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The determinants of heroin flows in Europe: A latent space approach

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ABSTRACT

This study utilises recent advances in statistical models for social networks to identify the factors shaping heroin trafficking in relation to European countries. First, it estimates the size of the heroin flows among a network of 61 countries, before subsequently using a latent space approach to model the presence of trafficking and the amount of heroin traded between any two given countries. Many networks, such as trade networks, are intrinsically weighted, and ignoring edge weights results in a loss of relevant information. Traditionally, the gravity model has been used to predict legal trade flows, assuming conditional independence among observations. More recently, latent space position models for social networks have been used to analyze legal trade among countries, and, *mutatis mutandis*, can be applied to the context of illegal trade to count both edge weights and conditional dependence among observations. These models allow for a better understanding of the generative processes and potential evolution of heroin trafficking routes. This study shows that geographical and social proximity provide fertile ground for the formation of heroin flows. Opportunities are also a driver of drug flows towards countries where regulation of corruption is weak.

Introduction

Transnational drug trafficking is an illicit activity that involves exchanges between actors in different countries (Naylor, 2003; Paoli et al., 2009). As such, international drug flows can be analyzed in terms of a network of economic relationships between countries; hence, models designed for bilateral legal trade can be adapted to identify their determinants. Previous studies have documented how drug trafficking is concentrated within a limited number of particular routes, and that countries thus have a limited number of trading partners compared to legal trade networks (Boivin, 2013, 2014a; EMCDDA and EUROPOL, 2013; UNODC, 2015a). However, there is a relative dearth of information concerning the determinants of the routes used to supply drugs to the European markets.

This study addresses the lacunae in extant research by identifying the determinants of heroin flows to and within Europe. It estimates the amount of heroin trafficked between European countries and non-European countries importing from or exporting to Europe. Finally, through recourse to criminological and economic theories the study identifies the factors that may influence heroin trafficking, before adopting a latent space approach to model both the presence and the amount of heroin flows between countries. Analysing international heroin trade as a directed, weighted network represents a more accurate description of the complexity of the phenomenon than its binary counterparts (Boivin, 2014b; Chandra and Joba, 2015).

The article is structured as follows. The next section reviews extant literature on drug trafficking networks. The third section discusses the respective options for modelling illicit flows between countries. The fourth section presents the manifold factors underpinning international drug trafficking, and outlines the theoretical framework adopted in the study. The fifth section introduces the data and the methodology before presenting the main results in the penultimate section. The final section provides a conclusion and recommendations for policy makers.

Background

International drug trafficking generates considerable profits and represents one of the primary sources of income for criminal organizations. For example, the United Nations Office on Drug and Crime (UNODC) estimates that cross-national trafficking of heroin along

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the Balkan route solely is worth between USD 6.7 and 10 billion (UNODC, 2015b). The estimate rises to USD 28 billion per annum when consumption and production are included, and is exponentially higher yet still if drug-related expenditure is added up (e.g. health costs, enforcement costs). Indeed, heroin consumption continues to account for a substantive share of drug-related health and social costs in Europe (EMCDDA, 2015a), with the number of overdose deaths recently increasing along with the purity of heroin available in European markets (EMCDDA, 2015a), which goes some way to explaining why heroin is considered the most harmful illicit psychoactive substance in Europe (van Amsterdam et al., 2015).

Despite the magnitude of the problem, and the undoubted interest of practitioners and scholars, there remains little systematic research on drug flows between countries. Historically, the lack of data has been the principal factor hindering quantitative studies in this field. However, over the course of the last decade governments and international institutions have collected and provided a considerable amount of data on international drug trafficking, such as wholesale prices, seizures and purity (Chandra and Joba, 2015). These datasets constitute an unprecedented source of information that scholars have begun to use for the purposes of understanding how illicit drugs move across countries.

Data on drug flows are relational in nature, and, as such, are well suited for applying social network analysis methods (Boivin, 2013). Having said this, hitherto only a small amount of recent studies have adopted a network approach to analyze drug trafficking flows between countries (Boivin, 2014a,b, 2013; Chandra and Joba, 2015; Giommoni et al., 2017). This is emblematic of both the recent availability of data, and criminologists' emergent interest in social network analysis methods to analyze the properties of illicit networks, including drug trade networks (see Carrington, 2011; Bouchard and Malm, 2016 for a review).

Thus far, the literature has provided two key contributions to the network analysis of international drug trafficking. The first contribution derives from a series of papers by Boivin (2014a, 2013), who uses macrosocial network analysis to both identify the role of countries with respect to drug flows, and to understand the structural properties of heroin, cocaine and cannabis trafficking networks. Boivin's (2013, 2014a) analysis of the networks— originally developed from data on seizures between 1998 and 2007— provides two main findings. First, that the trafficking of illicit drugs has a more *ad hoc* structure in comparison with the trade of legal commodities (e.g. coffee and chocolate). Second, that core countries within the legal economy tend to occupy peripheral positions within the international trade of illicit drugs. In a further paper, Boivin (2014b) analyses the wholesale prices of cocaine, heroin, and cannabis in an attempt to explain price mark-ups. OLS regression models were used to test the influence of country-level variables (e.g. level of corruption, flow betweenness score) and relational variables (e.g. geographical distance, direction of trade) on price mark-ups between any two given countries. The results show that some characteristics of the importer (e.g. risk of arrest), when viewed in conjunction with the position of the country within the global trafficking network, can predict wholesale price mark-ups (Boivin, 2014b).

Chandra and colleagues provide the second key contribution to the network analysis of drug trafficking flows (Chandra et al., 2011; Chandra and Barkell, 2012; Chandra and Joba, 2015; Chandra et al., 2016). The authors use wholesale prices reported by the UNODC between 2000 and 2008 to infer the presence and direction of transnational flows of heroin (Chandra and Barkell, 2012) and cocaine (Chandra et al., 2011) for seventeen western European countries. The results of the analysis are mobilized to build two directed, binary networks of the international trafficking of heroin and cocaine in Europe (Chandra and Joba, 2015). The overlap between the two networks is limited, most likely due to differences in the geographical location of cocaine and heroin producing countries. For instance, the heroin trade network has more redundant ties and is more diffused than the cocaine network, leading the authors to conclude that it may be more resilient to interventions geared towards reducing the supply (Chandra and Joba, 2015). Recently, Chandra et al. (2016) used the same method to document trafficking patterns using MDMA wholesale prices in 59 US cities, identifying, in particular, the key role of border and coastal cities in this illegal market. This study is especially relevant as it focuses on cities, rather than countries, as nodes in a drug trafficking network.

The studies summarized above share a common feature: they analyze networks with binary flow data, i.e. networks that report information on whether the drug flows between any two given countries are present or absent. A recent study on the supply of heroin to Europe also analyzed trading relationships between countries in terms of binary network ties, using Exponential Random Graph Models (ERGM) to identify the determinants of drug routes (Giommoni et al., 2017). There are two primary justifications for excluding edge weights from the network analysis of drug trade networks. First, the inclusion of information on quantities of drugs traded between any two countries entails estimating the scale of illicit drug markets. This is not a straightforward endeavor, especially if the focus is on more than one country (Kilmer et al., 2015, 2011). Second, most statistical models for networks do not allow for the inclusion of edge weights in the analysis (e.g. Caimo and Friel, 2014; Hunter et al., 2008). However, illicit trafficking networks are intrinsically weighted, and, thus, ignoring edge weights may result in a loss of relevant information (Newman, 2004).

The studies adopting a network approach to the analysis of international drug trafficking proffer several insights about the phenomenon, but they are largely descriptive in nature. For example, they provide an account of the structure of the networks of international trafficking of heroin, cocaine and cannabis (e.g. density, countries' centrality), but fail to explain what shapes and drives the flows of illicit drugs between countries. Gravity-type models and, more recently, latent space position models have been introduced to test theories on bilateral trade and can be applied to directed, weighted networks representing cross-country illicit activities, including international drug trafficking.

Models for illicit trade networks: gravity and latent space position models

Over the course of the last decade, social network analysis has proven its expedience for both refining criminological concepts and theories, and assisting law enforcement agencies in enforcing and preventing crime. That said, most research is descriptive in nature and focuses on the influence of personal and neighborhood networks on crime, and on the organization of criminal groups (see Calderoni, 2014; Carrington, 2011; Haynie and Soller, 2014; Papachristos, 2014 for a review). Illicit activities often involve the smuggling of goods or persons across countries. Human trafficking and smuggling, illicit firearms trafficking, trade-based money laundering are all archetypal examples of cross-country illicit activities that can be analyzed as networks (e.g. Ferwerda et al., 2011; Hernandez and Rudolph, 2015). As with drug trafficking, issues with the uniformity of available data has limited quantitative studies on these cross-country illicit activities. When such information is readily available, the determinants of illicit flows are identified using the same estimation strategies used for bilateral legal trade, i.e. gravity-type models (Akee et al., 2014; Ferwerda et al., 2011; Hernandez and Rudolph, 2015; Wiseman and Walker, 2017).

The gravity model postulates that the amount of traded goods and services moving between any two countries is proportional to the product of their size (or economic mass) divided by their geo-

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