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What America's Users Spend On Illegal Drugs

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U.S. Department of Justice
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An Office of National Drug Control Policy Technical Paper

June 1991

What America's Users Spend On Illegal Drugs

Introduction

For years, we have been fighting the drug war without knowing its exact contours. Yes, there is much data on both the supply and demand of drugs. For example, the National Household Survey on Drug Abuse, the High School Senior Survey, and the Drug Abuse Warning Network provide a sense of the demand for drugs. Other information such as the National Narcotics Intelligence Consumers Committee Report and the International Narcotics Control Strategy Report estimate the amount of drugs produced worldwide.

However, no one has attempted to answer the simple question: what do Americans spend on illegal drugs? This paper, prepared by Abt Associates for the Office of National Drug Control Policy attempts — for the first time — to make such an estimate. In doing so, it goes much further. It takes the available data on use and the available data on supply and tries to reconcile them to determine if the information from these very divergent sources is, in fact, consistent.

We had the study prepared to give us some sense of the scope and scale of the problem with which we are dealing. A measure, however imperfect, of the amount spent on drugs not only tells us where we are but gives us an indicator of how the problem is changing over time. Such an indicator is crucial to judging the effectiveness of public programs targeted to reduce drug use, to disrupt the drug trade, to reduce the amount of drugs sold and purchased through this underground economy, and to reduce or eliminate the profits channeled to leaders and workers in that illegal industry. Further, for the Office of National Drug Control Policy, it defines the magnitude of the challenge that we face.

This paper is not the final word. In fact, it is only the first word. It is intended to provoke an open and constructive discussion. I fully expect that there will be many who disagree with its rationale, methodology, and

conclusions. I acknowledge that there are many problems inherent in the available data.

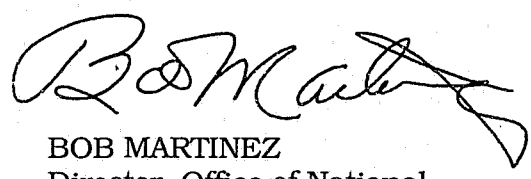
I further acknowledge that we don't know many of the things we ought to know to make estimates of this nature with any degree of precision. For example, information on quantities, trade patterns, and frequency of usage on drugs other than cocaine and marijuana is virtually nonexistent. But make estimates we must if we are to make policy decisions. The flaws and gaps in the data on which this paper is based point the way to the improvements needed to make better estimates in the future.

The paper is not intended for the scholar or researcher and may not meet their standards. In fact, the technical discussions were held to a minimum, though we would be pleased to discuss any technical aspects of the paper with those who contact this office. Rather, it is designed as a basis of action for policymakers, Federal officials, officials in State and local government, and the concerned citizens of our Nation.

As the findings show, there is more work to be done despite the dramatic and encouraging declines in overall drug use in this country. The market for illicit substances in the United States is immense and illicit drugs continue to be a major and unsavory industry. Therefore, our challenge remains: we must reduce even further the level of illicit drug use in this country and stop drug use before it starts. This demands our continuing civil and political resolve.

We stand ready to engage in the debate that we expect will ensue as a result of this report and to use these estimates as a guide to policy action until better ones are made.

We thank various Federal agencies, and law enforcement and treatment officials who have read drafts of the report and given us their comments and helpful suggestions, as well as Peter Reuter of RAND Corporation and Mark Kleiman of Harvard University.



BOB MARTINEZ
Director, Office of National
Drug Control Policy

Executive Summary

This paper is part of an ongoing project to develop estimates of what Americans spend on illegal drugs each year. This report focuses on the amount and retail sales value of cocaine, heroin, marijuana, and other illegal drugs consumed in 1988, 1989, and 1990.

We use two approaches to estimate the amount of illicit drugs consumed and available for consumption in America. Starting with drug consumers, we multiply estimates of the number of drug users by estimates of the average amount of drugs consumed. Then we examine the supply of drugs available for consumption by estimating the amount of drugs that enters the United States and escapes seizure. Prevailing retail prices are used in both approaches to convert drug amounts to dollar value when sold to final users.

According to our study of drug consumers, Americans spent approximately $18 billion on cocaine, $12 billion on heroin, $9 billion on marijuana, and $2 billion on other illegal drugs in 1990. These estimates are expressed in dollars, but may not have been payments in cash. Payment for illicit drugs is often "income in kind" such as dealers keeping drugs for personal use, users helping dealers in exchange for drugs, and users performing sex for drugs (especially crack cocaine).

Although it is difficult to be precise about changes in the illicit drug market, trends seem to emerge. Retail sales of both cocaine and marijuana appear to have fallen by about 24 percent from 1988 to 1990. Retail sales of heroin during the same period seem to have fallen slightly less—about 22 percent. We are unable to compute trends for expenditures on other illegal drugs.

From the supply perspective, about 310,150 metric tons of coca leaf crop were cultivated in South America during 1990. This leaf crop could yield a maximum of 873 metric tons of cocaine hydrochloride, but due to losses in shipment, only about 376–544 metric tons were shipped to the United States. Of the cocaine arriving on American shores, Federal authorities seized about 101–113 metric tons, leaving roughly 263–443 metric tons available for domestic consumption. The street value of this cocaine would be $26–$44 billion—an estimate that we consider high.

Again, it is difficult to report trends in an illegal economy with absolute assurance. However, it appears that leaf crops and the amount of cocaine it would be possible to produce from those leaf crops have increased by about 5 percent. Perhaps production increased to offset increases in foreign country seizures. These foreign seizures alone caused a 9 percent decrease in the amount of cocaine shipped to the United States. The amount of cocaine seized by United States authorities increased by 88 percent. The net effect of increases in both production and foreign and all seizures has been a 22 percent decrease in the amount of

cocaine available for consumption in the United States between 1988 and 1990.

We are unable to develop reliable supply-side estimates for heroin, primarily because the United States makes up such a small share of the world market for this drug. We are also unable to develop plausible supply-based estimates of marijuana sales given available data.

Table A summarizes our estimates for the retail sales values of all drugs; and Table B, our estimates for the production and distribution of cocaine. These estimates are not exact. Key data on users and their use patterns simply do not exist for most drugs. As a result, we must make major assumptions to piece together fragmentary and often conflicting evidence. Our calculations will be refined as better data become available. Our estimates based on drug consumption are remarkably close to those based on drug supply. From the consumption-based side, we estimate that $17–23 billion dollars were spent annually on cocaine between 1988–1990. Although this range is somewhat smaller than that derived from our supply-based estimates ($26–$54 billion dollars), this difference can be attributed to several reasons: The United States itself may be a greater transshipment country to Europe than is assumed in our model; State and local seizures have not been accounted for in our model; and part of the supply of cocaine may be to replenish dealer stocks.

Although these estimates are imprecise, they are reliable enough to imply that the trade in illicit substances is immense—roughly $40 billion to $50 billion. To put this amount into perspective, consider that Americans spend $44 billion on alcohol products and another $37 billion on tobacco products. Federal, State and local governments spend $46 billion on the criminal justice system and $183 billion on public elementary and secondary education.

The social costs from drug consumption greatly exceed the $40 billion to $50 billion spent on illicit drugs. Drug use fosters crime, both property crime to support consumption and violent crime to support drug distribution networks. Drug use intensifies catastrophic health problems, ranging from hepatitis and endocarditis to crack babies and AIDS. And drug use promotes general social disorganization as it disrupts or severs personal, familial, and legitimate economic relationships. The public bears much of the burden of these indirect costs by financing the criminal justice response to drug-related crime, maintaining a public treatment system, and educating the impressionable about the dangers of drug use. This research into the scope of drug use in the United States should help us to determine the wisest use of public funds and policies to combat drug use.

TABLE A

RETAIL VALUE OF ILLICIT DRUGS IN THE UNITED STATES

(in billions of dollars)

	1988	1989	1990
Cocaine	$22.9	$22.5	$17.5
Heroin	$15.8	$15.5	$12.3
Marijuana	$11.1	$10.0	$ 8.8
Other Drugs	$1.8	$1.8	$1.8
Total	$51.6	$49.8	$40.4

TABLE B

ESTIMATES OF PRODUCTION AND SUPPLY OF COCAINE

(in metric tons and billions of dollars)

	1988	1989	1990
Coca Leaf Crop	293,700 MT	298,090 MT	310,150 MT
Cocaine HCL Produced	829 MT	836 MT	873 MT
Transshipment, Foreign Seizures	38 MT	64 MT	92 MT
Cocaine Shipped to the United States	418-593 MT	388-557 MT	376-544 MT
Cocaine Seized by Federal Authorities	57 MT	95 MT	101-113 MT
Cocaine Available for Consumption in the United States	361-536 MT	293-462 MT	263-443 MT
Retail Value in the United States	$36-$54 B	$29-$46 B	$26-$44 B

What America's Users Spend On Illegal Drugs

Developing estimates of the retail value of the United States market for illicit drugs and for licit drugs consumed illegally is a pressing problem. The size of the illicit drug market is a principal indicator of the need for a public response to combat the drug epidemic. It is also essential to develop indicators of how this market is expanding or contracting over time. Such indicators are crucial to judging the effectiveness of public programs targeted to disrupt the drug trade, to reduce the amount of drugs sold and purchased through this underground economy, and to reduce or eliminate the profits channeled to leaders and workers in that underground industry.

This paper reports estimates of the retail value of illicit drugs and licit drugs sold illegally in the United States for 1988 through 1990. The bulk of this paper describes our methodology. A concluding section summarizes our estimates.

In order to estimate the retail sales value of illicit drugs consumed in the United States, we examine both the demand for and the supply of drugs. The demand or **consumption approach** involves multiplying estimates of the number of drug consumers by estimates of the average amount of drugs used. The **supply approach** requires estimating the amount of base crop raised in producer countries reduced by the amounts lost, seized or consumed in other countries and the amount seized in or shipped through the United States. We describe these two approaches in greater detail in the following sections. The supply approach requires estimating the amount of base crop raised in producer countries reduced by the amount seized in or shipped through the United States. Both approaches produce dollar amounts when the amount consumed (amount supplied) is multiplied by prevailing retail prices. These dollar amounts are expressed as dollar equivalents because payment for illicit drugs is often "income in kind" such as dealers keeping drugs for personal use,

drug users helping dealers in exchange for drugs, and users performing sex for drugs. We describe the consumption and supply approaches in the following sections.

The yearly retail value of illicit drugs and legal prescription-type drugs procured and consumed illegally in the United States during 1988–1990 is an estimated $40 to $50 billion. This range is imprecise—this report explains its derivation—but its precision is sufficiently accurate to conclude that the United States market for illicit substances is immense. By comparison, Americans spend $44 billion on alcohol products and another $37 billion on tobacco products. Federal, State, and local governments spend $46 billion on law enforcement and another $183 billion on public education.[1]

Just as a polluting industry fouls its environment, creating social costs not borne by the purchasers of its products, the illicit drug industry generates costs not fully reflected in expenditures on cocaine, opiates, marijuana, and other drugs. Drug abuse fosters crime (some incidental to paying for drugs, some instrumental to distributing drugs), catastrophic health problems (ranging from drug-addicted babies to AIDS, and including a variety of illnesses such as hepatitis and endocarditis), and general social disorganization as drug abuse disrupts or severs personal, familial, and economic relationships. Much of this cost is borne by the public as it meets the challenge of drug abuse by enhancing the criminal justice response, expanding treatment services provided by publicly funded programs, and making a concerted effort to educate the impressionable about the health risks of drug use and the financial and human costs of drug addiction. Added to these obvious costs is the insidious intrusiveness of a $40 to $50 billion underground economy that breeds contempt for normal social, political, and economic intercourse.

I. THE CONSUMPTION APPROACH

No single data source presents a comprehensive view of drug use among Americans. Consequently, we categorize users into seven groups and use different approaches to estimate the amount of drugs consumed by each group. Each of these groups varies as to frequency of use, the amount of drugs taken per session, the purity of drugs consumed, and the amount paid for those drugs. To derive a final aggregate figure, we sum drug consumption estimates derived from separate calculations for each group.

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[1]Source: Statistical Abstract of the United States, 1990. The figure for alcohol is from p. 780, Chart #1376; for tobacco from p. 430, Chart #698; for the criminal justice system from p. 180, Chart #307; and for public education (elementary and secondary) from p. 129, Chart #208.

The seven groups that entered these calculations are described in Figure 1. Drug users living in households are represented by a large circle, which overlaps with the circle representing drug users involved with the criminal justice system (CJS). Information about this group comes from the National Household Survey on Drug Abuse. Drug users identified by the CJS are represented by a second circle. Some of the CJS-involved users may live in households, so these two circles intersect. A third group, college students, also overlaps with household members: some college students live in households, and others live in dormitories and fraternity houses. Members of the fourth group, military personnel, live in households or in military barracks. A fifth group is the homeless, who are not represented in the Household Survey but a portion of whom are represented in the CJS-involved population. Members of the sixth group, drug users in therapeutic communities and detoxification programs, are not members of households while they are housed in a residential treatment facility. Some members of this population are also involved with the CJS. High School students, a subset of the household population, form a seventh group.

Having recognized these seven groups, our methodology for estimating the amount of drugs consumed in the United States involves several steps:

- We estimate the number of people in each group who used drugs.[2]
- We estimate the frequency with which those identified as drug users actually consume drugs.[3]
- We estimate the amount of drugs that are consumed per "session" of drug use.[4]
- We convert amount used per session into pure drug units.[5]

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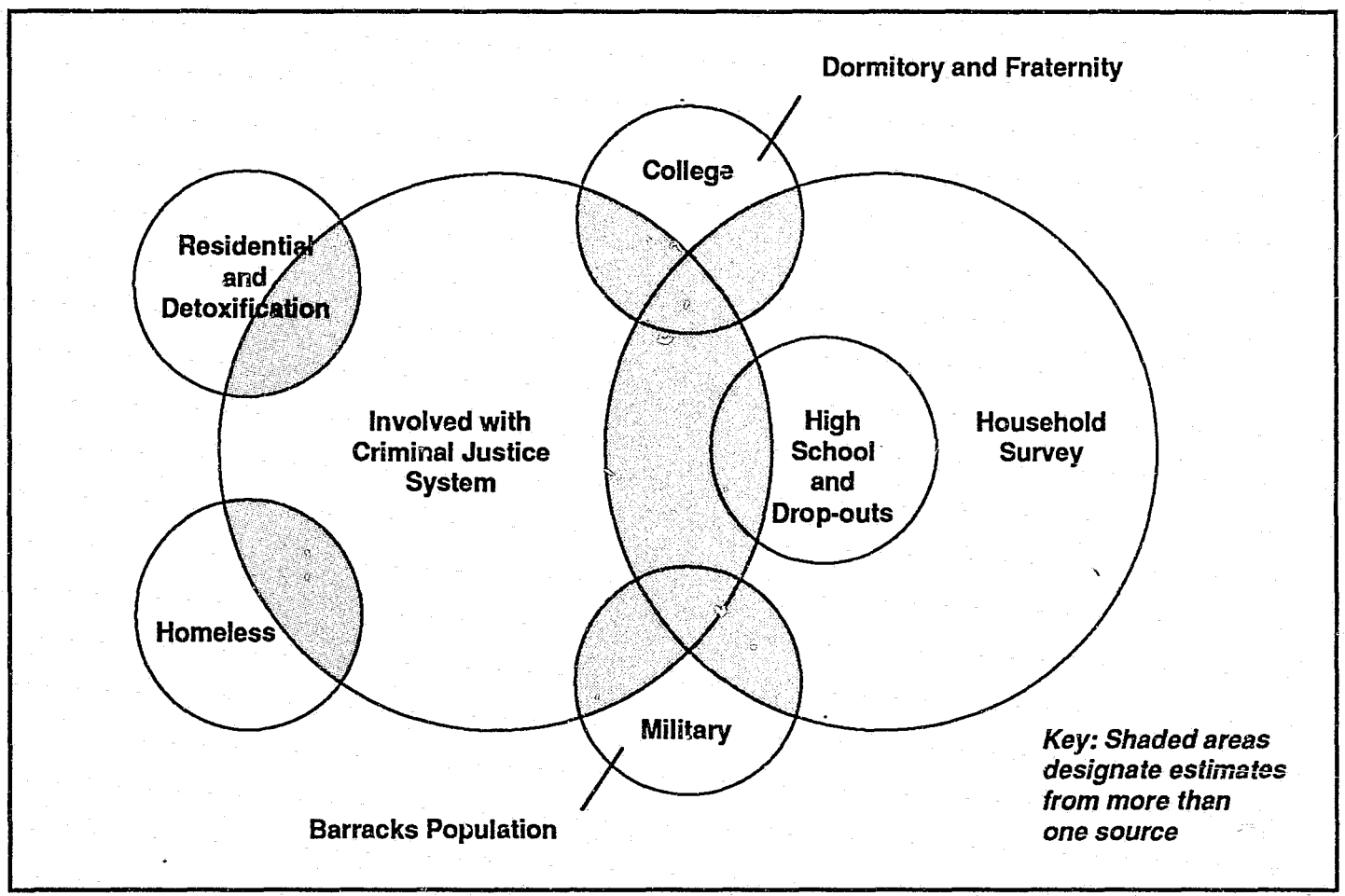
[2]Here we draw on several sources, including the 1985, 1988, and 1990 Household Survey, the 1988, 1989, and 1990 High School Senior Survey, and 1988 and 1989 data from the Drug Use Forecasting System (DUF).

[3]We draw on reports of use patterns from the AIDS Initial Assessment questionnaire, the Household Surveys, the High School Senior Surveys, and a range of studies of special populations, such as people incarcerated in jails and prisons.

[4]Published information in this area is sparse. We consulted with experts — principally with street ethnographers and other researchers, but also with some users and dealers — regarding usage patterns. In order to monitor drug consumption patterns, several of the nation's researchers maintain contacts with users and dealers of illicit substances. These relationships between researchers, users, and dealers are recognized by law enforcement authorities, who value better understanding markets for illicit substances. Obviously, users and dealers are promised confidentiality, and these promises are routinely backed by federal guarantees that the users and dealers will not be identified.

[5]Some information concerning units used per session is available from the Drug Enforcement Administration (DEA), but DEA reports were supplemented to achieve a more complete estimate. Supplementary data came from street ethnographers, recovering users, and dealers.

Figure 1 — Identification of Drug Users in the U.S.



Abt Associates, Inc.

- Using the results from the first four steps, we multiply users by frequency of use; we multiply the result by amount used per session; and we multiply that amount by purity. Results are reported as "pure amount of drugs consumed." Pure drug amounts are then multiplied by retail sales price. We sum the amount of drugs consumed by each group of drug users.[6]

- We use data about trends in drug consumption and the retail price of drugs to develop separate estimates of the retail sales value of drugs in 1988, 1989, and 1990.[7]

- We verify estimates by comparing our estimates with estimates from other studies.

The margin of error when estimating drug use is wide. Drug users are difficult to locate for questioning, and when found, are often reluctant or unable to answer questions about their drug use. Even when data are obtainable, patterns of drug use vary markedly across the Nation, so information derived from limited geographic areas may misrepresent drug use in the Nation as a whole. Furthermore, while researchers have devoted considerable time and effort to identifying the number of drug users and the frequency with which those users consume drugs, researchers have rarely inquired about the amounts consumed per session or purity and cost of those drugs. The reported estimates are the best we could derive from available data, but they should be considered to be accurate only within a broad (and unknown) band of confidence.

In addition, the trends in drug consumption reported here depend heavily on a presumed relationship between the number of heavy drug users and the number of emergency room admissions for drug-related problems, as reported in the Drug Abuse Warning Network (DAWN), for cocaine, heroin, and marijuana abuse. If this presumed relationship were nonexistent or if it were weaker than we have assumed, the trends we report could be largely spurious. We are unsure of the strength of this relationship.[8] Furthermore, trends in drug consumption are especially

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[6]Sources for price data were the Drug Enforcement Administration's Domestic Monitor Program, the June 1990 report of the Community Epidemiology Work Group, street ethnographers, other researchers, users and dealers.

[7]The Household Survey and the High School Senior Survey report trends from 1988 through 1990. Otherwise, we relied on reports from the Drug Abuse Warning Network.

[8]Although we are aware of no studies that examine what types of drug users seek services in emergency rooms, it appears that those users who are drug dependent predominate. Based on Tables II-4a and II-4b of the 1989 DAWN report, in 72 percent of emergency room admissions where cocaine was the drug of abuse the patient was classified as "dependent". For heroin/morphine, the figure was 83 percent; for marijuana, it was 55 percent. The predominance of dependent users among those seeking emergency room treatment is evidence in support of assuming that trends in the DAWN data mirror trends in drug use among heavy user populations.

sensitive to errors when measuring drug consumption during individual years within the time-series. We are uncertain of how much confidence to place in the magnitude of changes in the retail value of drugs consumed.

These caveats notwithstanding, our estimates of the retail value of drug consumption are reasoned estimates based on the best available data. They stand in stark contrast to what have heretofore been informed opinions or outright guesses. Just as important, the assumptions and data involved in our calculations are explicit, meaning that they are open to criticism and improvement. We expect more precise estimates to evolve from these early attempts.

Summary of Calculations

Drug use among those involved with the CJS. Heavy drug users are frequently in trouble with the law. Relying on interviews with over 20,000 intravenous drug users, we note that 29 percent had been in jail or prison during the six months prior to their interviews, that 52 percent had been in jail or prison during the two years prior to their interviews, that 62 percent had been in jail or prison during the five years prior to their interviews, and that 83 percent had been in jail or prison at some time during their lives.[9] Our own tabulations across a dozen sites indicate that about 25 percent of the respondents were on probation, parole, or pretrial release at the time of their interviews.

Because such a large number of drug users become enmeshed in the criminal justice system, we began our estimation of the number of drug users with individuals who were identified and questioned through the Drug Use Forecasting System (DUF), a reporting system developed and sponsored by the National Institute of Justice and currently operating in 23 cities.

The DUF system gathers information at the point where the criminal justice net is widest—at arrest and booking. Arrestees are interviewed about their drug use; they also provide urine samples for testing. However, several steps must be taken before statistics based on urine testing are useful for our purposes.

DUF data are available for samples of defendants in 22 cities. To extend DUF findings to other cities, we estimated statistical models based on the city's population size and region of the country. We then applied the results to estimate the percentage of all people who were arrested in each American city who would have tested positive for cocaine, heroin, marijuana, and other illicit substances had drug testing been conducted

[9]Because of the way the question was posed, the responses understate contact with the law. Respondents were asked how frequently they were in jail for three days or longer; hence, many arrests that resulted in booking and release would be excluded from the responses. These tabulations were based on the first 20,000 responses to the AIDS Initial Assessment Interview, provided by NOVA Research.

in every city. Special adjustments were required to project the relatively high drug use rate among urban arrestees to suburban and rural areas.[10]

At best, a positive drug test reveals recent use of drugs (within a few hours or days for most illicit substances except marijuana, which can be detected for weeks). A negative test indicates no recent use, but does not identify a subject as a drug abstainer. To use the results from drug testing to estimate the number of users, we must employ estimates of the frequency with which those who test positive and those who test negative for illicit substances actually use drugs. Data about frequency of use patterns is sparse. The best current source of frequency data is available from interviews with over 20,000 intravenous drug users who were interviewed from across the country (our data for cocaine and heroin use are restricted to users in a dozen cities).[11]

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[10]These regressions and adjustments are described in detail in Rhodes, "Using the Drug Use Forecasting system to estimate the prevalence of heavy cocaine and opiate use," a draft report to the National Institute of Justice, submitted April 3, 1991. Essentially, regressions were limited to 22 city cores that participated in the DUF system during 1988 and 1989. Separate regressions were estimated for males and females; separate regressions were estimated for each of six types of crimes; and separate regressions were run for each type of drug reported in DUF. These regressions were used to project urine test results to other core city areas. To determine positive urine test rates for suburban areas, we used the ratio of drug-law related arrests in urban core areas to drug-law related arrests in suburban areas to extend drug test results from core cities to suburban areas. Results for rural areas were inferred from the ratio of drug-law related arrests in rural areas to drug-laws related arrests in the rest of the country.

[11]The National Institute on Drug Abuse has funded projects in 57 cities to intervene in the lives of individuals at high risk of infection from HIV. To participate, a subject must have injected drugs at some time during the six month period prior to entering the project. (For our purposes, we ignore other project participants, who are not IV-drug users.) Project participants are required to answer a detailed, confidential questionnaire about their recent drug use. Because subjects are generally paid for their time, they have an inducement to participate, and data reliability appears to be acceptable. (See Myers, M., Snyder, F., Bryant, E. and Young, P. Report on reliability of the AIDS initial assessment questionnaire. Washington, D.C.: NOVA, 1990.

NOVA Research Corporation has been contracted by NIDA to assemble a national data file from interviews provided by the individual projects. NOVA has completed tabulations on the first 20,000 participants, most of whom are IV-drug users. In addition, for purposes of this report, we have conducted tabulations from data provided by researchers in a dozen sites.

The strength of the NOVA data is apparent: detailed questions have been asked of heavy drug users, who are difficult to reach in conventional surveys. The weakness of the NOVA data is equally apparent: the sample is a convenience sample rather than a random sample, and it is limited to drug users who have used a needle during the last six months.

Furthermore, the NOVA data provide responses to the general question about how frequently respondents used cocaine (and other drugs) but no question is asked about how much cocaine is used per session. We had to make assumptions about the amount of cocaine consumed per session.

To illustrate, we assumed that a person who answered that he or she used cocaine "2-3 times per day" used 3.5 grams per week. We assumed further that this cocaine was 50 percent pure, so this user would consume 1.75 grams of pure cocaine per week. Consuming cocaine at this rate is so physiologically demanding and puts the user at such risk of arrest and incarceration that we assumed that this level of consumption could be maintained only half the time, yielding about 46 grams of cocaine consumed per year. We note, however, that individuals who use crack "2-3 times per day" probably consume closer to 82 grams of pure cocaine per year. Similar assumptions were made about other usage patterns and other abused drugs.

Frequency of use patterns based on these interviews overstate drug use among an arrestee population, because intravenous drug users undoubtedly use drugs more frequently than other drug users do.[12] To reduce the bias, we adjusted the usage rates reported by these intravenous drug users. The "no drug use" frequency was increased so that these intravenous drug users, when arrested, would produce positive urine tests at about the same rate as is observed in the DUF data collection system.[13] Furthermore, the frequencies for use of cocaine and for use of heroin were modified to conform more closely with reported patterns of cocaine and heroin use among arrestee populations.[14] On balance, then, we consider these use patterns to be representative of drug use by arrestees.[15]

FBI arrest data were tabulated to determine the number of arrests across standard metropolitan statistical areas. The number of arrests was

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[12]In DUF interviews, the ratio of male arrestees who admit to ever using needles to male arrestees who admit to use of cocaine in the last 30 days is between 0.91 and 1.00; the ratio of women arrestees who ever used needles to women arrestees who admit to ever using cocaine is between 0.41 and 0.46. (We eliminated cities where 10 percent or more of male arrestees admit to the use of heroin because heroin use probably accounts for much of the needle use in those sites.) Consequently, we do not consider these drug use patterns, which are based on the drug use practices of those who used needles at some time during a six month reference period, to be excessively high. Furthermore, we are aware of no other large data base that describes drug use by individuals who are in frequent contact with the criminal justice system.

[13]To illustrate our approach, suppose that 33 percent of intravenous drug users (IVDUs) consumed cocaine daily. Each of these would have tested positive had they been arrested and their urine tested for cocaine. Suppose that 33 percent of IVDUs used cocaine 1 or 2 times per week. About half of these users would have tested positive for cocaine had they been arrested and their urine tested for cocaine. Suppose that the other 33 percent of IVDUs never used cocaine. Then given the cocaine usage patterns of IVDUs, a typical IVDU would yield a urine test that was positive for cocaine about half of the time (50 percent).

Suppose, in fact, that only 30 percent of all arrestees test positive for cocaine. Then we adjust the cocaine use patterns reported by IVDUs such that 66 percent of arrestees were presumed not to use cocaine, 17 percent used cocaine one or two times per week, and 17 percent used cocaine daily. This new distribution preserves (1) the observed 30 percent of drug-positive urines among arrestees and (2) the ratio of heavy users (defined as daily users) to more moderate users (who use one or two times per week) observed among IVDUs. As this hypothetical example illustrates, usage patterns by IVDUs who used drug x were used to infer usage patterns among arrestees who used drug x. DUF data were used simultaneously to infer the number of users.

[14]For reasons explained in Rhodes, "Using the Drug Use Forecasting System to estimate the prevalence of heavy cocaine and opiate use," we assume that about 50 percent of those cocaine users who test positive at the time of arrest are heavy users—defined as those who use cocaine more frequently than once per week—and that 75 percent of those opiate users who test positive at the time of arrest are heavy users. The responses from IVDUs were adjusted, generally by reducing the percentages of users who reported their frequency of use as more often than once per week, and by increasing the percentage of users who reported their frequency of use as less frequent than once per week, so that the 50 percent (cocaine) and 75 percent (heroin) usage patterns were preserved in the data.

[15]By representative, we do not mean accurate. As the two previous notes indicate, it was necessary to use three explicit assumptions (and several implicit assumptions about the relationship between drug use, being arrested, and testing positive for drug use) to draw conclusions about drug use among the arrestee population. Every one of these assumptions is based on limited data and the assumptions will likely change as data sources are improved.

multiplied by the frequency of drug use among arrestees, which was computed above.

Drug users cycle through American jails and prisons. Based on several data sources, we estimate that a drug user has roughly a 0.6 probability of being arrested during a reference year, and for those drug users who are arrested, an average of 1.5 arrests occur per year.[16] To account for drug users who are not arrested during the reference year (but who are likely to be arrested at some point in time), we divide the estimate of the number of arrestees by 0.6, and divide the result by 1.6. After some other minor adjustments, we conclude that roughly 9.4 million unique people are arrested or (because of their criminal behavior) are at risk of being arrested during the year.

Based on evidence provided by several ethnographers, researchers, and others (users and dealers), we translated use patterns into total amount consumed per session and annualized the results. Amount used per session depended on the route of administration: injecting, snorting, smoking, or ingesting; amount used per session also varied with the frequency with which the user consumed drugs. Purity of the drug also varied with the frequency and mode of consumption. These differences were taken into account in our calculations.

In summary, we distributed the total number of arrested users over the assumed use patterns, multiplied by the amount of drugs consumed, multiplied by the purity of those drugs, and summed the results. Individuals who are involved with the criminal justice system consumed about 329,000 kilograms (kg) of cocaine, 12,000kg of heroin, and 257,000kg of marijuana[17] per year during 1989. Cocaine and heroin are measured at 100 percent purity. The total retail values are: cocaine, $20 billion; heroin, $16 billion;[18] marijuana, $3 billion; and other illicit substances, $2 billion.

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[16]See Rhodes, 1991. These statistics apply to drug users who are involved with the criminal justice system because of criminal activity that goes beyond the consumption of illicit drugs per se. Members of households who consume drugs but who fail to come to the attention of the criminal justice system because of an otherwise conventional life-style are not included in these statistics.

[17]Throughout this report, we have assumed that one joint contains 1/4 gram of marijuana. More recent evidence indicates that 1/2 gram may be more accurate. Because our calculations are based primarily on joints consumed, and we have assumed that a joint cost $2.50, our estimates of amount consumed (in kilograms) is independent of our estimates of cost of this consumption (in dollars).

[18]It is useful to approach calculations for heroin users from different assumptions. According to our investigations, heavy heroin users spent about $300 per week for their habits. This figure takes into account the fact that heroin users sometimes are unable to purchase drugs. Assuming that there exist between 500,000 and 700,000 heroin addicts, and that a milligram of pure heroin has a retail price of about $1.33 (based on composite figures derived from a variety of sources including the Drug Enforcement Administration's Domestic Monitor Program, the June 1990 report of the Community Epidemiology Work Group, street ethnographers, other researchers, users and dealers), we estimate that between 6,000 and 8,000kg of heroin is consumed. Assuming that there are about 250,000 heroin users who are not addicted (cited in Turner, et al., AIDS: Sexual Behavior and Intravenous Drug Use, Washington, D.C.: National Academy Press, 1989, p. 229), and that these occasional users spend

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The above steps cannot be replicated for 1988 and 1990 because the requisite data are unavailable. However, trend data are available from DAWN for 1988, 1989, and the first two quarters of 1990. Assuming that emergency room mentions of cocaine, heroin, and marijuana mirror patterns in the general use of those substances, the retail value of cocaine, heroin, and marijuana consumed by those involved with the criminal justice system is shown in Table 1.

TABLE 1

RETAIL VALUE OF DRUGS CONSUMED BY THOSE IN THE CRIMINAL JUSTICE SYSTEM

(in billions of dollars)

	1988	1989	1990
Cocaine	$20.5	$20.2	$15.4
Heroin	$15.8	$15.5	$12.3
Marijuana	$2.8	$2.6	$2.3
Other Drugs*	$1.6	$1.6	$1.6

* DAWN data were unavailable for "other" drugs, so no trend is shown.

Drug use among the homeless. Based on evidence from a major survey by the Urban Institute,[19] it appears that few of the homeless who abuse drugs avoid contact with the criminal justice system. (This group is to be distinguished from the homeless whose lack of a residence is temporary, generally resulting from dissolution of a marriage or loss of employment.) Because the homeless who abuse drugs are already represented by arrestees, we make no further adjustment for drug use among the homeless.

Drug use among high school students and dropouts. High school students are represented in the Household Survey. However, the High School Senior Survey provides a better picture of drug use among high

$50 per week on heroin, an additional 489kg might be added to these figures, for a total of 6,000kg to 9,000kg. A recent report for NIDA (Hamill and Cooley, National estimates of heroin prevalence 1980-1987: Results from analysis of DAWN emergency room data. RTI technical report, 1990) has estimated that there are closer to 1 million heroin addicts, so even 9,000kg may underestimate the amount of heroin consumed in the United States.

[19]Burt, M. and Cohen, B. America's homeless: Numbers, characteristics, and programs that serve them. Washington, D.C.: The Urban Institute Press, 1989.

school students, for at least three reasons. First, more students are interviewed for the High School Senior Survey than for the Household Survey, so that estimates based on the High School Senior Survey are likely to be more accurate than those based on the Household Survey. Second, the High School Senior Survey provides a greater measure of privacy to its respondents than does the Household Survey. Third, the High School Senior Survey provides more precise measures of frequency of use and amount consumed per session than does the Household Survey. Consequently, we use results from the High School Senior Survey in place of results from the Household Survey to estimate drug use among students in grades 6–12.

The High School Senior Survey reports the frequency of drug use among seniors through categories "never," "once" and so on. The response "40 or more times" presents some difficulties. While few seniors consume drugs at this frequency, those few account for most of the drugs consumed. Simply put, one person who uses cocaine 40 times consumes as much cocaine as 40 people who use cocaine only once. We needed a more precise measure for the response "40 or more times." Based on the question assessing frequency over a 30-day period, we substituted "50 times" for the response "40 or more times" in the following calculations.

The High School Senior Survey is asked of seniors only. To extend the responses of seniors to students in grades 6 through 11, we assumed that the distribution of responses on frequency of use by seniors who reported drug use during the year would have been the same as the responses of drug-using students in the lower grades had those students been questioned. However, the percentage of students in the lower grades who were assumed to use drugs was reduced from that of responding seniors to reflect tabulations from the 1988 Household Survey regarding the yearly prevalence of drug use for students aged 12–18.[20]

Combining estimates for seniors and for students in grades 6–11, in 1988 high school students in the United States took cocaine during roughly 5 million sessions, marijuana during 46 million sessions, barbiturates during 2.0 million sessions, tranquilizers during 2.2 million sessions, amphetamines during 8.1 million sessions, and inhalants during 5.7 million sessions. By a "session," we mean a distinct time or times (such as once per day and three times per week) during which the respondent reported consuming drugs.

To estimate the quantity of drugs consumed per session, we made judgmental estimates, based on the length of time that students report being under the influence, on limited information about drug consumption from the Household Survey, and from discussions with ethnographers.

[20]Using the Household Survey data for 1988 and 1990, we computed the percentage of students who said they had used drug x during the year, by year (1988 and 1990) and by age (12 through 18). We assumed that drug prevalence for seniors was the reported average for respondents who were 17 or 18, that drug prevalence for juniors was the reported average for respondents who were 16 or 17, and so on. For 1989, we used the average for 1988 and 1990. The tabulations were conducted separately for cocaine, for marijuana, and for "any drug."

During 1990, students in grades 6 through 12 consumed an estimated 2,800kg of pure cocaine. They consumed 34,000kg of marijuana and an insignificant amount of heroin. These students spent an estimated $276 million on cocaine, $343 million on marijuana, and $32 million on other illicit substances.

This estimation method was repeated for 1989. However, complete tabulations were unavailable for the 1990 High School Senior Survey, so we projected the 1989 result forward one year based on the ratio of percentage of high school seniors who reported using drug X (cocaine, marijuana, and other drugs) during 1990 to the percentage who reported using drug X during 1989. The retail value of cocaine, heroin, and marijuana consumed by high school students is shown in Table 2.

TABLE 2

RETAIL VALUE OF DRUGS CONSUMED BY HIGH SCHOOL STUDENTS

(in millions of dollars)

	1988	1989	1990
Cocaine	$303	$299	$276
Heroin		INSIGNIFICANT	
Marijuana	$360	$358	$343
Other	$36	$37	$32

As for dropouts, roughly 15 percent of high school students drop out. When applied to the earlier estimates of drug use among high school students, this figure implies about 420kg of cocaine consumed by school-age dropouts during 1990. Direct estimates based on three years of Household Survey data suggest a figure of 392kg. Because the estimate of 15 percent seems accurate for cocaine consumption (for which we have separate estimates from the Household Survey), we will use it for other drugs as well (for which we do not always have estimates from the Household Survey). Thus, we conclude that the retail value of cocaine, heroin, marijuana, and other drugs consumed by those who are high school dropouts is as shown in Table 3.

TABLE 3

RETAIL VALUE OF DRUGS CONSUMED BY HIGH SCHOOL DROPOUTS

(in millions of dollars)

	1988	1989	1990
Cocaine	$45	$45	$41
Heroin		INSIGNIFICANT	
Marijuana	$54	$54	$51
Other	$5	$5	$5

Drug use among college students. The Household Survey excludes drug use by college students who live in fraternities and dormitories, so for these young adults, the Household Survey's coverage is incomplete. The High School Senior Survey reports drug use by a sample of college students, and we use these data to make some calculations.

The High School Senior Survey does not report frequency of use by college students with sufficient detail for use in our calculations. We assumed that college students who use drugs use them at the same frequency as high school seniors who use drugs. Consequently, we applied frequency of use estimates for high school seniors to college students.

The High School Senior Survey reports the percentage of college students who use drugs. We multiplied this percentage by the number of college students and applied the frequency of use distribution to estimate that during 1988 college students consumed cocaine during 12 million sessions, marijuana during 61 million sessions, inhalants during 3.2 million sessions, amphetamines during 6.6 million sessions, barbiturates during 1.0 million sessions, and tranquilizers during 2.5 million sessions.

Otherwise making the same assumptions as were made for high school students, we conclude that during 1988, college students consumed about 8,000kg of pure cocaine[21] and 46,000kg of marijuana. Heroin use is rare among college students (0.1 percent during a 30 day period). We have excluded heroin consumed by college students from our calculations.

[21]Separate estimates based on the Household Survey indicate that college students consume about 10,000kg of pure cocaine. Because the Household Survey excludes college students who lived in dormitories and fraternities, the figure based on the Household Survey is surprisingly higher than the figure based on the High School Senior Survey. This difference is especially notable, because according to the High School Senior Survey, about 43 percent of college students lived in dormitories and fraternities, so the estimates based on the High School Senior Survey would be expected to be about twice as large as those based on the Household Survey. The figure based on the Household Survey is considered unreliable, however, because calculation of the average amount of cocaine consumed was unduly influenced by a few responses of unreasonably high amounts.

To extend the 1988 results to 1989 and 1990, we equated the trends for college students to the trends for high school students. The retail value of cocaine, heroin, marijuana, and other drugs consumed by college students is shown in Table 4.

TABLE 4

RETAIL VALUE OF DRUGS CONSUMED BY COLLEGE STUDENTS

(in millions of dollars)

	1988	1989	1990
Cocaine	$651	$644	$594
Heroin		INSIGNIFICANT	
Marijuana	$453	$451	$431
Other	$22	$23	$20

Drug use among military personnel. The military sponsors a semiannual survey of drug use among military personnel, including those who live in barracks, who are not represented in the Household Survey. According to the most recent survey, roughly 39,000 servicemen and servicewomen used cocaine sometime during 1988; 14,000 used cocaine within thirty days of the survey.[22] (Estimates are revised to include only military personnel stationed in the United States.) Roughly 3,000 service personnel used heroin or other opiates during 1988; about 1,500 used heroin within 30 days of the interview.

If we assume that military personnel who used heroin and cocaine, use those drugs at about the same rate as civilians who responded to the Household Survey, then military personnel consume about 83kg of pure cocaine and 0.2kg of heroin. These amounts are almost insignificant when compared to the amount of drugs consumed by other Americans. Consequently, we have not estimated the amounts of other drugs consumed by military personnel.

Drug use among individuals in treatment. At the time of the Household Survey, some drug users are in therapeutic community residential settings or otherwise outside of households while undergoing treatment. However, sources at NIDA advise that drug use among this population is insignificant, so they are not included in our tabulations.

[22]Bray, R., et al. 1988 Worldwide Survey of Substance Abuse and Health Behaviors among Military Personnel. RTI/4000/02FR, December 1988.

Drug use among members of households.[23] The steps taken above allow us to estimate the number of drug users and the frequency at which drugs are used for six cohorts: individuals who are involved with the criminal justice system, the homeless, children who are in high school and grade school, dropouts, young adults who attend college, and military personnel. To these estimates, we add the estimates of drug use among other Americans as that drug use is represented by the Household Survey.

From the Household Survey, we excluded respondents who were high school students, who were high school dropouts, who were college students, or who indicated that their drug consumptions caused them to have problems with the criminal justice system. Remaining respondents were members of households who have not been covered already by our calculations.[24]

Using the 1990 Household Survey, we tabulated responses for the question: "How much cocaine did you use during the last 30 days?" Using the number of responses as the base, we derived estimates of drug use by the household population. This involved multiplying the responses by 12 (to annualize them), applying sampling weights (the data overrepresent some groups and underrepresent others), and computing an average. The average was multiplied by the number of Americans who admitted to using cocaine during the 30 days prior to the interview.[25] Similar calculations

[23]We could estimate drug consumption bases on the Household Survey alone. To illustrate, the 1990 Household Survey indicates that, of about 200 million Americans who were age 12 or older, roughly 0.8 percent—1.6 million Americans — used cocaine during the month prior to the 1990 interview. According to our calculations, which were based on the Household Survey data, those people who consumed cocaine during the reference period consumed about one gram per month — 12 grams when annualized. Assuming that these drugs had a street standard purity of 50 percent, the Household Survey implies that Americans consumed about 19,000kg of cocaine during 1990. Estimates presented later in this report indicate that 19,000kg is, in fact, less cocaine than is consumed in America.

Three factors explain why estimates based on the Household Survey understate drug use: (1) Many heavy drug users do not live in households, so these drug users are not represented by the Household Survey. Even those heavy drug users who live in households may be undercounted, because heavy drug users are frequently out of the house, hustling, and even when they are home, they may be reluctant to be interviewed. (2) Because drug use is illegal, drug users may refuse to reveal or may understate their drug use to the interviewer, promises of confidentiality notwithstanding. (3) The minority of drug consumers who are addictive or compulsive users receive no special representation in the survey. Consequently, while the Household Survey provides an indispensable picture of drug use among members of the household population, it cannot provide a complete picture of total drug use by all Americans, both those who live in households and those who live outside households.

[24]The residual group probably contains a significant number of individuals who are already included in the group of arrestees because the variable used to exclude people involved with the criminal justice system was not comprehensive. During 1985, respondents were asked whether drug abuse had resulted in an arrest. This question was not asked in 1988 and 1990. As an approximation, we excluded from the residual group the same percentage of respondents who were involved with the criminal justice system according to the 1985 survey data.

[25]Not all respondents who admitted to drug use during the 30 days prior to the interview answered the question about the amount consumed during that time frame. Consequently, we had to estimate an average based on the available responses and then multiply this average by the number admitting to use. In 1985, members of the residual group used almost 1 gram of cocaine on average per month. In 1988 and 1990, the figure was about 0.9 grams. We assume these reported amounts were about 50 percent pure.

were made for marijuana consumption, except we deemed it necessary to adjust the reported responses for the amount of marijuana consumed during the 30 days prior to the interview.[26]

Also, because only about 70 percent of drug use is likely to be reported on the Household Survey, we multiplied all estimates by 1.43. Thus, to the yet unmeasured part of the household population, we attribute 12,000kg of cocaine and 242,000kg of marijuana. Unfortunately, with the exception of cocaine and marijuana, the Household Survey does not report patterns of drug consumption with more detail than "consumed in the last 30 days" and "consumed during the year." We adopted an expedient to fill the remaining gap in our estimate of the household population's consumption. We used the Household Survey to determine the amount of other drugs that were consumed by high school students, college students, and dropouts relative to the residual group. We found that the residual group (the unmeasured part of the household population) consumed about 2.2 times as many drugs as the students and dropouts combined.[27] Consequently, we attributed to this residual group 2.2 times as much drug use as we had already attributed to the students and dropouts. We estimate that this population spent $1.2 billion on cocaine, $2.4 billion on marijuana, and $108 million on other illicit substances.

The above calculations were repeated using data from the 1988 Household Survey. To derive estimates for 1989, a year during which no national survey of drug use was conducted, we averaged the responses from 1988 and 1990. Thus, we conclude that the retail value (in billions) of cocaine, heroin, marijuana, and other drugs consumed by those members of households who are not students or dropouts is as shown in Table 5.

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[26]Respondents are asked a question about how much marijuana they consumed during the last 30 days. Allowable responses are 1-10 joints, 11-20 joints, 1 ounce, 2 ounces, and so on. We first assumed that 1-10 joints meant 5 joints, that 11-20 meant 15 joints, and that ounces were the midpoint when reported as a range. Assuming further that a joint was 0.25 grams and that marijuana cost $10 per gram, we derived estimates of amount consumed that were unreasonably large when compared to other sources, including results based on DUF and the High School Senior Survey. Further investigation revealed that the question about amount consumed yielded results that were inconsistent with the responses from other questions in the Household Survey, such as questions about frequency of use. Our conclusion was that respondents did not answer the question about amount of use with sufficient accuracy to be credible. However, we were willing to believe that responses of 1-10 joints and 11-20 joints were accurate; all other responses were treated as "more than 20 joints." The distribution of responses appeared to be roughly consistent with an exponential distribution. We estimated the parameters for this distribution first based on the percentages of 1-10 joints and second based on the percentages of 11-20 joints. The average value of those two parameter estimates was used to infer that the average member of the residual group consumed 3 grams of marijuana per month—roughly 12 joints.

[27]The adjustment figure of 2.2 was derived by computing the amount of cocaine consumed by members of the residual group relative to students and drop-outs for each year 1985, 1988, and 1990 (three estimates). The calculations were repeated for marijuana (three estimates). The six estimates were averaged. Prior to computing the estimates, we doubled the amount of drug consumption attributable to college students by the Household Survey to adjust for the fact that roughly 50 percent of college students do not live in households as defined for purposes of the Household Survey.

TABLE 5

DRUGS CONSUMED BY MEMBERS OF HOUSEHOLDS WHO ARE NOT STUDENTS, DROPOUTS, OR CJS*-INVOLVED

(In billions of dollars)

	1988	1989	1990
Cocaine	$1.4	$1.3	$1.2
Heroin		INSIGNIFICANT	
Marijuana	$3.5	$3.0	$2.4
Other	$0.1	$0.1	$0.1

*Criminal Justice System

Drug use totals. According to our consumption-based estimating procedure, during 1990 Americans spent approximately $18 billion on cocaine, $12 billion on heroin, $9 billion on marijuana, and $2 billion on other illegal drugs. These estimates are expressed as dollar equivalents because payment for illicit drugs is often "income in kind" resulting from dealers retaining drugs for personal use, users helping dealers in exchange for drugs, and users performing sex for drugs (especially crack cocaine).

Although it is difficult to be precise about changes over time, given the imprecision in estimates of amounts consumed and street prices for illegal drugs, trends seem to emerge. The retail value of cocaine appears to have fallen by about 24 percent from 1988 to 1990. The retail value of heroin seems to have fallen by a smaller percentage—about 22 percent. Expenditures on marijuana consumption have fallen by 24 percent from 1988 to 1990. We were unable to compute trends for expenditures on other illegal drugs.

Estimates of Drug Users and Drug Use from Other Sources.

Our crude estimate is that in the United States during 1990 there were between 1.7 and 1.8 million heavy cocaine users[28] and approximately 0.7 million heroin addicts.[29] (Heavy opiate and heavy cocaine users overlap.) Although we are not interested in estimates of the number of users, per se, the reasonableness of these figures is important. Because a minority of heavy drug users consume a disproportionately large amount of drugs, our estimates of the number of heavy drug users must be accurate.

[28]Abt Associates, Inc. Heavy cocaine use in the United States: The number of users. Paper prepared for the Office of National Drug Control Policy, dated April 2, 1991.

[29]Rhodes, W. Using the Drug Use Forecasting system to estimate the prevalence of heavy cocaine and opiate use. Draft report submitted to the National Institute of Justice, dated April 3, 1991.

Lending credence to these estimates are similar estimates by others based on different assumptions and data. Homer[30] estimated somewhat fewer than two million weekly cocaine users for 1989. Although Clayton[31] estimated only 500,000 compulsive users during 1982-84, his estimates predate the explosive growth in the use of crack cocaine, which has addictive properties exceeding that of powdered cocaine. Estimates developed for the National Institute of Justice find about two million heavy cocaine users during 1988-1989.[32]

Regarding heroin users, Brodsky,[33] in a review of four approaches used to estimate the number of heroin addicts, reports estimates of 242,000-558,000 for 1969 through 1975, 540,000-584,000 for 1974 through 1975, 420,000-523,000 for 1976 through 1980, and 434,000 through 496,000 for 1972 through 1982. Turner et al.[34]—reporting for a Panel of the National Academy of Science—report NIDA estimates of about 500,000 heroin addicts. Hamill and Cooley[35] estimate 853,000 heroin addicts in 1987 and projected about one million for 1989, figures that they consider to be high. Gerstein and Harwood[36] provide estimates of the total number of drug users who are in need of treatment: 2.4 million were clearly in need of treatment, and 5.5 million were probably in need of treatment. Were we to consider heavy drug users as those who are in need of treatment, then the Gerstein and Harwood estimates seem to bracket our estimates for cocaine and heroin abuse alone.

As Spencer[37] has argued, these statistics are not based on firm statistical knowledge, but they are probably the best available. They are consistent with the 1990 estimate of between 1.7 and 1.8 million heavy cocaine users and 0.7 million heroin users assumed for the calculations made in this report.

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[30]Homer, J. A system dynamics simulation model of cocaine prevalence. University of Southern California, 1990, unpublished paper.

[31]Clayton, R. Cocaine use in the United States: in a blizzard or just being snowed? In Kozel, N. and Adams, E. Cocaine use in America: epidemiological and clinical perspectives. Washington, D.C.: U.S. Government Printing Office, NIDA research monograph 61, 1985.

[32]Rhodes, W. Using the Drug Use Forecasting system to estimate the prevalence of heavy cocaine and opiate use. Draft report submitted to the National Institute of Justice, April 3, 1991.

[33]Brodsky, M. History of heroin prevalence estimation techniques. In Rouse, B., Kozel, N. and Richards, L. (eds.) Self report methods of estimating drug use: meeting challenges to validity. NIDA research monograph 57, 1985.

[34]Turner, C., Miller, H. and Moses, L. (eds.) AIDS: Sexual Behavior and Intravenous Drug Use. Washington, D.C.: National Academy Press, 1989.

[35]Hamill and Cooley. National estimates of heroin prevalence 1980-1987: Results from analysis of DAWN emergency room data. RTI technical report, 1990.

[36]Gerstein, D. and Harwood, H. (eds.) Treating drug problems: Volume 1. National Academy Press, 1990.

[37]Spencer, B. The accuracy of estimates of numbers of intravenous drug users. In Turner, C., Miller, H. and Moses, L. (eds.) AIDS: Sexual Behavior and Intravenous Drug Use. National Academy Press, 1989, pp. 429-446.

As a rough cross-check of the numbers presented earlier, if we assume that 1.9 million heavy users of cocaine consumed 80 percent of the cocaine that was sold during 1989, and if we assume that pure cocaine cost about $100 per gram, a heavy user of cocaine consumed about 1.8 grams per week on average. The weekly cost was about $182. If we assume that 0.7 million heavy users of heroin consumed 90 percent of the heroin that was consumed during 1989, and if we assume that heroin cost about $1.33 per milligram, a heavy user of heroin consumed an average of 0.29 grams of pure heroin per week. The weekly cost was about $380. These estimates are within the ranges that seem credible to many experienced drug researchers with whom we spoke.[38]

A rough cross-check for marijuana expenditures is less convincing. Based on responses to the Household Survey's question about the amount of marijuana used during the month preceding the survey, we would estimate that the average marijuana user consumes 15 grams per month. At a street price of $10 per gram, this suggests that the average user spends $1,800 per year for marijuana alone. Although we consider this estimate to be too high, it is useful as an upper bound.

About 10.2 million Americans admitted using marijuana during the month preceding their interview; about 2.6 million Americans tested positive for marijuana use at the time of their arrest. If each of these individuals spent $1,800 per year, then after eliminating overlap between arrestees and household members, the retail sales value of marijuana must be about $20 billion dollars. In fact, we consider these estimates to be far too high, but they do suggest that the estimate for the retail value of marijuana ($5.6-$7.3 billion when all the above user groups are considered) is too small. As a judgement estimate, we inflate the original 1989 estimate for marijuana ($6.3 billion) to $10 billion.

Some additional independent verification that our estimates are too small comes from a study by Kleiman.[39] He estimates that during 1988 the marijuana market had a retail value of $3.5 billion for domestic crops and $10.4 billion for imported crops—for a total retail value of $14 billion. The revised estimate is roughly consistent with Kleiman's estimate, especially if we take into account survey results that show a recent decline in marijuana consumption.

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[38]All experienced drug researchers are reluctant to describe a typical heavy user, partly because drug consumption is volatile. Cocaine is often consumed in binges. The user may go days or weeks with no consumption and then use cocaine for several days at an extremely high rate. After this binge, he or she may recuperate prior to beginning a new cycle of use. The two grams per week should be considered as an average over long periods of time during which the user's pattern of use fluctuates greatly.

[39]Kleiman, M.A.R. Marijuana; Costs of Abuse, Costs of Control. New York: Greenwood Press, 1989, pp. 43-44.

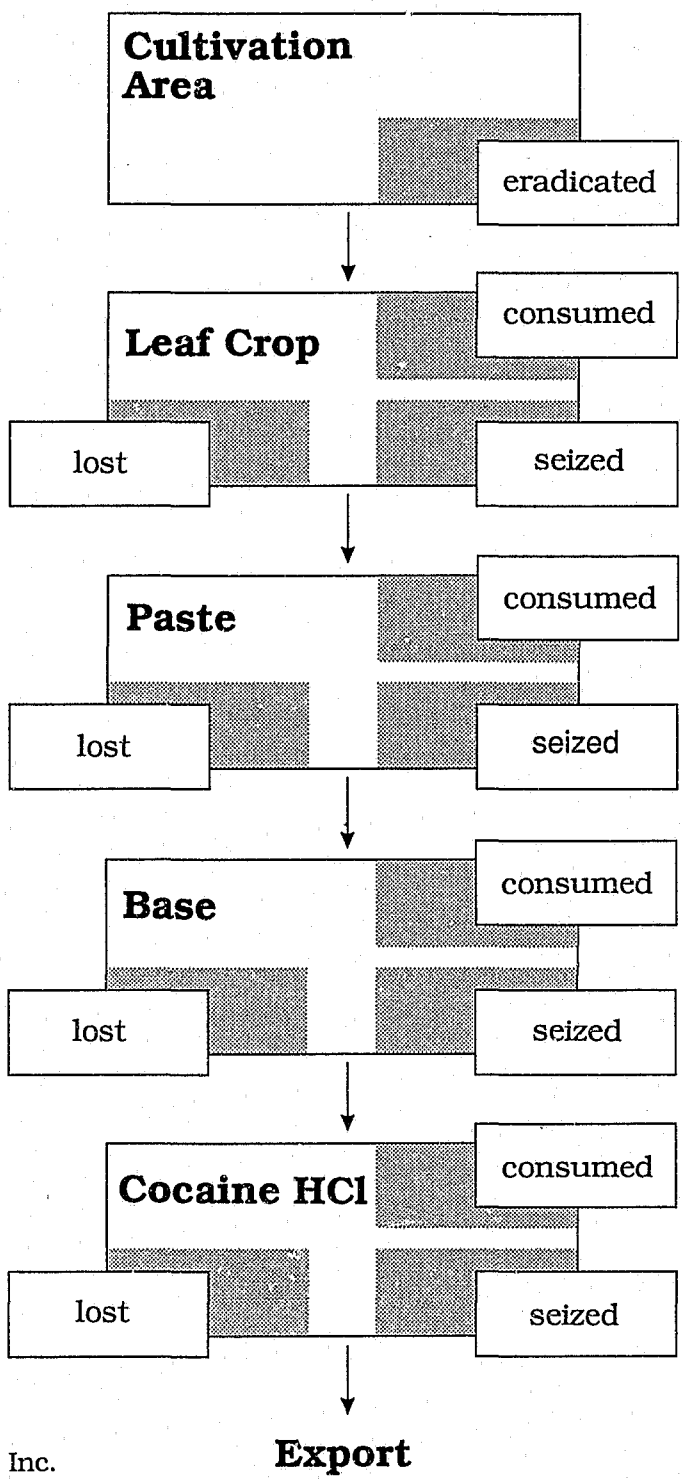
II. THE SUPPLY APPROACH

A second approach to estimating the retail sales value of illicit drugs consumed within the United States is to develop estimates not of consumers' demand but of the amounts supplied to the domestic markets. For reasons discussed below, the development of such estimates is practical only for cocaine. This section discusses the information and assumptions relied upon to estimate the supply of cocaine to the United States, and then discusses why the supply of heroin, marijuana, and other illegal drugs cannot be estimated satisfactorily.

Cocaine. Efforts to determine the amount of cocaine available for consumption in the United States have typically relied upon estimates of the maximum possible harvests of coca leaf in South American countries. Such estimates are problematic for two reasons. The first is that information about these yields at each of the various stages of coca cultivation and cocaine processing is imprecise, while estimates of annual cocaine production are dramatically affected by the assumptions one makes about these yields. The second problem is that estimates of maximum available supply cannot be translated readily into amounts actually available to United States consumers because some portion of the coca leaf harvest and its derivative products—including cocaine—is taken out of the production "pipeline" by various means, including spoilage, seizures, and other losses. Cocaine is also sent to destinations other than the United States.

The steps in the processing of cocaine are illustrated in Figure 2. Coca bushes are cultivated in several zones of South America — principally in the Andean Nations. Some bushes are destroyed by government-sponsored eradication efforts. Coca leaf has long been consumed by the indigenous South American population for medicinal and dietary purposes, and some proportion of each year's crop continues to be consumed locally. What remains — and survives spoilage, seizure, and loss — is used to produce cocaine. This transformation occurs by chemically treating coca leaves to produce coca paste, which can then be treated further to create "base." Still another chemical process is used to turn base into cocaine hydrochloride (HCl), or pure cocaine. Each of these final and intermediate products may be consumed, lost, or seized, and thereby taken out of the pipeline. Trying to determine the amount of cocaine that this industry produces is complicated further by the fact that most cocaine is not manufactured in the same country in which coca leaves are grown. Instead, intermediate products and the chemicals needed for cocaine production are moved across borders to clandestine laboratories in a number of different countries.

Figure 2 — Cocaine Production Process



Abt Associates, Inc.

Once pure cocaine is produced, it enters a complex distribution network, and various transshipment points are used to facilitate undetected entry into the United States. At these transshipment points, some of the cocaine is taken out of the pipeline by local consumption and seizures by government authorities. Figure 3 illustrates the routes taken by coca leaves grown in Bolivia as they are transformed into intermediate products and ultimately into cocaine, which is then shipped to world markets. The routes indicated here are thought to be the principal ones; routes of lesser importance are omitted. The number of countries through which cocaine is shipped on its way to the main consumer countries is also larger than shown here. Moreover, the proportion of cocaine shipped through each of the transshipment countries cannot be estimated reliably.

The Abt Associates Cocaine Supply Model: Information, Assumptions, and Findings. To integrate information about the cocaine pipeline, including both its manufacturing and transportation aspects, Abt Associates has developed a computer-assisted Cocaine Supply Model, which implements a preliminary version of a model of cocaine supply being developed by RAND for the Departments of the Air Force and the Army.[40] This model computes the inputs and outputs at several different steps as coca leaves are processed into derivative products and then cocaine.

This model uses various kinds of information. These include estimates of: (1) land area under cultivation in known producer countries, (2) eradicated cultivation areas, (3) coca leaf crop yield, (4) the efficiency of the process for converting leaf to intermediary products and then to cocaine, (5) losses, consumption, and seizures within producer and transshipment countries, (6) quantities destined for the United States and other markets, and (7) amounts seized by Federal authorities in or near the United States.

Figures 4, 5 and 6 show a report derived from the model for each of three years: 1988, 1989, 1990. Each of these figures traces estimates of the cultivation and manufacturing steps that result in the production of pure cocaine available for transport to potential consumers. Estimates of the amounts seized, consumed, and lost to and from transshipment countries, and of the amounts seized by United States authorities are not included in the figures. (Cells without information signify that data are not available to support an estimate, rather than indicating zero amounts.) Because data pertaining to transshipment are so inconsistently available, we are not able to model the complex transshipment process usefully. Known seizures are therefore computed separately, in aggregate, for all transshipment countries combined. Using the model, we estimate that during 1990 approximately 594-696 metric tons of pure cocaine were produced and available for export to consuming countries, either directly or through transshipment countries. This compares to an estimated 582-683 metric tons in 1989 and 595-697 metric tons in 1988. (The higher

[40]The final version of the model, authored by Susan Resetar, will be published by RAND; at that time RAND will also make available a disk with the data and the model.

Figure 3 — The International Cocaine Network
Bolivian Cociane

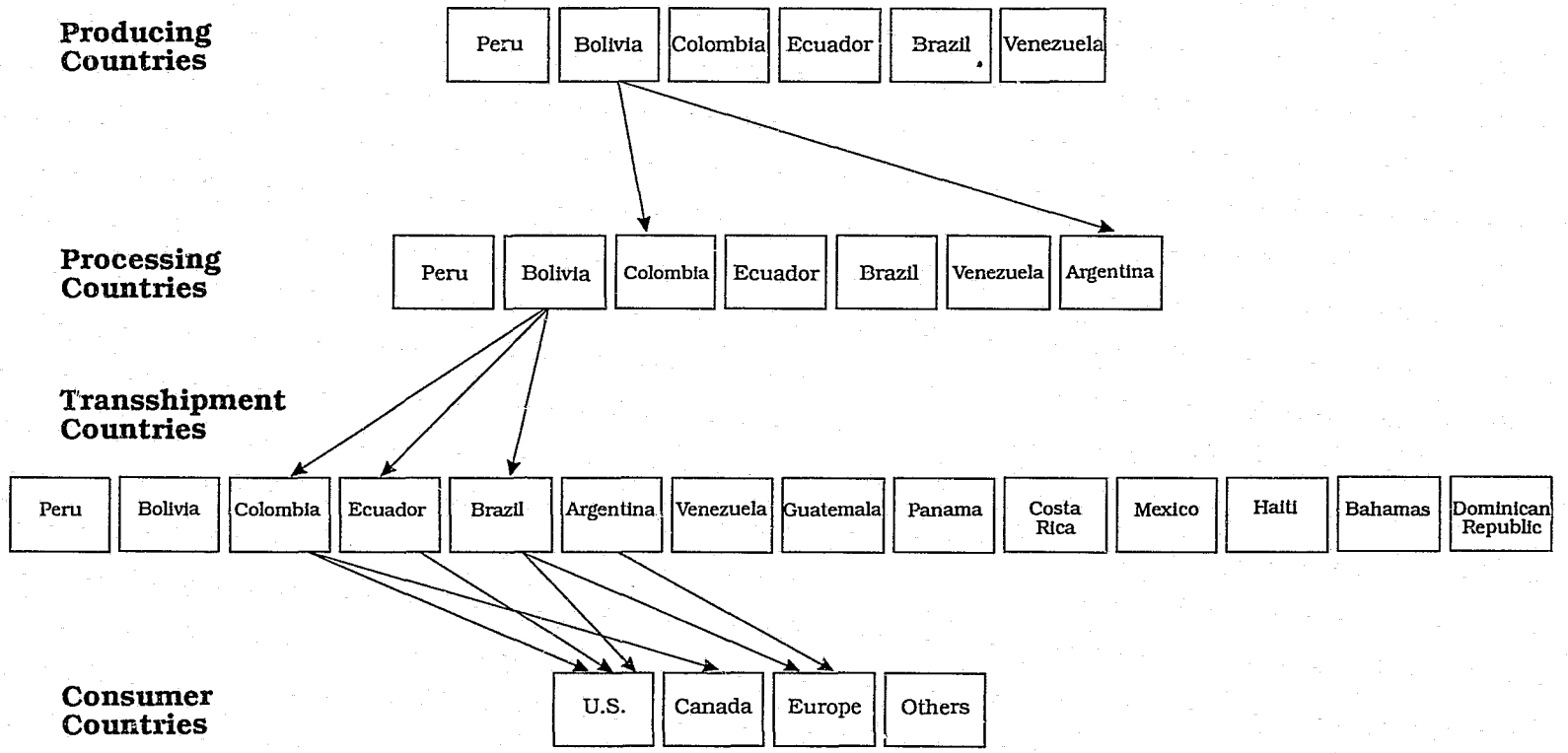


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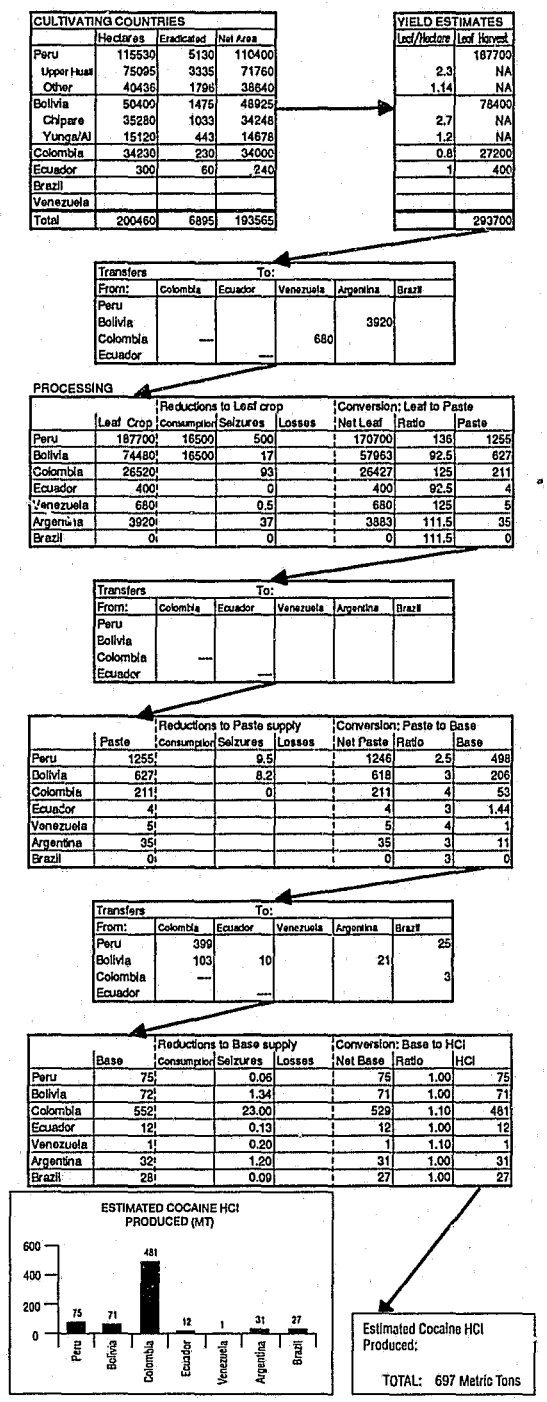
Figure 4
Cultivation and Production of Cocaine HCl, 1988



CULTIVATING COUNTRIES

	Hectares	Eradicated	Net Area
Peru	115530	5130	110400
Upper Huall	75095	3335	71760
Other	40436	1796	38640
Bolivia	50400	1475	48925
Chipare	35280	1033	34248
Yunga/Al	15120	443	14678
Colombia	34230	230	34000
Ecuador	300	60	240
Brazil			
Venezuela			
Total	200460	6895	193565

YIELD ESTIMATES

Leaf/Hectare	Leaf Harvest
	187700
2.3	NA
1.14	NA
	78400
2.7	NA
1.2	NA
0.8	27200
1	400
	293700

Transfers

From: \ To:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru					
Bolivia				3920	
Colombia	---		680		
Ecuador		---			

PROCESSING

	Leaf Crop	Reductions to Leaf crop: Consumption	Seizures	Losses	Conversion: Leaf to Paste: Net Leaf	Ratio	Paste
Peru	187700	16500	500		170700	136	1255
Bolivia	74480	16500	17		57963	92.5	627
Colombia	26520		93		26427	125	211
Ecuador	400		0		400	92.5	4
Venezuela	680		0.5		680	125	5
Argentina	3920		37		3883	111.5	35
Brazil	0		0		0	111.5	0

Transfers

From: \ To:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru					
Bolivia					
Colombia	---				
Ecuador		---			

	Paste	Reductions to Paste supply: Consumption	Seizures	Losses	Conversion: Paste to Base: Net Paste	Ratio	Base
Peru	1255		9.5		1246	2.5	498
Bolivia	627		8.2		618	3	206
Colombia	211		0		211	4	53
Ecuador	4				4	3	1.44
Venezuela	5				5	4	1
Argentina	35				35	3	11
Brazil	0				0	3	0

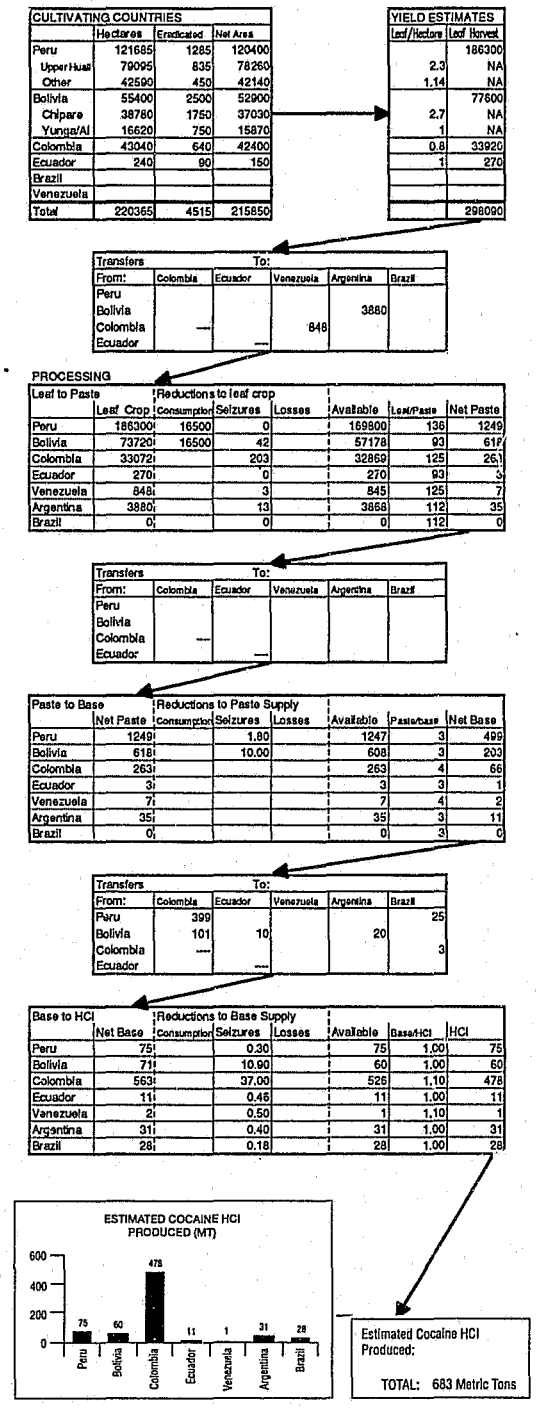
Transfers

From: \ To:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru	399				25
Bolivia	103	10		21	
Colombia	---				3
Ecuador		---			

	Base	Reductions to Base supply: Consumption	Seizures	Losses	Conversion: Base to HCl: Net Base	Ratio	HCl
Peru	75		0.06		75	1.00	75
Bolivia	72		1.34		71	1.00	71
Colombia	552		23.00		529	1.10	481
Ecuador	12		0.13		12	1.00	12
Venezuela	1		0.20		1	1.10	1
Argentina	32		1.20		31	1.00	31
Brazil	28		0.09		27	1.00	27

Source: INCSR 1991; memorandum from ONDCP; telephone conversations with Bureau of International Narcotics Matters, Department of State.

Figure 5
Cultivation and Production of Cocaine HCl, 1989



CULTIVATING COUNTRIES

	Hectares	Eradicated	Net Area
Peru	121685	1285	120400
Upper Huallaga	79095	835	78260
Other	42590	450	42140
Bolivia	55400	2500	52900
Chipare	38780	1750	37030
Yungas/Al	16620	750	15870
Colombia	43040	640	42400
Ecuador	240	90	150
Brazil			
Venezuela			
Total	220365	4515	215850

YIELD ESTIMATES

Leaf/Hectare	Leaf Harvest
	186300
2.3	NA
1.14	NA
	77600
2.7	NA
1	NA
0.8	33920
1	270
	298090

Transfers	To:				
From:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru					
Bolivia				3880	
Colombia	---		848		
Ecuador		---			

PROCESSING

Leaf to Paste		Reductions to leaf crop					
	Leaf Crop	Consumption	Seizures	Losses	Available	Leaf/Paste	Net Paste
Peru	186300	16500	0		169800	136	1249
Bolivia	73720	16500	42		57178	93	615
Colombia	33072		203		32869	125	263
Ecuador	270		0		270	93	3
Venezuela	848		3		845	125	7
Argentina	3880		13		3868	112	35
Brazil	0		0		0	112	0

Transfers	To:				
From:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru					
Bolivia					
Colombia	---				
Ecuador		---			

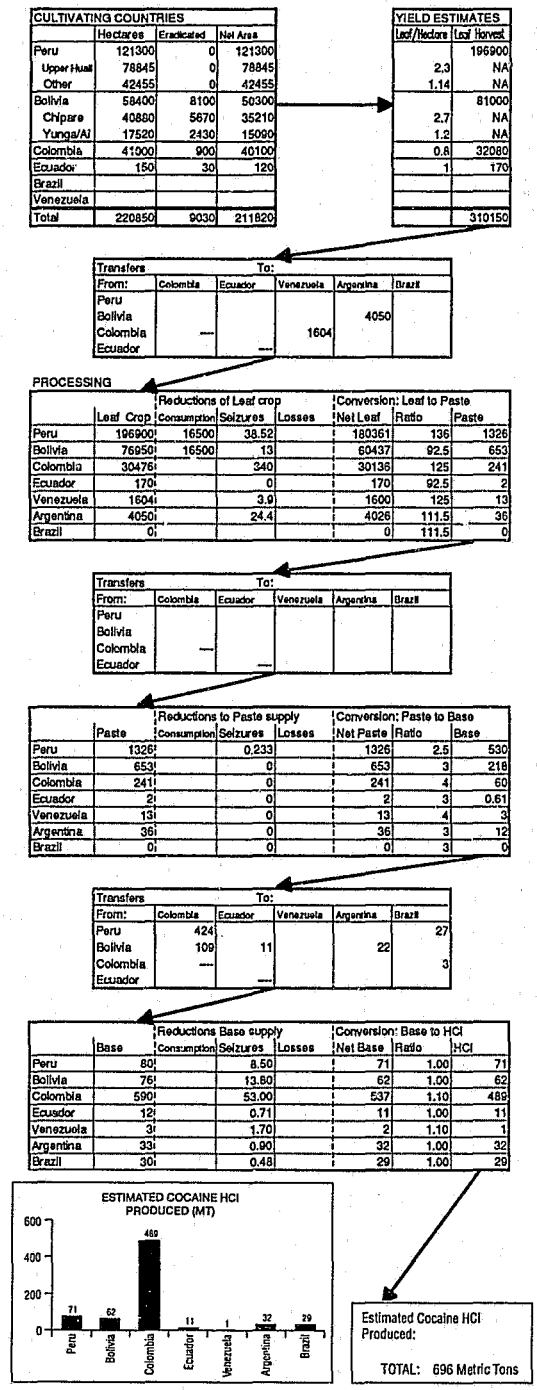
Paste to Base		Reductions to Paste Supply					
	Net Paste	Consumption	Seizures	Losses	Available	Paste/base	Net Base
Peru	1249		1.80		1247	3	499
Bolivia	618		10.00		608	3	203
Colombia	263				263	4	66
Ecuador	3				3	3	1
Venezuela	7				7	4	2
Argentina	35				35	3	11
Brazil	0				0	3	0

Transfers	To:				
From:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru	399				25
Bolivia	101	10		20	
Colombia	---				3
Ecuador		---			

Base to HCl		Reductions to Base Supply				
	Net Base	Consumption	Seizures	Losses	Available	Base/HCl	HCl
Peru	75		0.30		75	1.00	75
Bolivia	71		10.90		60	1.00	60
Colombia	563		37.00		526	1.10	478
Ecuador	11		0.46		11	1.00	11
Venezuela	2		0.50		1	1.10	1
Argentina	31		0.40		31	1.00	31
Brazil	28		0.18		28	1.00	28

Source: INCSR 1991; memorandum from ONDCP; telephone conversations with Bureau of International Narcotics Matters, Department of State.

Figure 6
Cultivation and Production of Cocaine HCl, 1990



CULTIVATING COUNTRIES	Hectares	Eradicated	Net Area
Peru	121300	0	121300
Upper Huall	78845	0	78845
Other	42455	0	42455
Bolivia	58400	8100	50300
Chipare	40880	5670	35210
Yunga/Al	17520	2430	15090
Colombia	41000	900	40100
Ecuador	150	30	120
Brazil			
Venezuela			
Total	220850	9030	211820

YIELD ESTIMATES	Leaf/Hectare	Leaf Harvest
		196900
	2.3	NA
	1.14	NA
		81000
	2.7	NA
	1.2	NA
	0.8	32080
	1	170
		310150

Transfers	To:				
From:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru					
Bolivia				4050	
Colombia	---		1604		
Ecuador		---			

PROCESSING

	Leaf Crop	Reductions of Leaf crop: Consumption	Seizures	Losses	Conversion: Leaf to Paste: Net Leaf	Ratio	Paste
Peru	196900	16500	38.52		180361	136	1326
Bolivia	76950	16500	13		60437	92.5	653
Colombia	30476		340		30136	125	241
Ecuador	170		0		170	92.5	2
Venezuela	1604		3.9		1600	125	13
Argentina	4050		24.4		4026	111.5	36
Brazil	0				0	111.5	0

Transfers	To:				
From:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru					
Bolivia					
Colombia	---				
Ecuador		---			

	Paste	Reductions to Paste supply: Consumption	Seizures	Losses	Conversion: Paste to Base: Net Paste	Ratio	Base
Peru	1326		0.233		1326	2.5	530
Bolivia	653		0		653	3	218
Colombia	241		0		241	4	60
Ecuador	2		0		2	3	0.61
Venezuela	13		0		13	4	3
Argentina	36		0		36	3	12
Brazil	0		0		0	3	0

Transfers	To:				
From:	Colombia	Ecuador	Venezuela	Argentina	Brazil
Peru	424				27
Bolivia	109	11		22	
Colombia	---				3
Ecuador		---			

	Base	Reductions Base supply: Consumption	Seizures	Losses	Conversion: Base to HCl: Net Base	Ratio	HCl
Peru	80		8.50		71	1.00	71
Bolivia	76		13.80		62	1.00	62
Colombia	590		53.00		537	1.10	489
Ecuador	12		0.71		11	1.00	11
Venezuela	3		1.70		2	1.10	1
Argentina	33		0.90		32	1.00	32
Brazil	30		0.48		29	1.00	29

Source: INCSR 1991; DEA Worldwide Cocaine Situation, 1990; memorandum from ONDCP; telephone conversations with Bureau of International Narcotics Matters, Department of State.

boundary in each year's range is computed on the basis of data and assumptions shown in Figures 4 through 6. The lower boundaries reflect an assumption that consumption of coca leaf in Bolivia and Peru amounted to 66,000 metric tons rather than the 33,000 shown in the figures).

Coca cultivation. Estimates of the amount of land under cultivation in the major coca producing countries—Peru, Bolivia, Colombia, and Ecuador[41]—are published annually in the International Narcotics Control Strategy Report (INCSR) by the State Department's Bureau of International Narcotics Matters.[42] The Bureau's calculations of land under cultivation are reportedly based on "proven methods similar to those used to estimate the size of licit crops at home and abroad"—principally, from satellite photographs.[43] However, the Royal Canadian Mounted Police report different estimates of the land under cultivation.[44] Because we lack the ability to provide an independent assessment of the conflicting estimates, we rely upon the data in the INCSR for our modelling estimates. It should be noted, however, that making different assumptions about the amount of land under cultivation has substantial effects on our estimates of the amount of pure cocaine that is ultimately produced.

Because the yields in the various regions of the cultivating countries vary—resulting in widely different harvest estimates—the Abt model distinguishes among the various regions within certain countries. For example, the INCSR estimates that 65 percent of Peruvian coca cultivation occurs in the Huallaga Valley, and 70 percent of Bolivian coca cultivation occurs in the Chapare region. We estimate that approximately 220,850 hectares were under cultivation for coca leaf during 1990, approximately the same as in 1989 (220,365), but higher than in 1988 (200,460 hectares).

Eradication efforts undertaken by the governments in producer countries, sometimes with the cooperation of the United States Government, result in a reduction of harvestable coca leaves. In 1990, 9,030 hectares—4 percent of the total area reported under cultivation—were destroyed.[45] Lacking information on the exact location of the eradicated areas, we assume for the purposes of the model that eradication is evenly distributed among all cultivated lands. Any different assumption would affect the estimates of leaf harvest.

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[41]Coca is reportedly cultivated in Brazil and Venezuela, but estimates of hectares under cultivation are not available.

[42]Bureau of International Narcotics Matters. International Narcotics Control Strategy Report. Washington, D.C.: Department of State Publications, March 1991.

[43]Ibid., p.7.

[44]Royal Canadian Mounted Police. National Drug Intelligence Estimate 1988/1989. Ottawa, Ontario: Drug Enforcement Directorate, p. 45.

[45]International Narcotics Control Strategy Report, 1991, p.21.

During 1990, approximately 211,820 hectares of land under cultivation for coca leaf were thought to remain after eradication efforts. This was slightly lower than the 1989 estimate of 215,850 hectares, but higher than the 1988 estimate of 193,565.

Coca crop yields are difficult to determine because the process is affected by various conditions, including drought and uncertainty regarding the yield potential of coca bushes. In the 1991 INCSR, assumptions about leaf harvests have changed substantially. Previously, the State Department calculated all coca leaf yields assuming that bushes are harvested once or twice a year. However, according to field research conducted in producer countries, mature coca plants—those two to fifteen years old—in the largest cultivating regions of Peru and Bolivia can be harvested three or four times a year, while younger plants may not be harvested at all or are harvested less frequently. Using this new methodology—which produces "mature cultivation estimates"—the State Department has reanalyzed data for 1988 and 1989, increasing estimates it previously reported for those years. For example, the old methods estimated leaf yield in 1990 to be 244,926 metric tons, whereas the new procedures produced an estimate of 310,150 metric tons. In this report, and in the model, we adopt the estimates produced by the revised procedures.

Cocaine manufacturing. Converting the coca leaves into cocaine HCl is an involved process requiring laboratory equipment and large quantities of chemicals. Clandestine laboratories are located in the cultivating countries and in Argentina, Brazil, and Venezuela. Our knowledge of processing and of the network of clandestine laboratories is based upon reports of laboratories destroyed and upon speculation about the production capabilities of laboratories in various countries.[46]

The model takes into account, where data are available, the transfers of leaf and base to other countries. Unfortunately, most of the cells in the model's section pertaining to transfer are empty because data needed for these estimates are unavailable. Moreover, some of the estimates we have been able to make are quite speculative. For example, we estimate that 3.2 metric tons of base were available in Venezuela for conversion to cocaine HCl during 1990. The government there reported seizing 1.7 metric tons, about half of the estimated supply. This may suggest that the estimate of the supply of base in Venezuela during 1990 is too conservative. However, the data needed to develop a more precise estimate are unavailable.

As law enforcement officials in producer countries increase their activities, more drug traffickers may move their processing facilities to

[46]In the model, we estimate that 5 percent of Bolivian leaf is transferred to Argentina based on "International Narcotics Control Strategy Report" estimates of Argentinean production capabilities. International Narcotics Control Strategy Report, 1991, p. 79.

[47]The Drug Enforcement Administration reports seizures of cocaine HCl conversion laboratories in the Netherlands and Spain. Drug Enforcement Administration, Office of Intelligence. Worldwide Cocaine Situation. Washington, D.C.: January 1991, p. 34.

other countries. This possibility is limited for the initial stage of the process because of the spoilage rate of leaves. However, there are reports of paste/base to HCl laboratories in some consumer countries.[47]

The conversion process can vary widely from one location to another in the processing countries. According to information currently available from a variety of sources, the International Narcotics Control Strategy Report accurately reflects the conversion process in each of the producer countries.[48] The report indicates that leaves are first converted into paste. Second, the paste can be further refined into washed coca paste, also known as base.[49] Finally, the washed paste or base is converted to cocaine HCl. (The conversion ratios in the Abt model come from the INCSR.)

The first stage—leaf to paste conversion—varies significantly from country to country because of differing alkaloid contents of the leaves grown in different countries. For example, Colombian coca leaf has about one-third the alkaloid content of leaf from Peru or Bolivia.[50] Whereas 330 kilograms of leaf can be converted into one kilogram of base in Bolivia, 500 kilograms of leaf from Colombia are required to produce one kilogram of base.

The second stage—paste to base conversion—may not be followed in all regions. However, the process is relatively simple and increases the purity of the final product. By "washing" the coca paste in acetone before the final purification process, the purity level of the cocaine product can be enhanced.[51] There are no clear data on the prevalence of this process, although the INCSR assumes its occurrence in its calculations of conversion in both Bolivia and Peru.

The final stage—base to cocaine HCl—requires acetone, ether, and hydrochloric acid, which are produced in Brazil and other industrialized Nations. One unit of base yields an equal unit of cocaine HCl.

As noted above, the end result of this cultivation and manufacturing process was an estimated 594–696 metric tons of pure cocaine being made available in 1990 for shipment to the world markets. (The range reflects different assumptions about consumption of coca leaf in Bolivia and Peru.) This estimate excludes amounts seized, lost, and consumed in the producer countries, and losses and consumption in transshipment to world markets.

Losses from the manufacturing process. Consumption of leaf, paste, base, and cocaine in South American countries substantially

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[48]James A. Inciardi, The War on Drugs, Palo Alto, CA: Mayfield Publishing Company, 1986, pp. 71-89; Royal Canadian Mounted Police, National Drug Intelligence Estimate, 1988/1989, Ottawa, Ontario: Drug Enforcement Directorate, p. 45; and telephone interviews with Edmundo Morales, Ph.D., West Chester University, PA. Dr. Morales has studied cocaine cultivation and processing in Andean nations.

[49]Edmundo Morales indicates this process is not required but is becoming more common because it improves the purity of the final product.

[50]International Narcotics Control Strategy Report, 1991, p. 100.

[51]Edmundo Morales.

[52]Memorandum from R. Flynn, dated January 24, 1991.

reduces the potential cocaine supply. Extensive consumption of coca leaves occurs in Bolivia and Peru and to a lesser extent in other countries where processing occurs. Consumption of intermediary products and cocaine HCl occurs to a lesser extent, but it is thought to be on the rise. Adjustments for the large volume of coca leaves consumed for dietary and medicinal purposes in Peru and Bolivia are made, following various medical and sociological studies that place the number of persons who chew coca leaves in these two countries at three to four million.[52] Assuming that each person who chews coca leaves ingests between 30 and 60 grams of dry coca leaves each day,[53] between 33,000 and 66,000 metric tons of coca leaf are consumed in these two countries each year.

Consumption of paste occurs in many of the producer countries. Called "bazuco," coca paste is smoked in combination with tobacco. The prevalence and extent of this usage is difficult to estimate. Additionally, information about the consumption of base and cocaine is limited in the producer countries by the limited ability of the local governments to survey their citizens on drug abuse.

Seizure of coca leaves and intermediary products by local authorities further reduces the potential supply of cocaine to the world market. Unfortunately, information about seizures is of questionable reliability. An incentive exists to inflate reports of seizures because aid from the United States government is contingent upon countries' progress in eradicating illicit drugs. Because confiscated coca is registered by different agencies within local government establishments, substantial opportunity exists for overcounting. Undercounting may also occur if corrupt law enforcement officials fail to report all of the seized cocaine and choose instead to sell it on the market for personal gain.

During 1990, approximately 420 metric tons of coca leaves, approximately .2 metric tons of paste, and 79 metric tons of base were reportedly seized in the producer countries. In the transshipment countries, approximately 80 tons of cocaine was reportedly seized by authorities. As discussed below, additional amounts of cocaine were seized by United States officials inside or near the United States borders.

Coca supply may be reduced significantly by the rapid spoilage that occurs in the hot and humid climate of South America. Losses also occur throughout the manufacturing process because of sloppy and inefficient use of chemicals. Entire batches of coca can be contaminated and thereby ruined. The amount of potential cocaine supply lost in the course of manufacturing is difficult to estimate. Lacking information about losses, we make no assumptions about the amount lost in the cocaine manufacturing pipeline.

After accounting for available estimates for consumption of dry leaf as well as seizures and losses of leaf and intermediate products, the

[53]Carter, Parkinson, and Mannami. Cocaine 1980: Proceedings of the Interamerican Seminar on Medical and Sociological Aspects of Coca and Cocaine.

estimated total amount of cocaine HCl available for transshipment from producer countries in 1990 ranged from 594 to 696 metric tons.

The transportation pipeline. Some cocaine is shipped from manufacturing countries (such as Colombia) directly to the primary consumer countries, principally the United States. Some is transshipped through other countries to elude detection. These countries include Caribbean Nations, as well as South and Central American countries. Some cocaine destined for the United States may come through Canada as well. Not all of this cocaine ultimately arrives in the principal consumer countries because some portion of it is seized, lost, and consumed in the countries through which it is shipped. Determining how much cocaine is consumed in South and Central America, the Caribbean, and Mexico is difficult; governments in these countries lack the resources to adequately survey their citizens on drug abuse. Officials in the Bahamas, for example, report a "serious" drug abuse problem stemming from the use of the country as a transshipment point of cocaine HCl to the United States, but estimates of how much drug is taken out of the pipeline by consumption are not reported. Summing up all reported seizures of cocaine in transshipment countries, we estimate that approximately 80 metric tons of cocaine was eliminated from the pipeline during 1990.[54] In addition to consumption and seizures, supply was reduced by losses of various sorts. Lacking data, we are not able to estimate the size of these losses.

From the transshipment countries, cocaine is smuggled into consumer countries by land, sea, and air routes. The percentage of cocaine HCl shipped to consumer countries depends, to some extent, on the demand in each country. Changing demand for cocaine in Europe, Canada, and the Asian/Pacific regions may affect the amount of available cocaine in the United States. For example, cocaine use is reportedly increasing in Asia. As demand there increases, cocaine may be diverted to this region, which may in turn reduce the net amount available in the United States. (Another possibility, however, is that supply will be increased to feed this new market, without a concomitant reduction of supply to the United States.) The significant rise in seizures of cocaine HCl in Europe could indicate expansion of the cocaine market there.[55] Of the estimated total amount of cocaine HCl available after seizures in transshipment countries, an estimated 10 to 25 percent of the supply is diverted to consumer countries other than the United States. (This estimate lacks firm grounding, but is probably wide enough to capture the actual proportion consumed outside the United States.) Following these assumptions, the Abt model estimates the amount of cocaine entering United States jurisdictions for 1990 to be in the range of between 376 to 544 metric tons.

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[54]International Narcotics Control Strategy Report, 1991, and data provided by the United Nations International Narcotics Control Board and the Royal Canadian Mounted Police. These data conflicts with the data in the DEA "World Cocaine Supply, 1991" report.

[55]World Cocaine Supply, 1991, pp. 32-35.

Federal interdiction efforts succeed in capturing some of the cocaine headed for United States markets. Determining the precise amount seized prior to 1989 is difficult because passing seized drugs from one agency to another (e.g., from the Coast Guard or Customs to the Drug Enforcement Administration) has resulted in some double- and even triple-counting. In 1989, the Federal-Wide Drug Seizure System (FDSS) was instituted, so that a single number is registered and passed along with the captured drugs to eliminate double-counting. During that year, Federal agencies seized 95 metric tons of cocaine. Preliminary estimates for 1990 place the amount at 101-113 metric tons. For 1988, the pre-FDSS amount was 57 metric tons.

State and local law enforcement officers also seize cocaine, but no Federal system exists for counting and reporting such seizures. No data exist upon which to base an estimate.

Accounting for the amounts seized by Federal authorities within the jurisdiction of the United States, we estimate the amount of pure cocaine penetrating the United States border and theoretically available for domestic consumption to be approximately 263 to 443 metric tons during 1990, compared to 293 to 462 during 1989 and 361 to 536 during 1988.[56]

Assuming that a gram of pure cocaine costs about $100 (estimate from the Drug Enforcement Administration, discussions with street ethnographers, and reports from the Community Epidemiology Work Group), the total retail value of 340 to 443 metric tons is between $26 and $44 billion for 1990. Not all of the available supply of cocaine imported to the United States need be consumed in a given year—it may go into inventory or stockpiles in an effort to maintain or increase prices. For earlier years, comparable ranges are $29 to $46 billion (1989) and $36 to $54 billion (1988).

Summary. From the supply-side perspective, during 1990, about 310,150 metric tons of coca leaf crop was cultivated. This leaf crop could yield a maximum of 873 metric tons of cocaine HCl, but due to losses in shipment, about 376–544 metric tons were shipped to the United States. Of the cocaine arriving on American shores, Federal authorities seized about 101–113 metric tons, leaving 340–443 metric tons available for domestic consumption. The street value of this cocaine is $26–$44 billion—an estimate that we consider high.

Again, estimating trends is subject to considerable error, but based on the midpoints of our supply-based estimates for 1988 and 1990, we estimate that leaf crops and the maximum amount of cocaine produced from those leaf crops have increased by about 5 percent. Perhaps this increase in production was partly to offset increases in foreign country seizures. Because of increases in foreign seizures, shipments to the

[56]The low end of this range was computed by subtracting the maximum of the seizure range (113) from the minimum of the cocaine shipped range (376), which yields 263 metric tons. The high end of this range was computed by subtracting the minimum of the seizure range (101) from the maximum of the cocaine shipped range (544), which yields 443 metric tons.

United States fell by about 9 percent. The amount of cocaine seized by United States authorities increased by 88 percent. The net effect of increases in both production and foreign and domestic seizures has been a 13 percent decrease in the amount of cocaine available for consumption in the United States between 1988 and 1990 (see Table 6).

Heroin. Estimates of heroin supply available for United States consumption cannot be calculated with any degree of confidence given the available data. Estimates are available for opium yields worldwide. Conversion ratios of opium to morphine to heroin are known, but no accurate estimates exist for consumption within producer countries and other transshipment countries. (Various sources estimate only the number of addicts/users in these countries and not the estimated amounts consumed.) Moreover, the market for heroin and opium is more widespread than for cocaine. Whereas the majority of cocaine is probably consumed by United States residents, the United States market share is much smaller for heroin. Consequently, changes in assumptions about the size of that share have dramatic effects on the estimates of available domestic supply in the United States.

Marijuana. Developing an estimate of the size of the retail market for marijuana in the United States from estimates of available supply is also fraught with difficulties. Users in the United States are able to grow small amounts of their own marijuana for personal use, and the amount of drug so cultivated is impossible to estimate. A large amount is also grown within the borders of the United States for the domestic market. The Drug Enforcement Administration estimates that approximately 5,000 to 6,000 metric tons of cannabis were cultivated domestically during 1989, an increase over 1988 estimates (4,350–4,850 metric tons).[57]

Cannabis is also grown in dozens of countries in South and Central America, the Caribbean, Asia, North Africa and the Middle East. The amount of cannabis available worldwide for export to the United States and other consumer countries during 1989 was thought to be 49,281 to 51,281 metric tons, after accounting for estimated losses, seizures and consumption within producer countries, as well as seizures within the United States[58] (This includes the estimated amounts cultivated within the United States.) Comparable figures for earlier years are considered unreliable by the United States intelligence community because Mexican production—which in 1989 was thought to account for 87 percent of worldwide production—was underestimated dramatically, by a factor of nearly ten. According to estimates by the State Department's Bureau of International Narcotics Matters, worldwide production was roughly the same during 1990 (although different estimating methods and data and the lack of an estimate for domestic United States production make it difficult to compare this estimate with the 1989 figure cited above).[59]

[57]Reported in the National Narcotics Intelligence Consumers Committee (NNICC). The NNICC Report 1989: The Supply of Illicit Drugs to the United States. Washington, D.C.: National Narcotics Intelligence Consumers Committee, June 1990, pp. 55-56.

TABLE 6

SUMMARY TRENDS IN COCAINE SUPPLY

(in metric tons unless otherwise noted)

	1988	1989	1990
Coca Leaf Crop[60]	293,700	298,090	310,150
Cocaine HCl Produced	829	836	873
Transshipped to or Seized in Foreign Countries[61]	38	64	92[62]
Shipped to the United States	418-593	388-557	376-544
Seized by Federal Authorities[63]	57	95	101-113[64]
Available for Consumption in United States	361-536	293-462	340-443
Retail Value in the United States (in billions of dollars)	$36-$54	$29-$46	$26-$44

[58]Ibid. pp. 55-56.

[59]International Narcotics Control Strategy Report 1990. This report estimates worldwide production, not counting the U.S., to have yielded 45,559 metric tons in 1990. Subtracting estimates for amounts seized (843 metric tons), the net production was estimated to be 44,706 metric tons. This would have to be reduced still further to include estimates of consumption in producer countries and seizures by U.S. authorities.

[60]International Narcotics Control Strategy Report, 1991. p. 22.

[61]International Narcotics Control Strategy Report, 1991, and data provided by the United Nations International Narcotics Control Board and the Royal Canadian Mounted Police.

[62]This figure includes 12 metric tons seized in Europe during the first half of 1990. World Cocaine Supply, 1991, pp. 33-35.

[63]Drug Enforcement Administration, Domestic Statistical Summary, undated copy. Methods of counting seized amounts changed in 1989. The figure for 1988 reflects the conventional method, which involved some double-counting of seized drugs by different federal agencies. Figures for 1989 and 1990 are from the new Federal-Wide Drug Seizure System, designed to minimize overcounting.

[64]This range is from the DEA Federal-Wide Drug Seizure System reported in a telephone conversation with DEA officers on April 9, 1991. The final figure, to be released shortly, could vary from the range given.

Because marijuana and hashish consumption are prevalent throughout many parts of the world, it is difficult to estimate the size of the market share that United States consumers constitute. If we assume that none of the domestically-grown marijuana is exported, that 75 percent of all Mexican marijuana is imported into the United States, and that all marijuana produced elsewhere is exported to other countries (all of which are conservative assumptions), and if the DEA/NNICC Report estimates are reasonably accurate, approximately 36,700-37,700 metric tons would have been available to United States consumers during 1989. At an average cost of $10 per gram, the retail value of this amount of marijuana would have been $367-$377 billion dollars. If the average price were closer to $5 per gram, the retail value would have been half that large.

These estimates are implausibly large. During 1989, approximately $269 billion was spend on all public education, at all levels. During 1988, expenditures for alcohol totalled $44 billion, and for tobacco, $37 billion.[65] That expenditures for marijuana exceeded all these amounts combined is impossible to believe. Because the average retail cost of marijuana was probably within the $5-$10 range, this suggests that either the estimates of worldwide cultivation and production are wildly overinflated, that seizures, losses, and consumption within producer countries have been underestimated by an equal amount, or that the United States share of the worldwide marijuana consumer market is much smaller than we suggest here. Unfortunately, the data needed to develop better estimates of all these factors are not available, and we have no independent ability to assess the reliability of the marijuana cultivation estimates. We are, therefore, unable to develop a plausible supply-based estimate of the retail value of the marijuana market in the United States.

Comparison with Other Sources. The range for supply-based estimates is necessarily wide. As we have emphasized throughout this section, the data upon which these estimates are based are too imprecise to produce a narrower range of estimates. The fact that we have excluded some losses of cocaine and its raw ingredients from the model (because of lack of data) probably means that this range is too high—that is, given our current knowledge of cocaine use and price, it is highly unlikely that the retail sales expenditure on cocaine approaches $46 billion dollars.

Nevertheless, estimates far in excess of $46 billion exist. According to the Latin American Weekly Report,[66] the United States drug market was close to $200 billion, most of this apparently attributable to cocaine. Supposing that all $200 billion was attributable to cocaine, and that 1.9 million heavy cocaine users consume 80 percent of the available cocaine, then each user would be required to spend $84,000 per year on cocaine. In contrast, a heroin addict has been estimated to spend $300-$400 per

[65]Statistical Abstract of the United States 1990. pp. 129, 780, 430.

[66]Latin American Weekly Report, WR-91-12, March 28, 1991.

week on his or her habit—less than $20,000 per year. Even if only $100 billion is attributable to the cocaine market, a heavy user of cocaine (more frequently than once per week) would have to consume about eight grams of pure cocaine every week. This far exceeds the two pure grams per week that we assume as the upper limit that can be consumed by the most compulsive user of cocaine. In short, estimates from the Latin American Weekly Report are not credible.

In contrast to these competing estimates, our consumption-based estimates are remarkably close to our supply-based estimates. From the consumption-based side, we estimate that $17-$23 billion dollars were spent annually on cocaine between 1988-1990. Although this range is somewhat smaller than that derived from our supply-based estimates ($26–$54 billion dollars), this difference can be attributed to several reasons: The United States itself may be a greater transshipment country to Europe than is assumed in our model; State and local seizures have not been accounted for in our model; and part of the supply of cocaine may be to replenish dealer stocks. We also note that the supply-side estimates follow the same general trends as the demand-side estimates. From the supply-side, minimum estimates for cocaine fall from $36 billion in 1988 to $34 billion in 1990; maximum estimates fall from $54 billion to $44 billion. Similarly, demand-side estimates fall from $23 billion in 1988 to $17 billion in 1990.

III. CONCLUSIONS

We estimate that Americans spend roughly $40 to $50 billion per year on illicit drugs (see Table 7). The $40–$50 billion range is not a traditional confidence band. The accuracy of the components of the calculations used to develop these estimates is uncertain. For example, cocaine consumption is affected heavily by the number of consumers who use cocaine at least once per week. We previously estimated that figure as 1.75 million, but based on sensitivity analyses, we reported that 1.5 to 2.2 million is a reasonable range for heavy use. Based on our analysis of STRIDE data and our inspection of reports from the Community Epidemiology Work Group (CEWG) and Drug Enforcement Administration, we know that the price and purity of cocaine and other drugs vary markedly over time and across cities. For example, the latest CEWG report indicates that the street price of cocaine ranges between $50 and $125 per gram across 15 cities, while purity ranges between 10 percent and 96 percent in six cities. Our assumption of $100 per gram for 50 percent purity cocaine, which is a reflection of these reported prices and purity levels, only approximates what is likely to be the true price and purity of cocaine sold at the retail level. The same is true for other drugs. Similar

uncertainty exists regarding the amount of drugs consumed per drug-using session, an estimate that we derived from discussions with street ethnographers, dealers, and users. We offer the $40-$50 billion range as our best estimate given current data. Thus, the range of $40 to $50 billion is not firm. Data are too sketchy to allow precise measurements. Nevertheless, even if this figure is only approximate, its magnitude is daunting. Besides the untold misery of those who are captured within the morass of drug addiction, society in general suffers from the sequelae of drug abuse: crime and the costs of criminal justice, broken families and addicted newborns, disrupted social and economic relationships, the spread of communicable disease, and the costs of drug treatment.

Beyond the provision of an estimate of the retail value of drugs consumed, we have developed two methods—one based on the consumption of drugs and the other based on the supply of drugs— for estimating the retail value of drugs consumed. The methods clarify what information is needed to estimate the retail value of drugs consumed in America; our application of these methods highlights the deficiencies of available information. The utility of identifying needs and deficiencies is to indicate how future estimates can be improved.

Extant data that were unavailable to us (and unknown to us) might be used to sharpen our estimates. New data might be developed, especially where our ignorance of the patterns of drug use are the greatest, such as the amount used per session and the retail price of drugs. Ideally, both extant data will emerge, and new data will be gathered, so that future estimates will be based on a firmer empirical basis. This study is one important step on the path to developing better estimates of the amount of illicit drugs and the retail value of those drugs consumed in America.

TABLE 7

RETAIL VALUE OF ILLICIT DRUGS IN THE UNITED STATES

(in billions of dollars)

	1988	1989	1990
Cocaine	$22.9	$22.5	$17.5
Heroin	$15.8	$15.5	$12.3
Marijuana	$11.1	$10.0	$ 8.8
Other Drugs	$ 1.8	$ 1.8	$ 1.8
Total	$51.6	$49.8	$40.4