Using Drug Price and Seizures Data to Infer Trafficking Routes: The Case of Cocaine in Europe

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Abstract

Objectives: The aim of this paper is to introduce a general framework for the use of multidimensional data to infer patterns of illegal drug flows. Three types of data including drug prices, drug seizures, and anecdotal information about transnational flows are used in combination to create a comprehensive picture of drug flows. This framework is applied to data on cocaine in western Europe to show how cocaine flows across Europe.

Methods: Time series data on wholesale prices and seizures of cocaine in 17 countries in Europe from 2000 to 2012 are used. For each of the 136 possible pairs of countries, correlations of the wholesale price and of cocaine seizures are computed. The markets for cocaine in any pair of countries are inferred to be linked if the correlations for at least one (in the ‘weak’ case) or both (in the ‘strong’ case) of the two time series exceeds a threshold value. The threshold value of the correlation for each time series (wholesale price or seizures) is calibrated using anecdotal evidence on cocaine flows.

Results: The results demonstrate that cocaine flows from the south and west of Europe to the east and north. Countries in the south and west of Europe tend to have lower cocaine prices and higher levels of per capita seizures. A number of inferred links are identified that are not part of the anecdotal evidence, suggesting opportunities for further investigation for drug policy researchers and enforcement agencies.

Conclusions: The paper demonstrates the value of information on prices and seizures for triangulating flow patterns of drugs in particular and illegal goods in general. While the broad findings are consistent with what we would expect given the origin of most of Europe’s cocaine in South America, a number of additional inferred links that appear to have escaped the attention of drug policy experts are identified and listed for cocaine. The method presented can also be extended to include other dimensions of information, such as purity of drugs, and other markets in which illegal trade occurs, including weapons and people.
1. Introduction

In combined value, illegal drugs comprise one of the most valuable traded commodities in the world. The annual retail value of cocaine worldwide stands at a staggering $88 billion (United Nations Office on Drugs and Crime (UNODC) 2010, p.35). The European market for illegal drugs is one of the most important in the world by size. According to the UNODC, “[t]he second largest cocaine market is that of Europe, notably West and Central Europe, where consumption is estimated at 123 mt” (Ibid, p.15). Furthermore, in 2007 it was reported that approximately 500 deaths were associated with cocaine use and an increase in polydrug use has been contributing to a rise in treatment complications (Wiessing 2009). Because cocaine is illegal, however, law enforcement officials worldwide are constantly striving to track and intercept flows of this drug based on sporadic, often unreliable information. The difficulty of effectively doing so is compounded by the increasing sophistication of drug trafficking organizations, financed by the vast revenues generated from the trade. Consequently, reliance on a single mode of drug control based on a narrow source of information can limit the success of drug policy (Hayashi et al. 2013). Therefore, the drug research community faces a continuing challenge to provide mutually complementary approaches and methodologies to enhance the quality of information available to the drug policy and enforcement communities to effectively mitigate the problem.

A variety of organizations around the world produce data to track global drug production, trafficking, and consumption trends. At the international level, the United Nations Office on Drugs and Crime produces the comprehensive World Drug Report (WDR) and a variety of related publications. At the regional level, the European Monitoring Commission for Drugs and Drug Abuse (EMCDDA), for example, coordinates similar efforts in Europe. In the USA, the Drug Enforcement Administration (DEA) and, until its closure in 2012, the National Drug
Intelligence Center (NDIC) have been producing detailed data on American drug markets. In the above cases, time series data for multiple jurisdictions (countries, states, or cities) on some combination of prices, consumption, purity, seizures, and production are published. Despite the extensive literature published by these agencies, there is scope for expansion of such efforts into additional countries, for intensification by collecting higher frequency data, and for deepening them by collecting data on a broader array of related phenomena (Degenhardt et al. 2011). With the application of simple methodologies driven by simple theoretical notions, these data sets present a remarkable but under-utilized opportunity for the research community to contribute to the management of the drug trafficking problem.

The aim of this paper is to demonstrate a framework for detecting drug flows across administrative jurisdictions (i.e., countries, states, or cities) using a multi-dimensional analysis of data on prices and seizures of the kind reported by the above agencies that span more than one dimension and are therefore richer than one-dimensional data such as price, production, or seizures alone. This paper advances earlier work in which correlations of a single type of data (one-dimensional data), namely price, were used to infer cocaine (Chandra et al 2011) and heroin flows (Chandra and Barkell 2013) across Europe and cocaine flows across the USA (Chandra et al 2014). To illustrate this framework, we use a panel of annual data on wholesale prices and seizures of cocaine for 17 European countries reported in the WDR for the period 2000-12.

2. Literature Review

There is a rich literature on drug trafficking in general, and on the economics underlying this profitable activity. The literature analyzing drug markets is similar to literatures on most markets. For example, on the demand side, studies have focused on prices, own- and cross-price
elasticity, demand, and consumption of drugs (Grossman and Chaloupka 1998; Chaloupka, Grossman and Tauras 1999; Saffer and Chaloupka 1999; DeSimone and Farrelly 2001; Ritter 2006; Clements 2004; Williams 2004; Zhao & Harris 2004). Caulkins (1995, p.38) suggests that price data may be superior to quantity data because of the “notoriously suspect” nature of quantity data. For example, information on numbers of drug users and dealers and on the quantity of drugs consumed and purchased is generally considered to be inaccurate (Singer (1971), Reuter (1984)). In addition, since government officials are sometimes mandated to purchase illicit drugs for investigative purposes, price data collected through official channels are more reliable than quantity data. Although noisy, these price data can provide reasonably accurate estimates for market prices (Caulkins (1995)). Finally, information contained in price data can serve as a significant tool for policy prescriptions to control illicit drug trade. This information can help officials evaluate the efficacy of interventions (Anderberg (1991), Reuter, Crawford and Cave (1988)) and compare them to the alternative measures (Reuter and Kleiman (1986) and Hughes et al. (2011)). It can also be used to predict future changes in supply and consumption patterns (Kleiman and Caulkins (1992), and DeSimone and Farrelly (2003)) and, as a result, help draft future policies.

Another popular question researchers have looked into is explaining the price markup of an illicit drug. Retail prices of illicit drugs are much higher than the wholesale prices: “Heroin and cocaine sold at retail in developed countries are quite literally worth many times their weight in gold” (Caulkins and Gurga 2009). This feature is also present in the markets of other semi processed agricultural goods such as coffee and sugar that move through integrated, multi-layer distribution chains where price is altered through geographic variation from the source (Goletti, Ahmed, and Farid 1995). However, while legal goods are marked up as they move through the
supply chain and value is added to them, price mark ups of illicit drugs like cocaine can be very large even though they are not refined or processed in any significant manner (Caulkins and Reuter 1998). Thus, modeling price markups of illicit drugs has attracted the attention of many scholars (Caulkins and Padman 1993; Caulkins 1994; Caulkins 1997; Crane et al 1997; Clements 2006), and many studies have attempted to explain why these markups are so large in the case of illicit drugs (Miron 2003; Hough and Natraj 2000; Reuter and Kleiman 1986; Caulkins and Reuter 1998; Storti and De Grauwe 2008; Kuziemko and Levitt 2004; Caulkins and McCoun 2003; Caulkins and Gurga 2009).

A recent series of studies has used some of the observations made in earlier research along with economic principles to study drug flows using price data. From the aforementioned literature on markups, we know that the price gradient is indicative of the direction of drug flows, that is, drugs flow from areas with low prices to areas with high prices. The global cocaine market provides an excellent case study for price gradients because its production and distribution is highly centralized by cartels from Colombia, Peru, and Bolivia (Reuter 2009). Furthermore, because of the importance of the cocaine trade, the UNODC has invested significant resources in the collection of cocaine statistics (Carstairs 2009). When demand is inelastic, as is the case with cocaine, fluctuations in the price will be the result primarily of fluctuations in supply (Dave 2004). Hence, for any pair of countries linked in an upstream-downstream relationship, we would expect the price to be highly correlated. For this reason, for any pair of countries, positive and high correlations in prices are likely to be indicative of a link (Chandra et al 2011; Chandra and Barkell 2013; Chandra, Peters, and Zimmer 2014; Chandra and Joba 2015).

This study contributes to the literature on the geography of trafficking in addition to the literature on the economics of drug trafficking. Reuter et al (1988), Caulkins and Padman (1993) and
Caulkins (1993) explain the domestic geographic variation in the cocaine prices in the US. Caulkins (1995) examine the spatial variation in illicit drug prices within the United States and found that observed cocaine prices increase with distance from the source of the drug. Caulkins and Bond (2012) makes a similar observation with respect to marijuana prices.

In the context of Europe, Farrell et al (1996) is one of the earliest studies to use data from the United Nations to examine flows of heroin and cocaine across Europe. In addition to price statistics, that study uses seizures data to analyze cocaine and heroin markets. The authors make a variety of observations that are directly relevant to this study. First, they assert that seizure levels in a country through which a drug flows should be generally indicative of the volume of flow of the illegal drug through that country. This is the “tip-of-the-iceberg” phenomenon, where the seizures represent the visible fraction of the drug trade, and fluctuate in size in tandem with the underlying volume of drug flows. A corollary of this assertion is the tendency for seizures in two markets that are linked in an upstream-downstream relationship to be correlated, reflecting co-movement in the underlying volume of the illegal drug flowing between those two linked countries.

The UNODC, through its World Drug Reports series, and the EMCDDA, through its various bulletins, provide descriptions of routes along which cocaine is trafficked to Europe. Europe obtains the bulk of its cocaine shipments via the sea route, with Colombia, Peru, and Bolivia serving as the main suppliers and Venezuela as an important transit country. Recently, an emerging pattern has included at least two trans-shipment hubs in West Africa, one in Guinea-Bissau and Guinea, and one spanning the coast from Ghana to Nigeria.
In Europe, Spain and Portugal in the southwest and the Netherlands and Belgium in the north serve as key landing points for cocaine shipments. Several geographical and historical factors predispose these four countries to cocaine trafficking. Spain and Portugal have long westward-facing coastlines and a long and rich history of interaction with South America that has resulted in strong cultural and linguistic ties. The Netherlands and Belgium are home to some of Europe’s largest seaports (Rotterdam in the Netherlands and Antwerp in Belgium), and the Netherlands has had a presence in the Caribbean Sea and South America (Aruba, the Netherlands Antilles, and Suriname) since colonial times.

This paper derives its foundations from three key studies drawn from the above literatures, Caulkins (1995) on the role of prices, Farrell et al (1996) on the role of seizures, and Chandra et al (2011) on using price gradients and correlations to identify drug flows. Key insights from these three papers are combined into a single framework. Our analysis incorporates concepts based on phenomena observed in drug dealing, drug production and distribution networks, drug price markups, and law enforcement, including seizures. In the economic framework, prices and quantities serve as the most useful sources of information for understanding how a market functions, including insights into supply chains. This paper enriches the well-studied price data with the less-frequently used data on seizures. In particular, in addition to using correlations in the wholesale price of cocaine, we use correlations in the cocaine seizures to infer whether the cocaine markets in two countries are linked (Caulkins 2009). Though the data on seizures have been used previously, for example, in Farrell et al (1996), the treatment of these data in our paper is unique in the sense that our methodology integrates the use of the seizure data with the use of price data to infer a more complete set of linkages in the cocaine markets than is offered by existing anecdotal data.
3. Data and Methods

Data

Because of the illegal status of cocaine, accurate data on the size and direction of cocaine flows are difficult to come by. The annual *World Drug Report* published by the UNODC, from which the data for this study are drawn, is one of a small number of sources for three types of potentially useful data. These data, which are obtained from national government statistics, include wholesale cocaine prices, cocaine seizures, and anecdotal data on inter-country cocaine flows. Taken individually, each type of data has strengths that distinguish it from the two other types of data. As discussed above and in Farrell et al (1996), the annual data on seizures, which cover all 17 countries to be studied, may provide some clues about inter-country flows based on the volume of those flows. The annual wholesale price data, which also cover all 17 countries to be studied, may provide clues on inter-country flows by identifying the transmission of supply shocks that affect the price across borders (Chandra et al 2011). And the anecdotal data, which are drawn from the vast local contextual knowledge of drug enforcement authorities and informants, may provide direct information about such linkages, even though they do not systematically cover all the countries to be studied. A key strength of the framework proposed in this paper is that it uses all three types of data in combination to extract information about cocaine flows.

The UNODC data are available as an unbroken panel of annual observations from 1990 to 2012 for 17 countries in Western Europe, hence the analysis was restricted to those countries. Figure 1 shows the mean wholesale price of cocaine across the 17 countries in Europe over the period 1990-2012, overlaid on top of the coefficient of variation, a measure of the spread of wholesale
prices across the 17 countries. Both lines suggest that the price regime for cocaine in Europe underwent a change in 2000. The wholesale price of cocaine fell steeply between 1990 and 2000, after which it rose gradually. The slower and steadier rise in the price of cocaine after 2000 was likely a reflection of the gradual decline in the value of the US Dollar, in which the price is measured, against the then-newly introduced Euro. Similarly, the coefficient of variation of price across the 17 countries fell steeply until 2000, after which it stabilized on a slightly downward trend. These phenomena can be attributed to the rapid pace of integration of European markets in the 1990s that led to currency and market unification in 2000, following which the process of integration continued, but at a slower rate, and to efficiency gains in the production and distribution channels of illicit drugs (Wilson and Stevens 2000; Costa Storti and De Grauwe 2008; Baldwin and Wyplosz 2009; Bekaert and Harvey 1995). The regime shift in prices, coincident with the introduction of the common currency and the integration of markets across Europe suggests that the analysis of cocaine flows using price data should be divided into two time periods, 1990 to 2000 and 2000 to 2012. Therefore, we focus on the post-market-integration period of 2000-12, with the observation that results about direction of flow of cocaine in the pre-2000 period, obtained from similar analysis, should be and are broadly similar to results from the post-2000 period.

Analytic Method

The analysis consists of two steps that build on the analysis used in Chandra et al (2011), Chandra and Barkell (2013), and Chandra, Peters, and Zimmer (2014) by adding a dimension in the form of seizures data. In the first step, for each of the 136 possible pairs of countries derived from the original set of 17 countries, two correlations were computed, one for the wholesale price of cocaine and the other for cocaine seizures. This pair of price and seizures correlations
was used to determine, singly (the weak case) or in combination (the strong case) whether the cocaine markets for the two countries were linked, with a correlation value (in the weak case) or pair of values (in the strong case) that exceeded a specified threshold value being used as the criterion to infer linkage.

The threshold values of the price and seizures correlations above which a link was inferred was determined by calibrating the correlations against anecdotal data as follows. First, a list of transnational linkages (henceforth the ‘anecdotal’ list) was compiled from the text of the various editions of the WDR that were published during the time period under analysis. Next, for every possible pair of threshold values of positive price and seizures correlations, computed by varying each of the two correlations by 0.01 in the range 0.01 – 1 (for a total of 100 x 100 = 10,000 pairs), the list of country-pairs that were inferred to be linked was compiled, for a total of 10,000 possible inferred lists. The direction of cocaine flow between the two markets in each pair was inferred by comparing the mean wholesale price of cocaine between the two countries, and using the principle that cocaine flows from the country with the lower price to the country with the higher price. Finally, each of these 10,000 lists was compared with the anecdotal list, and the pair of threshold correlations (one each for prices and seizures) whose list yielded the highest concordance rate with the anecdotal list, measured as the number of country-to-country flows that appeared on both the anecdotal and the inferred lists, was selected as the threshold.

In order to test for the sensitivity of the methodology to the possibly noisy nature of seizures correlations discussed above, two separate criteria, a weak criterion and a strong criterion were used to infer country-to-country market linkages. In the case of the weak criterion, if either of the price and seizures correlations exceeded the candidate threshold, the pair of markets was inferred to be linked. In the case of the strong criterion, both the price and the seizures correlations for the
country pair were required to exceed the candidate thresholds in order for the country pair to be added to the inferred list. Intuitively, the criteria differ in that, for any pair of candidate threshold correlations, the weak criterion allows for a larger set of country pairs on the inferred list. The strong criterion is far more conservative, and should yield a much shorter inferred list for any pair of threshold correlations.

Finally, based on the above analysis, for each country, we computed the numbers of inward and outward country-to-country links and performed a cluster analysis using these two variables with a view to characterizing each country as a source, destination, transit country, or weakly integrated (into the cocaine flow network) country. For this purpose, we used the k-means method of clustering, constraining the number of clusters to four to determine whether the countries fell into simple categories like those identified in Chandra, Peters, and Zimmer (2014).

RESULTS

Figure 1, which was discussed above, was used to determine appropriate time periods for the analysis (i.e., 2000 and after). It shows the regime change that occurred in Europe as a consequence of the integration of the countries into a single monetary unit in 2000. Figure 2 shows total seizures in Europe, revealing a spike that occurred in the mid- to late-2000s subsequent to the monetary union. This variability in seizures is beneficial in that it will emphasize between-country correlations in seizures across the 17 countries in this study.

Figure 3 is a map showing average cocaine prices for the 17 countries in the sample. Countries were divided into three groups of equal size to show regions of low, medium, and high price. Ireland and Portugal, on the western edge of the region, and the three Benelux countries (Belgium, the Netherlands, and Luxembourg), show the lowest prices. The countries with
medium prices tend to lie in the central part of the region, and the high-priced countries lie on the northeastern and southeastern periphery of the region. This pattern is broadly consistent with the notion that the price of cocaine increases with distance from its source in the Andean region across the Atlantic Ocean to the west.

Figure 4 is a map showing per capita cocaine seizures for the 17 countries. This map shows an even more striking geographic pattern than the map in Figure 3 --- per capita seizures tend to be the highest in the western countries of Portugal and Spain, along with the Benelux countries, medium in the countries in the central part of the region, and low in the countries to the east (Austria, Germany, and the four Scandinavian countries). This is consistent with the notion that seizures will tend to be higher in countries for which there is both a local retail market and through which large volumes of cocaine flow en route to their final destinations in other countries. Thus, in general, we would expect countries closer to the source of the cocaine to show higher seizures per unit population (because of the excess cocaine in relation to local demand passing through the country) than countries farther away from the source (because they have progressively smaller amounts of excess cocaine).

Having established these two basic facts about cocaine prices and seizures, we now move to the results of the analysis. Figure 5 is a plot of the concordance rate between the inferred list for each of the 10,000 pairs of candidate price and seizure thresholds and the anecdotal list derived from the *World Drug Reports* using the weak concordance criterion. For any pair of candidate threshold correlations, the concordance rate is measured as the number of inferred links as a fraction of the total number of inferred or anecdotal links (Chandra, Barkell and Steffen 2011; Chandra and Barkell 2013; Chandra, Peters, and Zimmer 2014). The threshold correlations that maximize the concordance rate are 0.88 for the wholesale cocaine price correlation and between
0.34 and 0.35 for the seizures correlation. Within this range of thresholds, the concordance rate was 0.277, meaning that of all the unique country-to-country flows that were either inferred using these correlation values as thresholds or that were on the anecdotal list, 27.7% were on both the anecdotal and inferred lists. Figure A1 is a similar plot of concordance rates, but for the strong criterion. In this case, the range of price thresholds that maximize concordance is 0.27 to 0.31 and the seizures threshold is the range 0.03 to 0.05. The maximum concordance rate of 0.135 for the strong criterion is about half the value of that for the weak criterion, suggesting that it does a weaker job of capturing anecdotal linkages than the weak criterion. For this reason, we select the weak criterion to infer cocaine flows across Europe.

Figure 6 is a map of Europe classifying countries by the number of inferred outward cocaine links. The hot-spots are the Iberian peninsula (Portugal and Spain) and a cluster of countries in the center of the region, including the Benelux countries, Austria, and Germany. Figure 7, which displays inward links, shows that a large number of countries display more than one inward link, with only a few countries showing no links (Ireland and Portugal on the western edge of the region and Switzerland). In addition, the relatively small eastern countries of Austria and Finland also show only a single inward link.

Figure 7 shows graphically the results of the cluster analysis, based on two variables, the number of inward links and the number of outward links. The four clusters identified are consistent with countries that have source-like properties, destination-like properties, both sets of properties, or neither set of properties. The analysis produced simple threshold values of inward (threshold value = 3) and outward (threshold value = 3) links above or below which the cluster changes.
Finally, Figure 8 is a map of Europe based on the above classification of countries. Four countries display source-like properties: Portugal, Spain, the Netherlands, and Switzerland. Of these, two are coastal countries located on the western edge of the region. The other two are known to have liberal drug policies and are located in the central part of the region. Of the countries with source-like properties, Spain also has destination-like properties. The remaining four countries with destination-like properties form a cluster in the northern and western part of the region. These include the UK, Germany, Sweden, and Denmark. In general, the patterns of sources and destinations is consistent with the location of the original source of cocaine, to the south and west of Europe and across the Atlantic Ocean.

DISCUSSION and CONCLUSIONS

This study builds on a series of earlier studies that use data on drug prices to infer trafficking patterns (Chandra et al (2011); Chandra and Barkell (2013); Chandra, Peters, and Zimmer (2014)) by adding a second set of data on seizures to triangulate and infer with additional information possible trafficking patterns. Given the wide availability of seizures data, this two-dimensional triangulation approach can be applied to a variety of drugs for which both types of data (i.e., prices and seizures) are available. Consistent with earlier work (Chandra, Barkell, and Steffen 2011), prices for cocaine in Western Europe gradually increase from the southeast to the northwest of the region. Interestingly, seizure volumes follow a related pattern --- on a per capita basis, seizures are highest on the Iberian Peninsula and in the Netherlands and Belgium. Triangulating results from the analysis of both seizures and prices generates a compelling picture that points to Portugal and Spain on the Iberian Peninsula, and the Low Countries (Netherlands and Belgium) as key entry points for cocaine into Europe. The cluster analysis bolsters this
finding by producing a picture of Europe in which key sources are in the west and destinations are in the east.

Limitations of this study stem largely from the nature of the data. For example, data on seizures represent a small fraction of the actual underlying drug flows (Farrell et al 1996), and are vulnerable to fluctuations depending on the chancy nature of drug interdiction. Similarly, price data collected from law enforcement authorities or informants, while valuable in that they contain signals about market forces, also cannot be considered to be completely reliable because they are obtained from intelligence gained from potentially inaccurate reports. Second, entry points identified in this study should not be interpreted as primary sources of cocaine in the global context. Rather, they should be viewed as entry points for the 17-country region being studied and as transit countries from other points of origin outside Western Europe. Viewed another way, countries that appear to be prominent in limited geographic context of this study may not be significant players in the context of the larger worldwide cocaine trade. Third, conducting the calibration exercise for seizure correlation thresholds in only the positive range of values implicitly assumes that the seizure correlations between linked countries should be positive. That is, if seizures in one country rise, then seizures in linked countries should also rise. However, it is in theory possible that, if seizures in a source country are large enough to materially affect drug flows, then seizures in destination countries depending on that source may decline. For a number of reasons, however, we believe that this is not the case. First, seizures account for only about ten percent of the illicit drug flows (Farrell et al, 1996). In other words, because the volume of seizures reflects a very small proportion of the actual volume of drug flows, it is unlikely that these seizures have a significant impact on the volume of drugs flowing from one country to another. Hence, greater flows in a source country resulting in higher seizures
in that country should translate into great flows in destination countries, resulting in higher seizures in those countries as well. Second, the concordance-maximizing seizure correlation threshold in Figure 5, at 0.34-0.35, occurs well within the positive range of values, providing additional validation of this conjecture.

This study showcases an important potential use of data on prices and seizures to track illicit drug flows. If such data could be collected in real time, then this methodology could be used to track supply lines as they evolve. Furthermore, disaggregated data (at the city level, for example) would provide a more complete picture of cocaine flows through Europe with tangible geographic locations on which law enforcement authorities can focus. In the European context, even aggregated data reveal clear ‘weak points’ on the Iberian peninsula and the Low Countries through which cocaine enters the continent. Within these countries, policies to prevent the passage of narcotics across the continent should be considered. The methodology of this paper can be employed to examine the flows of other drugs, such as methamphetamine, and a comparison of the separate drug networks could yield rewarding results (Chandra and Joba 2015). Lastly, other potentially valuable data can be used to further refine the picture of drug flows, including purity or prevalence of consumption.
Figure 1: Average Unweighted Inflation-Adjusted Cocaine Price in Europe (1990-2012)

- Average Price Across Countries ($/kg)
- Coefficient of Variation of Inflation Adjusted Price

The graph shows the average unweighted inflation-adjusted price per kilogram of cocaine in Europe from 1990 to 2012, along with the coefficient of variation of the inflation-adjusted price. The y-axis represents the average price across countries ($/kg), while the x-axis represents the years from 1990 to 2012. The coefficient of variation is also plotted on the right y-axis, showing the variability of the inflation-adjusted prices across different countries.
Figure 2: Cocaine Seizures in Europe (1990-2012)
Figure 3: Average Cocaine Price in Europe (2000–12)
Figure 4: Average Per Capita Cocaine Seizures in Europe (2000—12)
Figure 5: Calibration of Cocaine Price and Seizure Threshold Correlation Pair Using Weak Concordance Criterion

Price threshold = 0.88
Seizure threshold = [0.34, 0.35]
Figure 6: Outward Cocaine Linkages in Europe (2000–12)
Figure 7: Inward Cocaine Linkages in Europe (2000—12)
Figure 8: Classification of Countries Based on Cocaine Flows
(Four Clusters Based on Inward and Outward Linkages)
Figure 9: Cocaine Flow Status in Europe (2000–12)
Classification Determined by Cluster Analysis
# Tables

## Table 1: Summary and Fit Statistics for Variables in Cluster Analysis

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<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Total STD</th>
<th>Within STD</th>
<th>R-Square</th>
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<tr>
<td>Inward links</td>
<td>1.82</td>
<td>1.47</td>
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<td>1.82</td>
<td>2.13</td>
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<td>Overall</td>
<td>3.64</td>
<td>1.83</td>
<td>0.86</td>
<td>0.82</td>
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## Table 2: Clusters and Their Characteristics

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<th>RMS Std Deviation</th>
<th>Inward Links</th>
<th>Outward Links</th>
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<td></td>
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<tr>
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<td>1</td>
<td>.</td>
<td>3.00</td>
<td>6.00</td>
<td>Source and Destination</td>
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<td>0.98</td>
<td>3.75</td>
<td>0.50</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>0.96</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>0.83</td>
<td>1.33</td>
<td>0.89</td>
<td>Weakly Integrated</td>
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<td></td>
<td>0.87</td>
<td>0.78</td>
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*Standard errors in italics
## Table A1: List of Countries Included in Analysis

<table>
<thead>
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<th>Country Name</th>
<th>Country Name</th>
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<tbody>
<tr>
<td>Austria</td>
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<td>Belgium</td>
<td>Netherlands</td>
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Figure A1: Choice of Threshold Values of Cocaine Price and Seizure Correlations Using Strong Concordance Criterion

Price threshold = [0.27, 0.31]
Seizure threshold = [0.03, 0.05]
References:


European Monitoring Centre for Drugs and Drug Addiction (EMCDDA). (2008). Monitoring the supply of heroin to Europe. Lisbon: EMCDDA.


