

Levitt, Steven D.

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the gains in consumer welfare from new products. I demonstrate how this gain in consumer welfare could be estimated, and provide an approximation result, which the BLS could use to calculate gains in consumer welfare from new products for use in the CPI.

The BLS has three potential approaches to the inclusion of new goods into the CPI: 1) It can ignore the new goods for a long time, as with the 15 year delay for cellular. This paper demonstrates that the BLS missed approximately 50 percent of the price decline in cellular using this approach. 2) It can add new products to the CPI earlier. My calculation shows that if cellular service had been included in the CPI in 1988, 5 years after its introduction, the BLS would have missed only about 25 percent of the price decrease, which would have been a significant improvement. 3) It could introduce a true COLI measure that reflects the value to consumers of the new product's introduction, as well as the subsequent decrease in price. I demonstrate that the value of new products such as cellular service to consumers can be very large. Thus, even if the

BLS includes new products earlier, the CPI will still miss a large part of the effect on a COLI of new products. I demonstrate how an approximate measure of the consumer value of new goods can be included in the CPI.

I find a bias in the BLS estimate of the telecommunications services index of between 0.8 percent and 1.9 percent per year over the period 1988-97, because of the omission of cellular telephones from the CPI during this time period. Rather than telecommunications service prices increasing at about 1.1 percent per year, as the BLS calculated for the CPI, the correct calculation has them decreasing at about 0.8 percent per year. Differences of this magnitude are significant and likely arise from the introduction of other new goods and services, for example Internet services. Thus, the omission of new goods and services imparts a significant upward bias to the CPI. Because the CPI is used in many places in the U.S. economy and for making policy decisions, this bias distorts these decisions and gives a misleading impression of real (adjusted for inflation) magnitudes in the U.S. econ-

omy, such as changes in real income and the economic welfare of the U.S. population.

¹ J.A. Hausman, "Valuation of New Goods Under Perfect and Imperfect Competition," in *The Economics of New Products*, T. F. Bresnahan and R. J. Gordon, eds. Chicago: University of Chicago Press, 1996.

² J.R. Hicks, "The Valuation of the Social Income," *Economic Journal*, (1940).

³ E. Rothbarth, "The Measurement of Changes in Real Income Under Conditions of Rationing," *Review of Economic Studies*, (1941), pp. 100-7.

⁴ J.A. Hausman, "Valuing the Effect of Regulation on New Services in Telecommunications," *Brookings Papers on Economic Activity*, Microeconomics, 1997.

⁵ See J.A. Hausman, "Valuation of New Goods Under Perfect and Imperfect Competition."

⁶ J.A. Hausman, "Telecommunications: Building the Infrastructure for Value Creation," in *Sense and Respond*, S. Bradley and R. Nolan, eds. Boston, MA: Harvard Business School Press, 1998.

⁷ J.A. Hausman, "Cellular Telephone, New Products and the CPI," *NBER Working Paper 5982*, March, 1997; forthcoming in *Journal of Business and Economic Statistics*.

⁸ M. Boskin et al., "Toward a More Accurate Measure of the Cost of Living," *Final Report to the Senate Finance Committee*, December 4, 1996.

The Economics of Crime and the Criminal Justice System

Steven D. Levitt*

My recent empirical research focuses on crime and the criminal justice system. Within this broad area, three primary themes emerge: identifying the causal link between criminal justice policies and crime rates; differentiating empirically between deterrence and incapacitation; and using nonstandard data sources to

**Levitt is a Research Associate in the NBER's Program on Public Economics and an assistant professor of economics at the University of Chicago. His "Profile" appears later in this issue.*

test economic theories. This synopsis of my research is organized around these themes.

Identifying the Causal Link Between Criminal Justice Policies and Crime Rates

Differentiating between correlation and causality is critical when analyzing the impact of crime policies. For instance, Newark has a violent crime rate four times higher than that of Omaha, and it also has twice as many police per capita. A likely explana-

tion for this relationship, however, is that high crime rates lead cities to hire more police, not that police cause crime. Similarly, when crime is rising, prison populations also tend to rise. This is not surprising: if criminals continue to be caught and punished at a constant rate, then the prison population should mechanically rise one-for-one with the crime rate. From the perspective of ideal public policy, reliance on such correlations provides no guidance. Identifying the causal link between increases in police and the number of prisoners and crime is necessary.

I have examined the impact of police on crime, using the timing of mayoral and gubernatorial elections as "instruments" for changes in the police force.¹ Indeed, the size of the police force appears to be affected by election timing. Over a 25-year period, the average increase in the size of the police force in large U.S. cities in mayoral election years was 2 percent; in gubernatorial election years it was 2.1 percent, and in non-election years there was no change. It appears that incumbent politicians attempt to bolster their re-election prospects by appearing "tough on crime." If elections do not otherwise affect crime rates (after controlling for other factors that may be influenced by elections, such as changes in the local economy), then electoral cycles may plausibly influence changes in the police force. In one set of estimates, I find a positive relationship between police and crime. But when I include elections in the analysis the sign reverses, and police appear to significantly reduce crime.

In a related paper, I consider the relationship between the number of prisoners and crime rates.² In this paper, I use prison overcrowding lawsuits as an indicator of change in prison populations. These lawsuits affect prison populations, but they may be otherwise unrelated to crime rates (especially because the cases often take a decade or more to be resolved). In 13 states, lawsuits brought by the American Civil Liberties Union have affected a state's entire prison system. In the three years after a final decision was handed down by the courts in those cases, prison populations fell by 14.3 percent compared to the population of the nation as a whole, whereas violent and property crime rates increased 10.2 percent and 5.5 percent respectively. Using my estimate of the elasticity of crime with respect to the prison population and previ-

ous estimates of the costs of crime from Miller, Cohen, and Rossman, I cannot reject the possibility that the marginal social cost of imprisonment equals the marginal social benefit of the reduction in crime.³

Deterrence, Incapacitation, and the Response of Criminals to Incentives

Becker's well-known economic model of crime is based on deterrence: potential criminals alter their behavior in response to changing incentives.⁴ Empirically, however, it is often difficult to distinguish between deterrence (which is a behavioral response) and incapacitation (in which reductions in crime are attributable solely to criminals being unable to commit crimes because they are locked up). Virtually all of the empirical work that purportedly supports the economic model of crime is equally consistent with incapacitation. In some cases, such as determining the impact of policies like "three strikes and you're out" laws, the distinction is critical. If deterrence is the operative force, then "three strikes" laws are likely to be effective; if only incapacitation is at work, then "three strikes" laws will lead to a geriatric, cost-ineffective prison population. Three of my papers thus have attempted to distinguish between deterrence and incapacitation.

In one, I note that both deterrence and incapacitation predict that changes in the expected punishment for one crime (burglary, for example) will lead to a decrease in that crime.⁵ Thus, this prediction cannot be used to distinguish between deterrence and incapacitation. In contrast, the two theories of crime make different predictions as to what will happen to a second crime (auto theft, for example) when the expected punishment for burglary rises. Deterrence predicts

that criminals will substitute auto theft for burglary. Incapacitation, on the other hand, suggests that levels of both crimes will fall. Exploiting this insight empirically seems to show that deterrence is more important than incapacitation, particularly for property crime.

Daniel Kessler and I exploit a unique feature of sentence enhancements to isolate deterrence.⁶ We look at the passage of Proposition 8 in California, which selectively institutes sentence enhancements for some crimes. Sentence enhancements are additional penalties tacked on to a base sentence (as a result of, for instance, past criminal history or use of a weapon). Since the enhancement increases the expected punishment, it will increase deterrence. Because it is added on to an existing punishment, however, it will not affect incapacitation until the base sentence expires. Thus, any immediate effect of a newly instituted sentence enhancement law must result from deterrence. We find an immediate, sharp decline in eligible crimes relative to those that are unaffected by the law, again suggesting the importance of deterrence.

Finally, I study the relationship between crime and punishment for juveniles.⁷ Over the last two decades, juvenile crime has grown at a much faster rate than adult crime. During that same period, the adult prison population has grown dramatically, but the number of juveniles in custody has not. I estimate that changes in relative punishment can explain 60 percent of the differential growth rates in juvenile and adult crime over the period I examine. Moreover, sharp changes in criminal involvement with the transition from the juvenile to the adult court suggest that deterrence, rather than simply incapacitation, plays an important role.

Using Nonstandard Data Sources to Test Economic Theories

The study of crime offers many opportunities to test microeconomic models of behavior. Often, however, standard data sources are not appropriate for such tasks. Consequently, a number of projects with which I have been involved in recent years have relied on unusual data sources.

Ian Ayres and I consider what externalities are associated with potential victims taking precautions.⁸ In particular, we look at Lojack, a radio transmitter device hidden inside automobiles (the Lojack company provided proprietary market share data). There is no external indication on the vehicle that Lojack is installed. Thus, Lojack provides general deterrence, even to vehicles without it. This is in stark contrast to observable devices, such as "The Club," that presumably cause crimes to shift from one vehicle to another. We find sharp decreases in auto theft in cities where Lojack becomes available. Further, car owners who install Lojack internalize only 10 percent of the total

social benefit, leading to underprovision of Lojack by the market, we conclude.

Sudir Venkatesh and I use an even more unusual data source: financial records kept over a four-year period by a drug-selling street gang.⁹ These include information on the price and quantity of drugs sold; wages at various levels of the organization; and expenses such as tribute, weapons, and so on. We supplement the financial information with ethnographic observations and data on arrests, deaths, and injuries. Wages appear to be surprisingly low—not much above the federal minimum wage for street-level sellers. The distribution of wages within the gang is extremely skewed, though, and there is some evidence of compensating differentials in wages. During the time period we study, the gang expands its territory, providing a number of tests of market power and pricing. Among other results, we find that gangs price below marginal cost during gang wars.

¹ S.D. Levitt, "Using Electoral Cycles in Police Hiring to Estimate the Effect of

Police on Crime," *American Economic Review*, 87(3), (June 1997), pp. 270–90.

² S.D. Levitt, "The Effect of Prison Population Size on Crime Rates: Evidence from Prison Overcrowding Litigation," *Quarterly Journal of Economics*, 111, (May 1996), pp. 319–52.

³ T. Miller, M. Cohen, and S. Rossman, "Victim Costs of Violent Crime and Resulting Injuries," *Health Affairs*, 12, (Winter 1993), pp. 186–97.

⁴ G. Becker, "Crime and Punishment: An Economic Approach," *Quarterly Journal of Economics*, 76, (March/April 1968), pp. 169–217.

⁵ S.D. Levitt, "Why Do Increased Arrest Rates Appear to Reduce Crime: Deterrence, Incapacitation, or Measurement Error?" *Economic Inquiry*, forthcoming.

⁶ D. Kessler and S.D. Levitt, "Using Sentence Enhancements to Distinguish Deterrence from Incapacitation," *NBER Working Paper No. 6484*, March 1998.

⁷ S.D. Levitt, "Juvenile Crime and Punishment," *Journal of Political Economy*, forthcoming.

⁸ I. Ayres and S.D. Levitt, "Measuring the Positive Externalities from Unobservable Victim Precaution: An Empirical Analysis of Lojack," *Quarterly Journal of Economics*, 113(1), (February 1998), pp. 43–77.

⁹ S.D. Levitt and S. Venkatesh, "An Economic Analysis of a Drug-Selling Gang's Finances," *NBER Working Paper No. 6592*, June 1998.

Do We Still Need Commercial Banks?

Raghuram G. Rajan*

According to many observers, the commercial bank—the institution that accepts deposits payable on demand and originates loans—has outlived its usefulness and is in a state of terminal decline. Commercial banks' share of total financial institution assets in the United States has fallen dramatically, from more than

*Rajan is Director of the NBER's Program on Corporate Finance and the Joseph L. Gidwitz Professor at the University of Chicago's Graduate School of Business. His "Profile" appears later in this issue.

70 percent around the turn of the century to just around 30 percent today.¹ Bank share of corporate debt in the United States has declined from 19.6 percent in 1979 to 14.5 percent in 1994.² Competition on both sides of the banks' balance sheet has increased. On the banks' asset side, the growth of the commercial paper and junk bond markets has given large firms an alternative to borrowing from the bank. On the liability side, new technologies and deregulation have given customers choices. Instead of being forced to deposit at the local bank branch or make pay-

ments through a bank checking account, customers are able to use mutual funds that offer much the same services.

At the same time that banks appear to be losing business to financial markets and other institutions, they are also imposing huge costs on society. The savings and loan crisis in the United States cost taxpayers several hundred billion dollars by even the most conservative estimate. Estimates of the cost of cleaning up the Japanese banking crisis now exceed \$500 billion, and few will hazard a guess as to the costs of the East Asian bank-