Measuring Global Drug Markets

How good are the numbers and why should we care about them?

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Introduction

Drug markets are large enough that there is a demand, detached from any policy purpose, for putting a revenue figure to them. This demand for numbers creates its own supply. Indeed, figures on revenues are a staple of newspaper reports on the global drug trade, and on more acute issues such as the income sources of terrorist networks, like Al Qaeda. For such purposes, a broad-brush stroke is often enough; the reader needs only to know that the value of the global drug trade is in the order of many tens of billions of dollars and that Afghanistan's total exports are in the tens of millions of dollars. However, sometimes these figures take on policy significance that requires greater precision. Before September 11, 2001, the call for international money laundering controls, and approaches to their design, rested largely on beliefs about the size of the international drug trade.

The underlying data that give rise to estimates of global drug markets are riddled with discrepancies and inconsistencies. Nonetheless, they can provide useful information on the overall size or 'scale' of the global drug trade, the distribution of supply chain activities and value added across countries, and the distribution of final consumption across countries. This paper describes some of the data on production and consumption and summarises the estimates. A critical point is that the most widely cited

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figure for the international drug trade is in fact an estimate of something very different, namely total revenues at the retail level; the true trade figure is much smaller. The paper then identifies the potential limits and uses of these numbers and finally whether they can be much improved.

Current estimates of sales and international flows

The United Nations Drug Control Program (UNDCP) is the official source of estimates that world trade in illicit drugs is in the range of $300 to $500 billion "[A] growing body of evidence suggests that the true figure lies somewhere around the $US 400 billion level…accounting for approximately 8% of international trade…In 1994 this figure would have been larger than the international trade in iron and steel, and motor vehicles, and about the same size as the total international trade in textiles" (UNDCP, 1997, p.124).

Researchers, analytic commentators, and other journalists, routinely cite the UN's drug market valuation. Scarcely anyone challenges the numbers.

In fact, the $400 billion number is not a trade flow estimate but an estimate of 'turnover' or total retail expenditures. As we discuss below, it is an order of magnitude higher than actual trade flows because most of the retail price comes from value added in importing countries. Even for the purpose of estimating retail expenditures it is considerably too high because it uses US prices.

The estimate

We illustrate the problems with the UN's overall $400 billion estimate by analysing the estimate for heroin, globally the most widely used of the expensive drugs. The UN figure is based on multiplying global quantity consumed by something approximating US levels for prices. The range for US heroin retail prices cited is $70–$900 per street gram, which would produce total global sales of $50 billion to $641 billion, given estimates of total production minus seizures. The UN analysts, after reporting the midpoint of this huge range ($346 billion), then choose a lower price of $150 per gram, reflecting data from Western Europe and Oceania (presumably mostly Australia), to produce an apparently conservative figure of $107 billion for heroin. The heroin figure is a little more than a quarter of the total for all world drug sales, as estimated by the UN.

There is reference to the fact that prices must be lower in developing countries but not to the fact that these nations account for the overwhelming majority of world opium consumption. It is estimated that in the late 1990s world opium production was approximately 4,000 tons, equivalent to 400 tons of pure heroin. After seizures, this would amount to approximately 340 tons. Yet in the US, the Office of National Drug Control Policy (ONDCP), making explicit use of a variety of data sources, estimates total annual heroin consumption is approximately 12 tons (ONDCP, 2000). Other, less well-documented estimates for the US generate a consumption estimate of 18 tons. Even the higher figure for US consumption amounts to only about 5% of world heroin consumption.

Nor is the picture changed when one adds in other rich countries. Western Europe, Canada and Australia all have substantial heroin related problems; the total number of heroin dependents in these countries collectively is probably 1.5–2.5 million, about twice the US figure. Eastern Europe and Russia now have at least moderately serious problems (Paoli, 2001), adding perhaps another million. Assume, for purposes of estimating total consumption, that heroin addicts in these countries consume twice as much *per capita* as those in the US, reflecting lower retail prices for heroin. Taken together that adds another 60 tons of heroin to Western consumption. Rounding up and adding the US figure gives a total of 80 tons for consumption in Eastern Europe and the West.

As this suggests, most heroin is consumed elsewhere. Roughly three quarters of heroin is consumed in poor nations in Asia; indeed that is where the bulk of opiate addicts are found. *Per capita* rates of heroin addiction seem to be highest in Southwest Asia (Pakistan, Afghanistan and Iran) and Southeast Asia (Burma and Thailand; possibly Malaysia). Estimates from these nations are questionable but it is plausible that they have 5 million addicts. China and India each have a growing heroin addiction problem. It is unclear yet whether it involves a relatively large percentage of the population. However, given their population total of 2.3 billion, even with very low prevalence rates, the result may be a large contribution to world heroin addiction; for example a 0.2% prevalence, compared to the 0.4% for heroin in the United States,[1] generates an addict population of

[1] Cocaine provides approximately an additional 0.8%.

about 4.5 million. A total of 10 million in Asia is quite plausible though hard to document.

Our interest is less in the quantity than in expenditures. ONDCP estimates US heroin expenditures in 1999 at approximately $12 billion. Prices in Western Europe for heroin are lower than in the US. For example, Paoli (2000) estimates the price of a street gram in Frankfurt at about $25; if that gram were 25% pure, a conservative figure, it would be barely one-tenth of the US price, as estimated by ONDCP. Prices in Eastern Europe are still lower. Attributing a $5 billion expenditure to the 25–30 tons consumed in Europe is generous.

Prices in Asian nations are dramatically lower than in the US or Western Europe, perhaps even in terms of hours of wages of unskilled labour. The UN (1997) reports retail prices in Pakistan and Thailand. For Pakistan, the street price is $4 per gram at 40% purity, yielding a pure gram price of $10. The street price in Thailand is reported as $5–6.70 per gram; the purity is unknown, but if also 40%, the pure gram price is about $15. An addict in Pakistan spends only $500 on heroin. In Thailand, with a higher GDP per capita than Pakistan, an addict's annual heroin expenditures amount to about $1000. A figure of $10 billion is a very generous estimate for heroin expenditures by Asia's estimated 10 million addicts. Adding that to the figure of $12 billion for the US and $5 billion for the rest of the western world gives a world total at the retail level of $27 billion.

Interpreting the estimate

The $27 billion figure for heroin, like the UN's $107 billion figure, measures turnover, the revenue from global sales for final consumption. It is far removed from a trade flow number. In absolute terms, most of the value added in the supply chain accrues when drugs are distributed within consuming countries.

In true trade terms, a more reasonable estimate of the total for illicit drugs—cocaine, heroin, marijuana, and synthetic drugs—is only about $20 to $25 billion annually (Reuter, 1998). Again, we illustrate our approach with heroin. The landed price in the US is approximately 10% of the retail price. Thus the total revenue from exports to the US is no more than $1–1.5 billion. The ratios for Europe and Asia are somewhat higher but not more than 20%. We end up with a trade flow for heroin of less than $7 billion.

Table 1: World trade of selected agricultural and industrial products in 1999

Agricultural products	Exports	Imports
Cereals and preparations	54	57
Fruits and vegetables	71	79
Sugar and honey	16	17
Coffee, tea and spices	31	32
Beverages and tobacco	57	57
Alcoholic beverages	30	30
Tobacco	22	21
Non-alcoholic beverages	5	5
Oil seeds	13	15
Animal and vegetable oils	24	27
Other agricultural products	151	157
Total agricultural products	*417*	*441*
Industrial products		
Iron and steel	126	138
Chemicals	526	547
Automotive products	549	566
Office and telecom equipment	769	792
Textiles and clothing	334	352
Other manufactures	1882	1966
Total manufactures	*4186*	*4361*
Fuels	401	na

Sources: UN Food and Agriculture Organisation (2000) and the World Trade Organisation (2000)
Notes: Exports valued FOB and imports valued CIF, both in billions of current US dollars. See also footnote 4 to this article. Totals may not add due to rounding.

Doing this for cocaine, marijuana and amphetamines will produce a figure of perhaps $20–25 billion at landed import prices.

What should one make of that figure? The global drug market is significant—as a trade flow it is within range of many agricultural products, such as animal and vegetable oils and coffee, tea, and spices. However, it is not nearly as large as some key industrial products, such as automotives or office and telecom equipment (see Table 1). The UN claim that global trade in illegal drugs exceeds that for iron and steel is a gross exaggeration; it is only one fifth the size of that industry's trade flow. Drugs are a modest contributor to total world trade.

The distribution of supply chain activities and value added

It is also possible to say something about the distribution of production and income across countries and sectors of the industry. There are interesting differences and similarities when comparing the illicit drug industry with a legitimate trade flow.

Source country production

Despite significant difficulties in estimating acreage and (particularly) yields, the data consistently identify 'big' producers in quantity terms and suggest plausible distributions of value added in the supply chain. For example, from 1990–2000, Afghanistan and Myanmar/Burma unambiguously dominated the world's production of heroin, together accounting for upwards of 85%–90% of the estimated opium supply measured in metric tons (UN ODCCP, 2001; ONDCP, 2001). As shown in Table 2, their relative importance has shifted over time, but remained large in aggregate.

Table 2: Historical production data for opium and coca (metric tons)

Opium Gum

	1988	1990	1992	1994	1996	1997	1998	1999	2000
Afghanistan	1,120	1,570	1,970	3,146	2,248	2,804	2,693	4,565	3,276
Burma	1,125	1,621	1,660	1,583	1,760	1,676	1,303	895	1,087
Other Asian	482	507	383	356	226	207	190	173	219
Colombia			90	205	67	90	100	88	88
Mexico	67	62	130	265	121	136	160	131	109
Total	2,794	3,760	4,143	5,620	4,355	4,823	4,346	5,764	4,691

Coca Leaf

	1992	1993	1994	1995	1996	1997	1998	1999
Bolivia	80,300	84,400	89,800	85,000	75,100	70,100	52,900	22,800
Colombia	29,600	31,700	35,800	229,300	302,900	347,000	437,600	521,400
Peru	223,900	155,500	165,300	183,600	174,700	130,200	95,600	69,200
Total	333,900	271,700	290,900	497,900	552,700	547,300	586,100	613,400

Source: UN ODCCP, *Global Illicit Drug Trends 2001.*

Other Asian nations together with Colombia and Mexico,[2] have accounted for most of the remaining tonnage. Similarly, the data indicate that only a handful of countries account for most of the world's supply of coca and cocaine. Although their agricultural roles have also shifted in recent years, with coca cultivation expanding in Colombia and contracting in Peru and Bolivia, the three Andean countries taken as a whole account for all the commercial acreage and tonnage. Colombia continues to be the region's leading cocaine manufacturer, converting coca paste and base to cocaine hydrochloride and shipping it to the US, even as it produces an increasing share of the leaves.

In contrast, useful information on marijuana production is much more difficult to find, in part because production is globally diffuse—though, from a policymaking perspective, it is 'useful' to know that there are many players. According to UNDCP (2000a, p. 33), 120 countries have reported illicit cultivation of cannabis over the past decade, but, "while cannabis production is therefore known to be widespread around the globe there is little reliable information available to make a more precise estimate." Interpol lists Morocco, South Africa, Nigeria, Afghanistan, Pakistan, Mexico, Colombia, and Jamaica as "primary" source countries, with large growing areas and significant seizures. In these terms, UNDCP notes that the United States would also "feature prominently". It is perhaps ironic that the US produces estimates of cannabis production for other nations but not for itself. The CIA, the agency tasked with this responsibility, is not permitted domestic surveillance and the Drug Enforcement Administration has not filled the void; there is also a reasonable question as to whether it is feasible to estimate production which is carried out in secrecy, in small and dispersal plots, and frequently indoors.

Most agricultural goods that can grow in a variety of locations are grown by many countries. Why so few nations grow coca is an interesting question that Francisco Thoumi (forthcoming) has begun to analyse. Both opium and coca have been grown in many countries historically but production has been driven out by some working of comparative advantage that is surely other than the standard economic factors. The contrast with marijuana, highly dispersed, is stark. We conjecture that the critical factor is the high yield of active drug per acre for marijuana; very small

[2] Colombia and Mexico supply most of the US market and are dedicated to that market.

producers can be both efficient and discreet. They may also face less intense enforcement than would coca or poppy growers in most of the world.

Tracking value added in the supply chain

The overwhelming majority of the retail value of illicit drugs accrues beyond the farm gate; the largest percentage increase in value occurs in transit across national borders and the largest absolute increase occurs within importing countries. According to a 1994 UNDCP study, the farm-gate price of opium originating in Pakistan was about $90 per kilogram, implying a farm-gate value for the raw material in a kilogram of heroin of about $900; the wholesale price of heroin in Pakistan was $2,870 per kilogram; the wholesale price in the US was $80,000 per kilogram; and the retail price in the US was $290,000 for a kilogram at 40% purity, equivalent to $725,000 for a pure kilogram.[3]

Based on these UNDCP estimates and the foregoing estimate of the street value of pure heroin in Pakistan, the farm-gate value would account for about 30% of the Pakistani wholesale price, about 9% of the Pakistani retail price, and negligible fractions of the US wholesale and retail prices. In share terms, the largest mark-up, about 2,700%, would occur in transit between Pakistan and the US, taking Pakistani and US wholesale prices as rough proxies for export and import values. However, in absolute terms, the largest dollar increase would occur within the US. After adjusting for differences in purity, the import value would account for roughly 10% of the US retail price.

Table 3: Prices of Cocaine through the distribution system: 1997
(Prices per pure kilogram equivalent)

Leaf (Peru)	$650
Export (Colombia)	$1,050
Import (Miami)	$23,000
Wholesale-Kilo	$33,000
Wholesale-Oz	$52,000
Retail (100 mg. Pure)	$188,000

Source: U.S. Drug Enforcement Administration

More recent accountings of the distribution of the value added in Colombian- and Peruvian-originating cocaine reveal similar patterns.

Table 3 shows the price of a pure kilogram of cocaine as it moves through the production and distribution process. Note that most of the value added occurs at the bottom of the distribution system, where risks per gram are highest.

[3] Note that this is substantially lower than official US estimates of retail prices.

Comparing value added in agriculture and the illicit drug industry

How does the distribution of value added in the illicit drug industry compare to other agriculturally-based industries? The distribution within 'home countries', i.e., those countries in which the goods are actually produced appears to be rather similar; the most significant differences arise in cross-border shipping.

In the US, the marketing bill for domestically produced food substantially outweighs the food's farm value. The components of the marketing bill consist of non-farm labour, packaging, transportation, energy, profits, advertising, depreciation, rent, interest, repairs, business taxes, and other miscellaneous costs. In 1999, the marketing bill accounted for about 80% or $498 billion of total US consumer expenditures for US-derived farm foods; the farm-value share accounted for 20%.

Not surprisingly, the farm-to-retail price spreads for individual items vary, depending on the extent of processing, the costs of distributing, and other market conditions. For example, in the US, the farm value share of fresh potatoes in 1999 was 19%; the farm value share of frozen French fried potatoes was 10%.

How do illicit drug markets compare? If the experience of Pakistan is any indicator, they look similar. The farm-gate value of opium accounts for about 9% of the retail value of heroin in Pakistan. Undoubtedly, 'ordinary' processing and transportation costs affect farm-to-retail price spreads in drug markets, but the contribution is small when compared to the costs of illegality further down the supply chain.

Clearly, one of the biggest differences in the distribution of value added in the illicit drug industry is in cross-border shipping. In Table 1, the difference between export and import values for world agricultural trade amounted to about 6% of the export value; absent data for a particular product or market, the Food and Agricultural Organization typically applies a standard 'add factor' of 12%.[4] In glaring contrast, the cross-border mark-up on Pakistani-US heroin shipments is about 2,700%; the mark-up on Colombian-US cocaine shipments is about 2,100%.

[4] Exports are valued 'free-on-board' or FOB; imports are valued 'cost, insurance, and freight' or CIF. The FOB value includes the costs of transportation and insurance to bring the merchandise to the frontier of the exporting country or territory. The seller places the goods on board the ship at the port of shipment at which time the risk of loss or damage transfers to the buyer. The CIF value includes the additional costs of transportation and insurance to the frontier of the importing country or territory.

A brief look at data on trade in coffee provides another opportunity to compare patterns of value added in licit and illicit markets and, possibly, gain a better understanding of the effects of illegality. Coffee is especially interesting because Colombia is a market leader, accounting for a large share of 'mild' coffee exports; the US is a major market for imports; and it is a bulk commodity. Arguably, the 'pure' shipping costs for coffee and cocaine would be similar, were there no risk of seizure or penalty, so that the added costs of illegality, including risk compensation, could reasonably account for the net difference in export and import values.

According to the Colombian Federation of Coffee Growers, the export price of green coffee in Colombia was $90.40 per 70-kilogram bag, or $0.587 per pound, on November 14, 2001; that same day, the landed price in New York was $0.695 per pound.[5] The implied value added between the export and import markets is $0.11 per pound or about 18% of the export price. Though not 'scientific', a non-random inspection of a grocery store shelf in the US on November 15, 2001, found prices of several common name brand and generic Colombian coffees, all bearing the Colombian Federation's official logo, ranging from $3.74 per pound for a vacuum packed bag of ground coffee to $5.33 per pound for a bag of loose coffee beans. With the additional roasting, packaging, and distribution costs, the value added in the United States accounts for roughly 80% to 90% of the retail price; conversely, the landed import value accounts for roughly 10% to 20% of that price. This is not so different from the share of value added in the US for diluting, packaging, and distributing cocaine—the landed value is about 12% of the retail value.

More interesting is the comparison of the costs of moving the commodity from Colombia to the US. For a pound of coffee this costs pennies; the same pound of cocaine costs thousands of dollars to ship to Miami. The numbers suggest that a key difference lies in the value 'wedge' that occurs in overseas trafficking. Were that wedge removed, i.e., were the enormous cross-border mark-ups reduced to 18%, the illicit sector's profile might not look grossly different from others. Starting from a Colombian export price of $1,050 per pure kilogram, an 18% cross-border mark-up with 80% to

[5] The export price was downloaded from the Colombian Federation's website on November 15, 2001. For comparability to other data on 1999 agricultural trade, we note that the value of world exports of all types of green coffee averaged about $0.85 per pound and the value of all types imports averaged $0.93 per pound. That same year, the value of US imports of all types of green coffee from all sources averaged $0.97 per pound; the US retail price of all types of roasted coffee averaged $3.43 per pound.

90% of the final retail value accruing in the US would imply a US import value of about $1,200 and a US retail price of $6,200 to $12,400 per kilogram.

However, this assessment assumes that the costs of the risks associated with distribution in the US are somehow proportionally related to the acquisition cost at the border. This seems unlikely, though Caulkins (1990) developed an insightful model in which the principal distribution cost was compensating agents for not absconding with the drug and hence sensitive to the value at the point in the distribution system. If at least some of the risk-related costs are fixed rather than proportional (e.g., because jail sentences are unrelated to drug prices), then the shares of value added in the supply chain would shift so that the import cost would constitute an unusually small fraction of the retail price. Nevertheless, from a policymaking perspective it would be helpful to know who takes on the risk and earns the income from cross-country shipping—does this income flow into the Pakistani, Colombian, or US economy?

The limits of knowledge

Though the prior text has usually included 'about' before each number, the modifier does not provide much sense of the underlying uncertainty about expenditures. Estimates of the number of drug users, their distribution across countries, per capita consumption of drugs and prices paid are all very rough. Cumulatively the result is an extremely broad range within which the expenditure total might fall. This is not a classic statistical confidence interval, with a clear central tendency; it's just a range.

We will not belabour the matter by going through each component but will focus just on prices. The principal conceptual problem is that buyers cannot report a price in dollars per standardised unit, but only how much they spent on some quantity of white powder, the contents of which is unknown. Even after they have consumed their purchase, they cannot tell whether what they purchased was 30% pure or 70% pure, since their subjective experience with a given quantity of drug is highly variable, depending on many factors such as how recently they used and the setting in which they take it. The range of purities within cities is huge for heroin; the inter-quartile range for a given city might be 20%–50%, with a fairly flat distribution in this range. Nor is the price strongly related to purity; the

Table 4: Cocaine prices per pure gram in Chicago and Philadelphia, 1992

City	High	Low	Mean of high/low	25th percentile	75th percentile
Philadelphia	$257	$10	$133	$50	$121
Chicago	$630	$32	$331	$39	$106

Source: STRIDE

range of pure gram prices at the retail level is also huge. The 'price' of cocaine in Chicago, or anywhere else for that matter, may be a highly artificial construct. Nevertheless, prices are reported for many markets and we continue to use them for purposes of approximation.

Prices, whatever the drug and however calculated, appear to vary enormously across and within nations as well as over time.[6] For example, the retail price of cocaine in Spain fell from $84 to $44 between 1988 and 1993. In France over the same period the price rose from $72 to $107.[7] Thus in 1988 the Spanish price was twenty percent higher than that in France, while five years later the Spanish price was sixty percent lower. Within country variation is well documented in the United States. E.g. the retail price of cocaine in Pittsburgh in 1992 was $80 compared to $54 in Miami.[8] More recently data has become available from UNDCP on variation within some European nations: they show similar variability.

The consequences of these alternative measures can be illustrated by comparisons of prices across US cities (see Table 4). For example, 1992 retail cocaine prices (for transactions of less than 30 grams) in Chicago ranged from $32 to $630 per pure gram; in the same year the prices in Philadelphia ranged from $10 to $257. The arithmetic mean for Chicago was $331 and for Philadelphia $133. Though this suggests that cocaine was less expensive in Philadelphia, the inter-quartile range shows the opposite; for Philadelphia the range was $50 to $121, whereas in Chicago it was $39 to $106. Price data must be treated as a sample from a distribution of values rather than observations of a single number.

[6] A study of heroin prices in Sydney, Australia found the range for gram prices in a two-year period was two orders of magnitude, $118 to $11,667. Even fortnightly averages for price per pure gram showed dramatic changes, for example collapsing from about $6,000 in fortnight 7 to $2,000 in fortnight 11 (Weatherburn and Lind, 1996).

[7] Table 5 in Farrell, G., Mansur, K. and M. Tullis (1996).

[8] Based on analysis of STRIDE observations. For a more detailed analysis of prices prior to 1991, see Caulkins, 1994.

Using the plausible ranges for prevalence, consumption *per capita* and prices, we used available data on the cocaine markets to prepare estimates of the plausible range of cocaine expenditures for Western Europe and North America. The low-end estimate is $35 billion; the high end is more than three times as large, $115 billion.[9] "Many tens of billions" probably provides the right sense of these figures and one that is fairly robust. The confidence interval around the associated international trade figure is substantially smaller, because there is less uncertainty about import prices, as compared to retail prices, in the major markets.

Do we know enough?

As already suggested, for many purposes rough approximations are enough. The global trade is a small number of tens of billions; expenditures for the European Union and for the US are also each a few tens of billions. Most of the money in Western markets accrues to domestic distributors, only some of whom are foreign nationals. Farmers get only minuscule proportion of the total, a few hundred million.

Even for some policy purposes this may be sufficient. For example, knowing that the value of drug exports from Mexico to the US is $1–3 billion rather than $10–20 billion may be very important for purposes of allocating resources for money laundering investigations or even for passing money laundering regulations in Mexico.[10] It is also useful for policy analysts trying to understand, or at least set bounds on, the effects of drug flows and counter-narcotics measures on macroeconomic variables, such as the exchange rate of the peso. It may also shed light on microeconomic issues—while the lower range appears small in relation to Mexico's annual GDP or licit goods and services exports, the drug flows and their associated income streams may still be significant locally.

For other purposes this is not enough. For example, one use of measurements is to determine whether a problem is getting better or worse. Large black markets are an important element of the drug problem (partly because so much expenditure is financed by the proceeds of crime);

[9] Cocaine, though consumed by many fewer users, generates very much higher total revenues than heroin because such a large proportion is consumed within the US and so little in poor nations. The official estimate for US expenditures place cocaine at about $35 billion compared to less than $12 billion for heroin.
[10] The $1–3 billion range is implied by the 1,000 tons of marijuana consumed in the United States; the $10–20 billion range is implied by U.S. State Department estimates of 5,000–10,000 tons exported.

expenditure is the natural measure. If there is a consistent, though hard to measure, bias, then annual changes may be measured reasonably accurately even if the absolute value has higher uncertainty; this roughly characterises GDP estimates. If European policy-makers want to know whether this year's heroin expenditures are 10% different from those of the previous year, then estimates that range between $3 billion and $7 billion, without a known distribution of errors that allows for tests of significance, will be of little use. An observed difference of 10% in the mean, or any other measure of central tendency, is most reasonably dismissed as measurement error. By making the period of comparison five years, perhaps lower precision can be tolerated but these ranges provide very insensitive measures.

There is enough interest in these numbers that it is worth considering whether the estimates might be made substantially more precise. We tend toward pessimism on this matter. It requires data collection that is certainly expensive and, at some points in the distribution system, of doubtful feasibility. Sorting out the distribution of income between domestic and foreign distributors, useful for purposes of national income accounting etc., is equally difficult.

We are left then with numbers that will always attract attention. Though frail they should be good enough to help policy-makers and others understand the broad significance of drug markets internationally, domestically, and perhaps locally. They are not strong enough to support much more than that, in particular to help assess the effectiveness of policies. A warning label "use with considerable care" should be attached whenever they are published.

References

Caulkins, J. (1990) *The Distribution and Consumption of Illicit Drugs: Some Mathematical Models and Their Policy Implications*. Unpublished Ph.D. thesis in operations research, MIT, Cambridge, MA

Caulkins, J. (1994) *Developing a Price Series for Cocaine*. Santa Monica, RAND.

Drug Enforcement Administration (annual) *The Price of Illicit Drugs*. Washington, DC.

Farrell, G., Mansur, K. and M. Tullis (1996) "Cocaine and Heroin in Europe: 1983–1993, A Cross-National Comparison of Trafficking and Prices". *British Journal of Criminology* Vol. 36, No. 2, pp. 55–281, Spring.

Manski, C, Petrie, C. and J. Pepper (2001) *Informing America's Policy on Illicit Drugs*. Washington, DC: National Academy Press

Office of National Drug Control Policy (2000) *What America's Users Spend on Illicit Drugs*. Washington, DC.

Office of National Drug Control Policy (2001) *National Drug Control Strategy*. Washington, DC.

Paoli, L. (2000) *Pilot Project to Describe and Analyze Local Drug Markets: First Phase Final Report: Illegal Drug Markets in Frankfurt and Milan*. Lisbon: European Monitoring Center on Drugs and Drug Abuse.

Paoli, L. (2001) *Drug Policies and Problems in Russia*. Max Planck Institute on Foreign and International Criminal Law, Freiburg, Germany.

Thoumi, F. (forthcoming) "Illegal Drugs in Colombia: from illegal economic boom to social crisis". *Annals of the American Academy of Political and Social Sciences*.

United Nations Drug Control Program (1997, 2000) *World Drug Report*. Vienna, Austria.

United Nations Drug Control Program (2000a) *Global Illicit Drug Trends*. Vienna, Austria.

Weatherburn and Lind (1996) "The impact of law enforcement activity on a heroin market". *Addiction* Vol. 92, No. 5.