* 102:4, pp. 777–98, 1994.
18. "How Do Senators Vote? Disentangling the Role of Party Affiliation, Voter Preferences, and Senator Ideology," *American Economic Review,* 86, pp. 425–41, 1996.
19. "Comparing Interest Group Scores Across Time and Chambers: Adjusted ADA Scores for the U.S. Congress," *American Political Science Review,* 93, pp. 33–50, with Timothy Groseclose and James Snyder, March 1999.
20. "An Economic Analysis of a Drug-Selling Gang's Finances," *Quarterly Journal of Economics,* 115:3, pp. 755–89, with Sudhir Venkatesh, 2000.
21. "The Effect of School Choice on Student Outcomes: Evidence from Randomized Lotteries," NBER Working Paper No. 10113, with Julie Cullen and Brian Jacob, 2003.
22. "The Impact of School Choice on Student Outcomes: An Analysis of the Chicago Public Schools," *Journal of Public Economics,* 89:5/6, pp. 729–760, with Julie Cullen and Brian Jacob, June 2005.
23. "A Test of Mixed Strategy Equilibria: Penalty Kicks in Soccer," *American Economic Review,* 92:4, pp. 1138–151, with Pierre Andre Chiappori and Timothy Groseclose, September 2002.
24. "How Dangerous are Drinking Drivers?," *Journal of Political Economy,* 109:6, pp. 1198–237, with Jack Porter, December 2001.

running empirical controversy. Many studies have explored this issue, but most have faced a fundamental empirical difficulty. The crime rate is affected by law enforcement conditions, but it may also affect those conditions. If the crime rate in an area is high, police may maintain a greater presence there than in intrinsically safer areas, and private security outlays may be higher in the high-crime area than in other places. For this reason, a simple-minded regression in which law enforcement activity is treated as a determinant of the crime rate may show a misleading positive correlation. Researchers studying the effect of crime prevention efforts on crime rates have struggled to find ways to identify causal effects and have long recognized that a positive correlation between crime rates and the level of police protection cannot be interpreted as a causal relationship.

Steve found a number of clever and convincing identification strategies to address this question. One of his first papers on the economics of crime, his 1996 *Quarterly Journal of Economics* paper [1] on "The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Legislation," offers a vivid illustration. Previous research on prisons and crime recognizes two channels through which longer prison stays and higher rates of incarceration can reduce the crime rate. One channel is incapacitation: longer average prison stays prevent criminals from committing crimes by keeping them off the street. The other channel is deterrence: longer and more certain prison terms raise the costs that prospective criminals must balance against the benefits of criminal activity. These channels are difficult to evaluate separately, because sentence lengths and conviction rates are correlated in complex ways with a state or a community's aggregate crime rate. A high-crime location will typically generate more prison-years of incarceration than a low-crime one. However, this positive association between the prison population and the crime rate is not due to the incentive effects of prison terms on criminal activity. Alternatively, if some "anticrime" communities tend to be tough on criminals, work hard to solve crimes and apply longer prison terms to those who are convicted, such communities may have higher rates of imprisonment and lower crime rates than communities that are more tolerant of crime. This pattern could induce a negative correlation between prison time and crime rates that is not the result of behavioral response on the part of criminals.

To develop new insights on the causal relationships between prison time, incarceration rates and crime rates, a researcher would like to find changes in a jurisdiction's prison population or in its typical prison term that are not attributable to any of the confounding factors described above. Steve focuses on one such source of variation: court-imposed changes in prison populations. These changes are typically the result of suits brought under prison overcrowding legislation. Steve argues that these suits are exogenous shocks to the number of criminals held in correction facilities, in part because there are long and unpredictable delays between filing and resolution of these suits. Using these shocks as instrumental variables, he finds powerful evidence that the size of the prison population has a negative effect on the level of crime in a state. His estimates suggest that a 10 percent rise in the prison population is associated with a 4 percent decline in violent crime and a 3 percent decline in property crime. These estimates are several

times larger than ordinary least squares estimates, and they are substantially greater than conventional estimates. When these parameter values are combined with standard estimates of the costs of crime they suggest that the marginal social benefit of an additional prison-year in the 1990s was approximately $50,000, compared with a marginal cost of incarceration of roughly $30,000. The prison population has increased since these estimates were compiled, so the marginal benefit today is probably lower, but estimates of this type remain a critical input to the design of public policy. This important paper not only offers new estimates of the marginal effect of imprisonment on crime, but it also suggests a new research strategy for identifying key relationships in the economics of crime.

The relative importance of deterrence and incapacitation is a central issue in the economics of crime, and Steve investigates this issue further in two subsequent papers. Steve's 1999 paper with Daniel Kessler [2] on "Using Sentence Enhancements to Distinguish between Deterrence and Incapacitation" examines the impact of Proposition 8, a change in the California penal system that imposed mandatory increases in the prison time served by criminals who were convicted of particular offenses. Because these enhancements only apply to convicted criminals, who would be in prison anyway right after their conviction, the enhancements should not have any short-run incapacitation effect. Yet the paper finds a substantial decline in crime when sentence enhancements took effect. The decline is evident for crimes that were affected by the enhancements and not for others. This result offers strong support for the importance of deterrence. The other related paper is Steve's 1998 *Journal of Political Economy* paper [3] on "Juvenile Crime and Punishment." This paper observes that between the late 1970s and the early 1990s, the relative severity of criminal punishments for juvenile offenders declined sharply relative to those for adult offenders. During the same time period, the juvenile crime rate rose sharply relative to the adult crime rate. Steve concludes that juveniles are at least as sensitive to expected punishments as their adult counterparts and that these punishments can have an important effect on juvenile crime rates.

In a second strand of research on public policy and crime prevention, Steve examines the productivity of police in reducing crime. His 1997 *American Economic Review* paper [4] on "Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime" brings a novel identification strategy to this long-standing question. This paper starts by documenting a strong relationship between the timing of mayoral elections and police force growth in large U.S. cities. On average, mayors who are running for re-election expand police employment. Whether this pattern is due to mayors' perception that voters value police on the beat or mayors' desire to display a commitment to expand public employment, or both, is not clear. The critical point is that mayoral elections provide an arguably exogenous source of variation in police employment. Steve develops an instrumental variable strategy to relate the reported rate of violent crime to election-induced variation in the size of the police force. Other studies, such as Kubik and Moran (2003), have extended the use of electoral cycles as instrumental variables for the size of public sector programs.

Steve's paper on electoral cycles and police employment suggests that expanding the police force reduces the violent crime rate. While these findings have attracted substantial attention, subsequent research suggests that they were partly the result of a computer programming error that arose in differentially weighting data from different crime categories. The motivation for weighting data on different types of violent crime differently is that when the underlying crime rate varies across types of crime, there is more statistical uncertainty in the estimate of the crime rate for low-rate violent crimes, such as murder, than for high-rate crimes, such as robbery. When crime rates for several different crimes are studied simultaneously, and the residual variances of these crime rates differ, efficient estimation involves placing less weight on observations associated with more variable crimes than on those that are measured more accurately. Yet McCrary's (2002) replication study shows that Steve's published findings inadvertently weight data on rare violent crimes more than data for relatively frequent violent crimes. Many of the statistically significant findings in paper [4] are attenuated when the weighting error is corrected, largely because the estimated standard errors for the regression coefficients increase. Most of the point estimates for the regression coefficients are similar in the two weighting schemes.

Steve's response [5] to McCrary is a model of the advance of academic dialogue and the recognition that replication plays an important part in empirical research. Steve not only acknowledges the programming error that resulted in the difference between the original results and the results that flowed from correct implementation of the weighting procedure, but he praises McCrary for "his careful work that has laid bare these errors" (p. 1244). He then offers several additional empirical tests that use variables other than the electoral cycle to construct instrumental variables for identifying exogenous fluctuations in the size of a city's police force. He uses the number of public sector employees in fire departments and highway departments to capture broad variation in public sector employment, and he finds a stronger effect of police on crime than in his incorrectly weighted initial results. Many researchers become defensive when their findings are challenged. Steve took the discovery of a programming error as an opportunity to praise the importance of replication in empirical work and to extend his original analysis.

The third strand of Steve's research on crime prevention, which focuses on private rather than public law enforcement, is his 1998 joint paper with Ian Ayres [6] on "Measuring the Positive Externalities from Unobservable Victim Precaution: An Empirical Analysis of Lojack." This paper estimates the social returns to a particular type of private law enforcement expenditure. Private security outlays can have both positive externalities, as when one person's security guard catches a burglar who might have burgled other properties, and negative ones, as when a security guard at one property induces a burglar to target another unguarded property. Private security outlays may redistribute crime across victims without affecting the overall crime rate.

This paper examines the net externalities from making a particular vehicle recovery system, Lojack, available in a city. Lojack helps police locate a stolen vehicle, often quickly enough to apprehend the auto thief. The empirical analysis

reports the change in vehicle theft rates around the dates when Lojack receives regulatory approval to operate in a city. The findings suggest substantial declines in aggregate rates of vehicle theft, consistent either with a substantial deterrent effect or with more successful police apprehension of car thieves. The findings could also be consistent with displacement of auto theft to other localities, without Lojack, but the paper finds no evidence for such an effect. Since Lojack is not visible to the thief, it is unlikely that the negative externalities within a locality that are associated with some forms of private security expenditure would develop in this setting.

The paper recognizes that a key issue for interpreting the findings is whether changes in Lojack's availability can be treated as exogenous. If regulatory approval of Lojack coincides with other public or private programs to reduce vehicle theft, then the effect attributed to Lojack could be due to other omitted variables. There is no evidence, however, that police resources were reallocated from fighting other crimes to focusing on auto theft at around the time of Lojack approval. The authors also search for, but fail to find, evidence that auto theft rates were falling prior to Lojack approval in cities that ultimately approved this technology. This study is likely to stimulate further analysis and thought about private security outlays and the interesting externality issues associated with such security spending.

Explaining Long-Term Crime Trends

Aggregate crime rates in the United States rose throughout the 1970s and 1980s. Then, during the 1990s, both violent and property crime rates fell by nearly one-third. The explanation for these trends has attracted substantial interest in criminology and sociology as well as economics. Steve's research on how public and private policies affect crime offers valuable insight on this issue. His estimates of the marginal impacts of longer prison terms or expanded police activity can be combined with estimates of changes in these policy levers to attribute some of the changes in crime to these factors. In other work, however, Steve tries to attribute changing crime rates to other component factors. For example, in his 1999 *Criminology* paper [7], Steve suggests that demographic factors cannot explain more than one-sixth of the decline in crime rates during the 1990s. The crime-reducing effect of the passage of the baby boom cohort through the high-crime years of the late teens and early twenties during this period was partly offset by the changing racial mix of the U.S. population. Steve draws together various elements of his own research, and that of others, in his 2004 *Journal of Economic Perspectives* paper [8] on "Understanding Why Crime Fell in the 1990s." This paper downplays the contributions of economic growth, new policing practices, demographic change and gun laws in contributing to lower crime rates. It emphasizes four important contributory factors: longer and more certain prison terms, expansion of police forces, reduction in the prevalence of crack cocaine usage and legalized abortion. Steve's research on the last factor is among his best known and most controversial work.

Steve's joint paper [9] with John Donohue on "The Impact of Legalized Abortion on Crime" appears in the 2001 *Quarterly Journal of Economics*. In the four years since its publication, it has been discussed widely and sometimes critically, attracted several comments and extensions and exposed its authors to many attacks.

It has also stimulated a growing literature on the economic effects of legalized abortion. The paper documents a striking correlation between cross-state variation in abortion rates in the early 1970s and the rate at which young adults committed crimes in the early 1990s. It suggests that children who are born from pregnancies that proceed to term when abortion rates are low, as they were when abortion was illegal, but that terminate with abortion when abortion rates are higher, have an above-average likelihood of subsequent criminal behavior. These children have an enhanced probability of exhibiting attributes such as low birth weight and of being raised in conditions of childhood poverty. Both factors are positively correlated with criminal activity as young adults. Earlier studies, such as Gruber, Levine and Staiger (1999), provide strong support for such links. The Levitt-Donahue paper takes the additional step of suggesting that the abortion rate affects the size of the criminally inclined population in later decades and thus the overall crime rate. The authors explain (p. 415) that "our drawing a link between falling crime and legalized abortion should not be misinterpreted as either an endorsement of abortion or a call for intervention by the state in the fertility decisions of women."

The paper exploits a straightforward identification strategy based on state heterogeneity. Abortion was legalized in five states, including California and New York, around 1970. The U.S. Supreme Court's landmark *Roe v. Wade* (410 U.S. 113) decision in 1973 did not substantially affect access to abortions for residents of these states. It did affect abortion access virtually everywhere else. Abortion rates were higher in the mid-1970s in states where abortion had been legal for longer, but many other factors also contributed to cross-state differences in abortion rates. While crime rates for states with high and low abortion rates are similar for nearly 15 years after *Roe v. Wade,* the crime rates in these two groups of states begin to diverge in the late 1980s. This pattern suggests a potential link between abortion rates and subsequent criminal activity, since age-specific crime rates peak between the ages of 18 and 24. The divergence in crime rates in these two groups of states is robust to the inclusion of control variables for many other determinants of crime rates. Arrest data, which provide information on the age of the arrestee, offer particular support for the link between legalized abortion and crime. The arrest rate in the early 1990s is higher among those who were born before their state of birth legalized abortion than among those who were born subsequently. The empirical results suggest that legalized abortion in the 1970s, and the associated changes in abortion rates, could explain almost half of the decline in aggregate crime rates in the 1990s.

This paper's strong conclusions have drawn other scholars to this question. Joyce (2004a), who is sharply critical, argues that lagged state experience with legalized abortion is collinear with the evolution of the crack cocaine epidemic in the late 1980s and that this epidemic, rather than prior abortion policy, explains the time series pattern of state-specific crime rates. Using data from the late 1980s, he shows that adding controls for the level of crack cocaine use in a state sharply attenuates the estimated coefficient on lagged abortion rates. Steve and John Donohue respond [10] by showing that estimating Joyce's statistical models using a longer sample period generates results that reinforce their original findings. The

historical abortion rate variable remains a statistically significant explanatory factor for crime rates even after controlling for measures of crack cocaine use.

Ongoing research continues to explore new strategies for analyzing the link between abortion rates and crime rates, as well as other factors that may influence crime rates. Joyce (2004b) examines black-white differences in crime rates to provide additional evidence on the link between abortion rates and crime rates. Reyes (2004) investigates whether a decline in the presence of environmental lead that followed the elimination of lead additives in gasoline in the early 1970s resulted in fewer developmentally challenged children with a higher-than-average likelihood of criminal activity in later life. Sen (2003) estimates the effect of abortion rates on crime using Canadian data and finds results broadly similar to those from U.S. models.

Corruption

Steve has also explored the measurement and determinants of corruption in various settings. His innovative papers in this area have attracted attention within, as well as outside, the field of economics. One such paper is his 2002 *American Economic Review* study with Mark Duggan [11] on "Winning Isn't Everything: Corruption in Sumo Wrestling." This study finds evidence of a subtle form of collusion between professional Japanese sumo wrestlers. The reward structure in competitive sumo wrestling tournaments, which involve 15 matches, is nonlinear. There is a substantial payoff to winning at least eight matches. In the last match of a tournament, therefore, there are matches that pit a wrestler with a 7-7 record and much to gain from winning against a wrestler with a winning or losing record for whom the match is largely irrelevant. This paper demonstrates that the wrestlers with much to gain in this situation win these matches as much as 15 percent more often than when they face similar wrestlers in less critical situations. The authors then suggest that at least part of this increase in the win percentage for the 7-7 wrestler may be due to cooperation by the losing wrestler, who loses to help the victor's win record. Some former sumo wrestlers have made allegations about the presence of such collusion.

There are other potential explanations of the empirical finding, such as the possibility that the 7-7 wrestler tries harder when the stakes are high, and the paper tries to evaluate these possibilities. When contestants who met when one was in a 7-7 situation meet again, and the stakes are different, the wrestler who won when his incentives were strong is more likely to lose than to win. The paper interprets this as evidence of collusion between wrestlers: the subsequent loss by the 7-7 wrestler is a payback for the earlier loss by the wrestler who had less to gain in the final tournament match. Moreover, when the media are covering a match, the differential in the win probability for the 7-7 wrestler disappears—which suggests that public scrutiny may reduce the degree of collusion. The losing wrestler in the high-stakes match is also more likely to win the next time he faces a wrestler from the same *team* as the winning wrestler, even if he does not face the winning wrestler himself. This may suggest patterns of collusion across teams rather than just across individuals. This paper offers an ingenious measure of potential corruption and

yields results that bear on much broader issues than sumo wrestling, such as the role of media oversight in combating corruption.

Steve has also collaborated with Brian Jacob to study corruption in the Chicago public schools. Two papers, "Rotten Apples: An Investigation of the Prevalence and Predictors of Teacher Cheating" [12] and "Catching Cheating Teachers" [13] offer compelling evidence that teachers sometimes cheat to boost their students' scores on standardized tests. The papers develop novel strategies for detecting cheating. These include examining changes in scores for a student or class over time and focusing on the pattern of correct and incorrect answers on a given exam. Answer sheets that display no errors in one part of the test, and many errors in most others, may indicate that a teacher has "corrected" answers in one area. When students show a similar probability of correctly answering easy and difficult questions, there is also a heightened probability of teacher "correction." The findings in [12] suggest that at least one teacher in 20 in the Chicago public schools engaged in systematic cheating on behalf of their students. The Chicago public schools acted on these findings and retested a subsample of the classes that were identified as likely to have been manipulated, as well as a subsample of classes for which there were no such concerns. These retests were administered by external proctors rather than classroom teachers. The retests revealed much weaker performance by students in the suspect classrooms [13] and roughly the same performance by students in classrooms that were not suspected of cheating. These papers address the behavioral effects of an important policy trend, the growing use of high-stakes testing to reward teachers. They also sound a general alarm about the use of high-powered incentives in settings like public schools and underscore the need for safeguards to detect teacher cheating. More generally, the findings offer lessons about the behavioral response of economic agents whose pay depends on the outcome of a monitoring technology that is subject to manipulation.

Political Economy

Steve's second primary field of study is political economy. Like the economics of crime, this subfield of economics has a long and distinguished tradition. The role of political institutions in allocating resources and the determinants of electoral outcomes in representative democracies have been studied by generations of both economists and political scientists. In the last century, key contributions by Downs (1947), Buchannan and Tullock (1962) and many others helped to lay the theoretical groundwork for the field of political economy. Today, surveys in volumes like Persson and Tabellini (2000) offer extensive empirical and theoretical research on a wide range of topics.

Steve's contributions to the field of political economy can be divided into two categories. One line of research offers important insights on the determinants of electoral success, with particular emphasis on campaign spending, and explores why incumbents are so successful in defeating challengers. The second line of research focuses on the measurement of voting behavior by elected officials and in

particular the ranking of legislators on a liberal-to-conservative spectrum. Both of these research programs address central issues in political economy.

The Determinants of Electoral Success

Steve's interest in the factors that influence the success of political candidates began when he was an undergraduate. His early political economy papers examine electoral races for the U.S. House of Representatives. His 1994 paper [14] on "Competing Explanations for the Mid-term Gap in U.S. House of Representatives Elections" tries to understand a well-documented tendency for the party of the incumbent president to lose seats in the House at the midterm election. The paper suggests that the loss of coat-tail effects from the party's presidential candidate, coupled with voters' desire to signal discontent with the incumbent president's decisions, can explain most of this pattern. Steve showed me a version of this paper in early 1994. It included an audacious prediction that the Republican Party would gain control of the House of Representatives in the 1994 midterm elections, an event that appeared at the time to be highly unlikely. I argued that such a prediction was likely to be incorrect, and I persuaded Steve that publishing the paper with this prediction would forever detract from it. Steve removed his prediction from the text, and we bet a pizza on the 1994 House electoral outcome. Steve won the pizza when the Republicans swept to control of the House, and I have always suspected that my advice cost Steve the opportunity to be acclaimed as one of the foremost political seers of our time.

Steve has focused his research on the U.S. Congress. His 1997 paper [15] with Catherine Wolfram, "Decomposing the Sources of Incumbency Advantage in the U.S. House," explores alternative explanations for the growing success of incumbent congressmen seeking re-election. The paper suggests that incumbency advantage is best explained by focusing on the early stages in the electoral process, particularly on the behavior of the incumbent's potential electoral opponents. In recent years, the quality of the candidates opposing incumbents has declined according to various metrics. While the paper does not explain why challengers have become weaker, it adds an important dimension to the analysis of incumbency advantage by focusing on the behavior of potential challengers. This study also suggests that the value of media access and other direct officeholder benefits available to incumbents has remained reasonably stable over time.

One factor that might explain why incumbents are overwhelmingly re-elected is their ability to claim credit for directing federal spending to their district. Whether such spending has quantitatively significant effects is essential for evaluating distributive politics models of the coalitions that support public spending. In a 1997 *Journal of Political Economy* paper with James Snyder [16] on "The Impact of Federal Spending on House Election Outcomes," Steve tests whether targeted government spending affects the re-election success of incumbent congressmen. Most previous research on government spending and electoral success is potentially confounded by the endogeneity of spending patterns. Elected officials who are more successful at attracting spending to their district may also be more successful at many other things, such as campaigning for re-election and energizing their

supporters to vote. This pattern could generate a positive correlation between spending in a district and the re-election success of the incumbent that is not due to an effect of spending on electoral outcomes. However, paper [16] argues that government spending is likely to exhibit cross-district spillovers, so that when one legislator attracts federal money to her district, the legislators who represent adjacent districts will also benefit to some degree. The empirical evidence in this paper suggests that incumbents in districts that are adjacent to those with substantial spending have better re-election prospects than those without such adjacent districts. Critics might argue about the magnitude of spillover effects and about whether the legislator from the district which receives the federal money will be more successful than the legislators from adjacent districts in claiming credit for the spending program. While the empirical strategy does not solve these challenges, it nevertheless offers suggestive evidence that government spending with local benefits may have important electoral effects.

Steve's interest in explaining electoral outcomes has also included analysis of the role of campaign finance. Concern that financial resources can be used to tilt electoral outcomes is long-standing and has led to calls for public financing of elections or for regulations on private campaign spending. Steve's 1994 *Journal of Political Economy* paper [17] on "Using Repeat Challengers to Estimate the Effect of Campaign Spending on Election Outcomes in the U.S. House" offers interesting new evidence on how campaign spending affects electoral outcomes. Previous empirical research on the spending-voting relationship has been confounded by the fundamental endogeneity of candidate financial resources. On average, more popular candidates are better at raising money. They may also be better at building campaign organizations, at convincing voters to support them, and at other dimensions of the campaign process. A positive relationship between spending and electoral success may simply reflect the positive correlation of both variables with unmeasured candidate quality.

This paper [17] analyzes data on repeat trials in elections for seats in the House of Representatives—elections in which the same two candidates face each other more than once. Steve compares spending levels and votes received for each candidate in each election. The results suggest a very small effect of campaign spending on vote outcomes. This first differences approach is an attractive solution to the problem of unobserved candidate quality, provided such quality remains constant over time. As with so many other identification strategies, however, the validity of this assumption is open to debate. One reason why a defeated challenger may choose to rechallenge an incumbent is precisely because the incumbent's quality has been diminished in some way, for example by scandal. In this case, the coefficient on the challenger's spending would be biased upward, and that on the incumbent would be biased down. Debating these issues is left to future research. This paper's important contribution is its clever strategy for moving beyond past studies that report simple correlations between spending patterns and electoral outcomes. Moreover, this paper focuses the debate on the effects of campaign spending on central issues of identification that will have to be addressed in future work.

Voting Behavior of Elected Legislators

Steve's research in political economy has also explored the behavior of elected officials. Unlike much of his empirical work, which offers novel identification strategies for tackling difficult problems of endogeneity or reverse causation, in this research Steve relies on theoretical assumptions to advance his data analysis. An *American Economic Review* paper [18] on "How Do Senators Vote? Disentangling the Role of Voter Preferences, Party Affiliation, and Senator Ideology" offers a strategy for evaluating the relative importance of different factors that may affect legislators' voting behavior. The paper focuses on U.S. senators because it is possible to obtain information on the policy preferences of their constituents by studying the voting behavior of their state's delegation to the House of Representatives. Under the assumption that each senator has a time-invariant fixed effect that describes his or her ideology over a two-decade period and by imposing a particular functional form on the objectives of each senator, Steve evaluates the relative importance of the senator fixed effect, constituent preferences, and the preferences of the senator's party in explaining voting outcomes. The ideology fixed effect appears to be the most important factor in explaining voting patterns. Constituent preferences only account for about one-quarter of the variation in voting outcomes.

Steve also explores voting patterns in his 1999 study [19] with Timothy Groseclose and James Snyder on "Comparing Interest Group Scores Across Time and Chambers." This methodological paper tackles a difficult empirical issue that has plagued many studies in political science: how does one compare the ideology of elected officials? When the officials vote on the same bills, one can rely on a number of metrics, such as the vote scores offered by the Americans for Democratic Action and the American Conservative Union. But simple comparisons break down if one tries to compare a Senator with a member of the House of Representatives, or if one tries to compare Senators who serve at different times. The vote scores in different years or legislatures are not comparable because officials confronted different voting options. By making explicit assumptions about the voting behavior of elected officials, and by assuming that the underlying preferences of each legislator in each year can be described by a long-term fixed effect plus a year-specific error term, the authors develop a procedure for comparing vote scores in different years. This insightful paper offers empirical researchers a way to enhance the usefulness of standard measures of legislator ideology.

The Wide World of Economics

Steve has used the tools and insights of economics to analyze institutions or behavior in many other interesting settings, often at the border between economics and other social sciences. Dubner's (2003) profile of Steve and his many interests, and Levitt and Dubner's (2005) best-selling book *Freakonomics*, offer insight on how Steve identifies promising topics and then carries out research. This section illustrates Steve's broad reach by describing his work on four diverse topics: drug-selling gangs, school choice, strategic behavior in professional soccer and the fatality risk of drinking drivers.

One of Steve's most interesting studies, and certainly the one with the most difficult-to-obtain data, is his joint paper [20] with ethnographer Sudhir Venkatesh on "An Economic Analysis of a Drug-Selling Gangs Finances." This paper offers important insights on the return to criminal activity within a gang and on the structure of compensation within a criminal organization. The paper uses detailed financial records maintained by a drug lord, obtained at great risk to the authors, to investigate the returns to illegal activity. The findings suggest that criminal activity is broadly dispersed within an organization such as this, not highly concentrated among a few individuals. Moreover, the authors show that the gang they study obeys a number of key predictions from organizational economics. Street-level drug sellers earn roughly the minimum wage. Compensation is strongly skewed, so rewards exhibit something of a tournament structure. For most gang members, participation in gang activities is difficult to justify based on economic considerations alone. Most members of the gang have some connection to the legal economic sector, which may imply that gang participation is sensitive to economic opportunities in the legitimate sector. The paper raises a host of questions about the preferences that lead individuals to join criminal gangs and the capacity of neoclassical economic models to explain these choices.

Steve's collaborative research with Julie Cullen and Brian Jacob [21 and 22] on the effect of school choice on student performance makes an important contribution to a voluminous and controversial literature about whether allowing students to choose among different public schools improves school performance and student achievement. These papers examine the impact of school choice programs in Chicago. High school assignment is carried out by an open enrollment lottery, and nearly half of Chicago's students choose not to attend the school that is nearest to their home. This research develops a number of creative strategies for evaluating the impact of school choice. For example, the authors compare students who live close to several high schools, and students who would have to travel long distances to any school other than their nearest one, since taking advantage of school choice is easier for the first group. They also compare students who were lucky in the lottery and who are enrolled at one of the most widely sought schools with those whose lottery experience was less favorable. The results suggest that school choice has at most modest effects after one controls for differences between the students who choose to participate in the open enrollment program and those who do not. These findings, based on a very large urban school district, are very likely to attract ongoing attention in the school choice debate.

Yet another study that builds on an interesting data set is Steve's 2002 *American Economic Review* paper [23] with Pierre-Andre Chiappori and Timothy Groseclose on "A Test of Mixed Strategy Equilibrium: Penalty Kicks in Soccer." This paper, which is widely celebrated in the popular European sports press, offers one of the first tests for the practical importance of mixed strategy equilibrium outside a laboratory setting. The paper develops and tests a straightforward model of soccer player behavior in penalty-kick situations. These are situations in which a single player has an opportunity to try to score on a goal that is defended by a single goal-keeper. No other players are involved. Assume that the goal-keeper and the

penalty kicker make simultaneous choices about which part of the goal to defend and where to kick the ball. Divide the goal into three parts—left, center and right. No pure-strategy Nash equilibrium exists in this game. If the keeper chooses to play left, for example, the kicker will choose right or center. In that situation, the keeper would no longer choose to play left. However, a mixed strategy equilibrium does exist, with both kicker and keeper playing all three strategies with a one in three probability. The authors collect a new data set on 459 penalty kicks in the French and Italian professional soccer leagues between 1997 and 2000. They evaluate the behavior of both kickers and keepers, and they find that both appear to play mixed strategies. There are no systematic differences in the probability of scoring with kicks to the left, right or center, and both keepers and kickers appear to play a memoryless mixed strategy. This paper represents an ingenious contribution to applied game theory, but it also is a wonderful illustration of the broad power of economic analysis in addressing fun and interesting issues. Like Romer's (2003) study of optimal play on fourth downs in American football, this paper suggests that economic analysis has practical applications in competitive situations like professional sports.

A final empirical project that illustrates Steve's insightful data analysis is his 2001 *Journal of Political Economy* paper [24] with Jack Porter on "How Dangerous are Drinking Drivers?" This paper makes a significant contribution to the social regulation literature on the costs and benefits of various policies that would affect the likelihood of auto crashes. It focuses on the role of alcohol in such crashes. To determine the relative risk of an accident if a driver is drunk and sober, one needs to know the total number of drunk and sober drivers on the road. It is very difficult to measure this proportion, since roadblocks and other methods of collecting such data are expensive and often cannot compel driver participation. This paper uses data on two-car fatal crashes to estimate the proportion of drivers who are under the influence of alcohol. Police reports provide information on whether both drivers were sober, only one driver was intoxicated or both drivers were intoxicated. The authors make a number of plausible assumptions, and one that might be controversial, to draw inferences from these data. Their key assumption is that fatal accidents result from the error of only one driver. Under this assumption, and other conditions that ensure random mixing of drivers on the road, the proportion of fatal accidents that involve two drunk drivers will rise with the square of the fraction of drivers who are drunk, while the proportion involving only a single drunk driver will rise linearly with this fraction. This makes it possible to estimate the fraction of drivers who are drunk. The paper offers a novel approach to estimating an important parameter in many road safety models, and it delivers not just an estimate of the share of drivers who are drunk, but also an estimate of the relative crash probability for drunk and sober drivers. The results suggest that drivers who have been drinking at all appear to be seven times more likely to be involved in an accident than drivers who have not been drinking, and that drivers with a blood alcohol concentration above the legal limit are 13 times more likely than sober drivers to be involved in a fatal accident. The paper combines these estimates with information on the valuation of lives lost in accidents to compute the

optimal Pigouvian fine for being caught driving drunk. Given the externalities imposed on other drivers through the risk of a fatal crash, this fine should be approximately $8,000.

Conclusion

Steve's work displays the breadth and power of economic analysis. Many of the issues he has addressed, such as crime or the economics of public education, are recognized as first-order issues both within and outside economics. The range of data sets and identification strategies that Steve has used in his empirical research is remarkable. If one were to try to identify the trait that most distinguishes Steve from other empirical researchers, it would be his uncanny capacity to find convincing identification strategies for solving a long list of empirical problems. He has a remarkable talent for finding data sources that can be used to address interesting questions, posing questions that are both important and tractable, and then carrying out the corresponding empirical analysis. He is one of the most insightful and versatile empirical economists.

Steve recognizes that identification is at the core of convincing empirical analysis, and he never treats the issue lightly. Some of his research, such as that on legislator voting and drunk driving, relies on theoretical assumptions to tease important insights from data. Most of his research, however, relies on clever sources of quasi-experimental variation in key covariates to generate empirical findings. When debates have emerged about his conclusions, they have been constructive discussions of the extent to which some factors are exogenous with regard to the problem at hand or the degree to which an omitted variable might account for the central findings. Steve recognizes that his identification strategies can be challenged. Rather than simply offering an identification strategy and reporting its results, his papers often develop arguments in defense of his approach. Steve recognizes that identification is not a "zero-one" situation and that credible identification requires persuading others of the exogeneity of key variables.

Steve's research has enriched our substantive knowledge of many economic and social problems. It has provided new estimates of the rational response to incentives among potential criminals, stars in professional sports, politicians, teachers, drunk drivers and *homo economicus* in a range of other settings. This research has highlighted the importance of devoting attention to well thought-out identification strategies as well as to the econometric tools that are used in applied economic analysis. Steve has inspired others to follow his lead, and in the process his influence has exceeded his own direct research contributions. The 2003 John Bates Clark Medal is a well-deserved tribute to his accomplishments.

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