



## Research paper

# Modeling the structure and operation of drug supply chains: The case of cocaine and heroin in Italy and Slovenia



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## ABSTRACT

Multiple layers of dealers connect international drug traffickers to users. The fundamental activity of these dealers is buying from higher-level dealers and re-selling in smaller quantities at the next lower market level. Each instance of this can be viewed as completing a drug dealing “cycle”. This paper introduces an approach for combining isolated accounts of such cycles into a coherent model of the structure, span, and profitability of the various layers of the domestic supply chain for illegal drugs. The approach is illustrated by synthesizing data from interviews with 116 incarcerated dealers to elucidate the structure and operation of distribution networks for cocaine and heroin in Italy and Slovenia.

Inmates’ descriptions of cycles in the Italian cocaine market suggest fairly orderly networks, with reasonably well-defined market levels. The Italian heroin market appears to have more “level-jumpers” who skip a market level by making a larger number of sales per cycle, with each sale being of a considerably smaller weight. Slovenian data are sparser, but broadly consistent.

Incorporating prices allows calculation of how much of the revenue from retail sales is retained by dealers at each market level. In the Italian cocaine market, both retail sellers and the international supply chain outside of Italy each appear to receive about 30–40% of what users spend, with the remaining 30% going to higher-level dealers operating in Italy (roughly 10% to those at the multi-kilo level and 20% to lower level wholesale dealers).

Factoring in cycle frequencies permits rough estimation of the number of organizations at each market level per billion euros in retail sales, and of annual net revenues for organizations at each level.

These analyses provide an approach to gaining insight into the structure and operation of the supply chain for illegal drugs. They also illustrate the value of two new graphical tools for describing illicit drug supply chains and hint at possible biases in how respondents describe their drug dealing activities.

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## Introduction

Cocaine and heroin are primarily produced in a very few countries, but they are distributed to users throughout the world (Costa Storti & De Grauwe, 2009). Their supply chains encompass four broad activities: production, international trafficking, retailing, and the domestic distribution network that connects imports to street or retail sale. The last – higher-level drug distribution within final market countries – is in some respects the least

studied, particularly outside the United Kingdom and the United States.

This paper helps fill that gap by introducing a way of synthesizing descriptions of drug dealing “cycles” into a coherent model of the domestic supply chains for illegal drugs. The approach is illustrated with data obtained from interviews with 116 drug dealers incarcerated in Italian and Slovenian prisons (Pardal et al., 2014; Tzvetkova et al., 2014). By pooling information across respondents, we diagram typical sequences of transactions across the multiple market levels through which drugs pass between international importers and users purchasing at retail. Folding in prices observed at those market levels, we can estimate net revenues retained by market level. Factoring in “cycle frequency”, we can guesstimate how many organizations there might be at

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each level and, hence, the revenue per organization. (Use of the term “organization” does not imply that the operations are large or bureaucratic. Indeed, at the retail level, some organizations may consist of nothing more than an individual entrepreneur).

No level of the drug supply chain is easy to study, but there is ongoing data collection about users (e.g., from household surveys and studies of treatment populations) and production (e.g., from satellite imagery). Retailing can be studied by asking users to describe their purchases (e.g., [Caulkins & Pacula, 2006](#)) or by interviewing retailers directly; the nature of their trade requires them to be fairly visible. Even international trafficking is written about extensively (e.g., [Crane, Rivolo, & Gary Comfort, 1997](#); [Paoli, Greenfield, & Reuter, 2008](#)), albeit mostly in the law enforcement grey literature. Domestic distribution networks, by comparison, are relatively understudied.

That is not to underappreciate past contributions ([Desroches, 2007](#)). Tracing at least to the pioneering work by [Reuter and Haaga \(1989\)](#), scholars have used creative data sources such as wire taps ([Natarajan, 2006](#)), gangs’ financial records ([Levitt & Venkatesh, 2000](#)), prosecutors’ files ([Fuentes, 1998](#)), court records ([Becucci, 2004](#); [Tenti & Morselli, 2014](#)); police intelligence reports ([Malm & Bichler, 2001](#)), and judges’ sentencing comments ([Bright & Delaney, 2013](#); [Bright, Hughes, & Chalmers, 2011](#)). Nevertheless, much of this literature is focused on North America and the U.K. (e.g., [Desroches, 2005](#); [Dorn, Levi, & King, 2005](#); [Dorn, Lutz, & White, 1998](#); [Eck & Gersh, 2000](#); [Natarajan, 2006](#); [Pearson & Hobbs, 2001](#); [Pearson & Hobbs, 2003](#)) and/or is essentially ethnographic (e.g., [Adler, 1985](#); [Decker & Chapman, 2008](#); [Ruggiero & Kahn, 2006](#); [Zaitch, 2002](#)).

This analysis seeks to provide a more comprehensive picture of the middle of the drug supply chain that connects producers and exporters on the one hand, with users on the other. The methods extend earlier efforts to pool information from large numbers of individuals to study market segments, such as retail crack sellers ([Caulkins, Johnson, Taylor, & Taylor, 1999](#)), low-level dealers (e.g., [Tunnell, 1993](#)), cannabis wholesalers ([Morselli, 2001](#); [Tremblay & Morselli, 2006](#)) and growers ([Decorte, Potter, & Bouchard, 2011](#)); high-level dealers in the U.K. ([Matrix, 2007](#); [Caulkins, Burnett, & Leslie, 2009](#); [Caulkins, Gurga, & Little, 2009](#)), and various studies of drug couriers (e.g., [Green, 1996](#)). [Shammas et al.’s \(2014\)](#) study based on interviews with 60 incarcerated mid- to high-level drug dealers is a recent analog, but they focused on career trajectories, not market structure.

## Data and methods

### *Analytical paradigm and units of analysis*

The primary unit of analysis is technically not the respondent but rather a drug dealing “cycle”, although most respondents here described only one cycle. By a cycle we mean the collection of activities that begins with purchase from a higher-level dealer and ends when the drugs have been disposed of, mostly by sale at lower market levels. (Some may be consumed or given to employees as wages.)

A few respondents acted as “brokers” selling the entire quantity to a single customer, typically in a different location. However, most subdivided their purchase into smaller units for resale at lower market levels. We refer to the number of sales made per cycle as the dealer’s “branching factor”. Often the branching factor is the same as the number of customers, but sometimes a customer may buy on several occasions within a single cycle, before the dealer obtains a new supply.

The term branching factor is borrowed from graph theory because a drug distribution network looks like an (upside down) tree, with a node supplying multiple branches at the next lower

market level ([Nagurney, 2006](#)). That recursive branching creates a tree whose leaves represent the final retail sale to users.

With that tree image in mind, it is natural to ask:

- How many layers are there in the distribution chain?
- What are typical transaction sizes and prices at each level?
- What are the branching factors at each level?
- How frequently do nodes at different levels renew their supply?
- What are the markups from one level to the next?
- What proportion of total spending on drugs by users is retained at each market level?

While the general nature of these distribution networks has been known for years, few studies have characterized the network structure to the extent we do.

An additional unit of analysis is the price at a given market level. When respondents describe the amount paid for a given quantity but not sales prices and quantities, or vice versa, they provide information about prices but not a full cycle. Hence, sample sizes for analyses of prices can differ from those in analyses of cycles.

There is no specific method per se, analogous to ANOVA or instrumental variables regression. Rather the analysis proceeds through a series of elementary data plots and algebraic exercises that are best presented as they are applied to the data, not described in isolation.

### *Data collection process*

The Addictions and Lifestyles in Contemporary Europe Reframing Addictions Project (ALICE RAP) is a multidisciplinary study of addiction in Europe. The data here come from interviews with 116 imprisoned drug traffickers conducted as part of that ALICE RAP project, 72 in Italy and 44 in Slovenia. (An additional 19 interviews were conducted in Germany, but they did not provide sufficient data to support parallel analyses for Germany.)

Interviewees were adult males, convicted of at least one offence related to distribution/sale of heroin and/or cocaine, who had sufficient fluency in Italian or Slovenian to take part in the interview and who were not known to have any physical or psychiatric disorder which would impede the interview or their ability to consent to participation. The selection criteria did not explicitly target high-level traffickers, but the majority of respondents operated at the wholesale level and higher, in part because those dealers get the longest prison sentences.

Prison personnel suggested an initial list of potential interviewees. The purpose of the study and arrangements regarding confidentiality were shared with them in writing. Participating prisoners signed an informed consent form. The interviewers did not ask or record the names of the respondents.

The interviews covered 76 questions and lasted between one and four hours. The resulting written documentation was interviewer notes, not verbatim transcripts, although the notes sometimes include what appear to be direct quotes. These notes were translated into English and provided to RAND Europe for coding and analysis. For further details on the data collection process, see [Pardal et al. \(2014\)](#) and [Tzvetkova et al. \(2014\)](#).

### *Interview instrument and key questions*

After some preliminaries and questions about career development, respondents were asked:

Let’s think about one of your main suppliers. **Typically, how often did you receive a new supply of your main drug [heroin/cocaine] from your main supplier?**

[6 intervening questions about shortages]

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