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Violent disequilibrium: the influence of instability in the economic value of cocaine markets on homicides

Abstract

Many scholars have investigated the escalation of violence associated with cocaine trafficking. Despite the plethora of literature on the matter, limited attention has been paid to the consequences of instability in the economic value of markets. This study addresses this shortcoming by examining fluctuation of the gross value added of cocaine markets in terms of an etiological factor in the upsurge of interpersonal lethal violence at country level. To this end, the study produces an estimate of the gross value added of the cocaine market in 151 countries between 1998 and 2013. The analysis indicates how both expansions and contractions of the value of cocaine markets influence the level of violence within the countries that constitute the global cocaine trafficking network.

Key words

Cross-national study; Systemic violence; Homicide; Cocaine trafficking; Illicit markets; System GMM

1. Introduction

The aim of this study is to assess whether economic instability within cocaine markets, measured in terms of fluctuations of the gross value added, is a catalyst of violence. The hypothesis proposed is that both increases and contractions in the profits generated by cocaine trafficking and distribution are likely to cause an increase in the use of violence among criminals involved in this crime. Variations in the economic opportunities provided by the involvement in cocaine trafficking and distribution modify the competitive environment of cocaine markets. Since criminals active in the cocaine industry cannot access the institutions of the legal system and lack the means available to legal enterprises to cope with these changes, the modification of the competitive environment exacerbates their recourse to violence. Both expansions and contractions of cocaine trafficking profits are correlated with increases in recourse to interpersonal violence: the trigger element is the variation with respect to a previous equilibrium.

Due to its status as one of the determinants of violence, the drug market has taken centre stage within debates since the 1980s. In his seminal paper, Goldstein (1985) identifies three possible ways in which drugs and violence are related: psychopharmacological, economic compulsive, and systemic. In particular, the systemic dimension pertains to the modes of violence consistent with lifestyles and business methods oriented around drug distribution and trafficking. Since the publication of Goldstein's tripartite conceptual framework, the illegal drug trade has been identified as a key driver of violence, with a veritable host of scholars now investigating the drug/violence nexus by applying this conceptual framework (J. Collins 2014; Dickinson 2015; Ousey and Lee 2002; Werb et al. 2011). In recent decades, scholars have developed and expanded upon Goldstein's original model, identifying a further series of factors which help to account for the high levels of *systemic violence* concentrated within specific drug

markets. These drivers of violence are: the lack of legal instruments to settle disputes (Caulkins and Reuter 1998; Mejía and Restrepo 2013; Robles et al. 2013); the perpetuation of retaliation (Topalli et al. 2002); the interaction between drug traffickers and law enforcement agents (B. L. Benson et al. 2001; Werb et al. 2011; Rios 2013); the strength of competition and organizational structure (Kleiman 1989; Reuter 1983; Decker et al. 2008).

High levels of drug-related violence within various Latin American countries in the past decade have engendered a renewed interest in theoretical explanations pertaining to the relationship between drug markets and violence (Calderón et al. 2015; Dell 2015; Kleiman et al. 2015; Osorio 2015; Rivera 2016). However, despite the large body of academic research on the topic, "understanding the relationship between illicit drugs and violence is still underdeveloped" (Dickinson 2015, 81). More specifically, there is still a relative dearth of empirical literature analyzing how economic aspects of drug trafficking intersect with the recourse to interpersonal violence. The paucity of suitable data and the singular focus of scholars on enforcement actions are the principal reasons for this gap in the literature (Kilmer et al. 2014; Werb et al. 2011). Consequently, there is a need for research investigating how the recourse to violence is affected by economic drivers of the illegal drug trade – especially from a cross-national perspective (Mejía and Restrepo 2016; Werb et al. 2011).

With such considerations in mind, this study aims to explore the defining characteristics of the relationship between economic aspects of the drug industry and lethal violence. More specifically, the analytical gaze is fixed upon whether fluctuations in the overall economic value of cocaine markets have a positive association with homicide rates. In what follows, fluctuations in the value of the market are considered to be an expedient instrument with which to measure important patterns and shifts occurring in drug markets, which act as a determinant of the violence wrought by the drug industry. The focus on instability has its support in the fact that many scholars agree that violence is a distinctive feature of illicit

drug markets, but its outbursts tend to be linked to degenerate dynamics rather than being ordinary and ubiquitous.

To achieve its objectives, the study conducts a longitudinal and cross-sectional estimate of the gross value added related to national and international cocaine trafficking for a series of countries. A strength of this approach is its capacity to translate complex dynamics like competition, incentives, and constraints into quantities and numbers. The focus on cocaine trafficking is primarily driven by the exceptionally high levels of violence that characterize this market, above and beyond that of other notoriously violent markets such as the heroin market (Bean 2008; Reuter 2009). The study provides empirical support for the argument that specific economic dynamics of cocaine markets are important determinants of violence. Indeed, this study shows that fluctuations in the value of cocaine markets serve as a plausible explanation for the increase in lethal violence at country level. The analyses conducted here extends the relevance of this concept beyond both the American suburban context and the most problematic drug producing and trafficking countries upon which most previous studies have concentrated.

The paper is organized as follows. Section 2 provides an overview of the key literature which examines the relationship between economic aspect of cocaine markets and violence and presents the research question and hypothesis. Section 3 describes the rationale for the methodology adopted in this study, along with a brief description of the approach utilized to estimate the gross value added generated in cocaine markets. Section 4 delineates the results of the econometric regressions developed to test the hypothesis of the study. Section 5 outlines the principal limitations of the study. Section 6 centers around a discussion of the findings. The final section reflects on the key conclusions emerging from the study.

2. Value of drug markets and violence

One stream of research sets out to explain the link between drug markets and violence in economic terms. Researchers who adopt this perspective do not ordinarily reject socio-cultural theories of violence, nor do they downplay the importance of structural characteristics of drug markets (e.g. lack of a legal framework to resolve disputes, the structure of trafficking groups) (Castillo et al. 2018; J. J. Collins 1990; Dickinson 2015). Rather, they seek to understand the role played by the value of drug markets in the drug/violence nexus. To do so, they use indicators such as drug prices, revenues, supply shortages, profits, among others (MacCoun et al. 2003; Miron 1999; Reuter 2009; Wright and Decker 1997). Despite the abundant literature, little is known about the effect that fluctuations in the value of drug markets have on violence levels (Chi et al. 2013). Given that the primary motivation for involvement in drug trafficking is an economic one (Desroches 2007; Reuter and Kleiman 1986), this is an important gap in our knowledge about the relationship between drugs and violence.

Scant attention has been paid to the consequences of variations of the economic dimension of illicit drug markets, and when research has dealt with the matter, it has often obtained contradictory results (e.g. Angrist and Kugler 2008; Castillo et al. 2018; Ousey and Lee 2007; Robles et al. 2013). Moreover, studies have hitherto been unable to focus directly on the economic dimension of the markets. Rather, authors have adopted proxies, such as coca production (e.g. Angrist and Kugler 2008), shortages in cocaine supply (e.g. Castillo et al. 2018; Robles et al. 2013), prevalence of use, overdose cases (e.g. Rios 2015), or arrests (e.g. Fajnzylber et al. 2002). These proxies are effective in operationalizing specific aspects of the cocaine markets but, ultimately, they may be limited in representing the full complexity of the economic dynamics of a drug market. For instance, while the number of users may decrease in response to a prevention policy targeting drug consumption initiation, total expenditures may, in actual

fact, increase due to consumers transitioning to heavier usage, or because of an increase in supply or an increase in prices (Kilmer and Pacula 2009). Similarly, an increase in seizures may not cause the total value of the market to diminish, because such actions may lead to an increase in prices or in the amount of cutting agents. Moreover, while studies investigating the downsizing of cocaine trafficking are almost absent in the literature, the fact that cocaine markets also contract calls for them.

Informed by the literature review, this study sets out to answer the following research question: *does instability in the value of cocaine markets cause violence?* It has been observed that people are likely to become involved in drug trafficking for various subsidiary reasons—e.g. to experience a sense of excitement, to achieve or maintain a dominant position within existing political structures, and, more generally, to achieve social power (Adler 1993; Dorn et al. 2005; Marks 1997). However, there is a consensus that economic incentives are the principal driving force behind drug trafficking (Desroches 2007; Chi et al. 2013). That is to say, people active within the drug markets aim to maximize their economic utility and minimize their risks, which they achieve by modifying their behaviors in relation to external stimuli (Reuter and Kleiman 1986; Che and Benson 2014).

Even in more structured drug markets, a multitude of factors may cause important fluctuations in economic opportunities for traffickers and drug dealers. For example, arrests may cause an increase in the value of drugs because prices rise in response to the higher risks of running an illegal business (Caulkins and Reuter 1998; Reuter and Kleiman 1986). Drug seizures can likewise lead to a rise in the value of drugs by shifting the supply curve to a market where the demand is, instead, relatively stable (Castillo et al. 2018). Alternatively, a contraction in the availability of drugs may lead to an overall decrease in the value of the illicit market by reducing its size; both disruptions in drug dealing markets and reducing the availability of a drug can decrease the number of drug transactions, thus reducing the total value of the market (Kleiman et al. 2011). Fluctuations in the value of drug markets are likely to

modify the competitive environment in which traffickers operate, regardless of the specific reasons underlying the changes (Miron 2001; Castillo et al. 2018; Robles et al. 2013). In such a scenario, drug traffickers may either increase their gains or lose part of their income, which, in turn, further affects the balance of anticipated rewards and costs (Nettler 1978).

There are three main aspects to the illegality of their business which impede drug traffickers from peacefully handling the transformation of the market. Firstly, due to their status as criminals, traffickers are unable to rely upon the institutions that make up the legal system to settle their disputes and enforce contracts (Caulkins and Reuter 1998; Jacques and Wright 2011). Secondly, business operators in illicit markets cannot employ certain practices available to their legal entrepreneurial counterparts; for instance, they are unable to utilize advertising and branding to gain market share and increase profits (Che and Benson 2014; Gambetta 2009). Finally, during tough periods for their drug trade, it is difficult for traffickers to liquidate their businesses and find alternative employment which offers a similar income, not even if they remain engaged in illegality (J. J. Collins 1990; Reuter et al. 1990). Therefore, the recourse to violence in this instance can be understood as a potential substitute for legal practices in response to changes in the value of drug markets (Desroches 2007; Kleiman 1989; Rios 2013). Given that it is changes in market dynamics which influence the recourse to violence, we can say that both expansions and contractions in the economic value of drug trafficking influence levels of interpersonal violence.

3. Empirical strategy

The analysis reported in this paper tests the relationship between the fluctuation in the value of cocaine markets and violence by conducting a panel-data analysis of 58/126 countries during the1999-2013 time

span. The number of considered countries depends on the different specifications of the models and data availability on homicide and structural variables; the time span was determined on the basis of the available data on cocaine markets. The regression models rely on use of the system GMM. The record of the homicide rate in each year is regressed on different sets of variables describing drug markets and potential socio-cultural determinants of violence. The core explanatory variables are estimates of the fluctuations of the gross value added generated in the cocaine markets. As detailed in the sub-section *Structural explanatory variables*, the selection of the other independent variables emerged from the extant literature on structural theories of violence and cross-national studies on homicides (e.g., Eisner 2013; LaFree and Drass 2002; Pridemore 2008, 2011; Rogers and Pridemore 2017).

Dependent variable

The overwhelming consensus in the extant literature is that homicide figures are the most suitable source of information for cross-national analyses of violence (e.g. Neapolitan 1994; Fajnzylber et al. 2002; Pridemore 2008, 2011). Homicide data mitigate two issues concerning cross-national studies on violence. Firstly, homicides are less under-reported and less likely to be under-recorded than any other crime (Fajnzylber et al. 2002). The gravity of this crime makes it uncommon for a homicide not to be reported or discovered by law enforcement agencies, which makes it a reliable proxy for violence (Favarin 2014; LaFree and Tseloni 2006; Lin 2007). Secondly, homicide data are valuable from the perspective of cross-national studies, because of the high level of homogeneity in definitions within different legal systems (LaFree and Drass 2002; Lynch 1995).

The analysis reported in what follows adopts homicide rates as a proxy for the level of violence in each country. In particular, it utilizes homicide rate data from the *Intentional Homicide Victims* database compiled by the UNODC (2019a), in consideration of the fact that it provides the most complete

series of data on homicides for the period considered (Hart 2015). Homicide rates are measured per 100,000 inhabitants. To reduce skewedness, while inducing homogeneity in the error variance, homicide rates are expressed in natural logs and outliers are removed from the analysis. Other authors have treated homicide data in the same manner (e.g. Kleck et al. 2012). In order not to cause any loss of information with the log transformation, homicide rates are translated by 1, while a strategy based on interquartile ranges is adopted in order to identify any outliers. As a robustness check, the econometric analyses are performed also on a reduced set of countries including those whose average homicide rate is higher than the average homicide rate of the entire set of countries in the period 1999-2013 (see Table 1). The countries considered characterize for significant differences in the level of violence and—to a lesser extent—in its stability in time (see Figure 1).

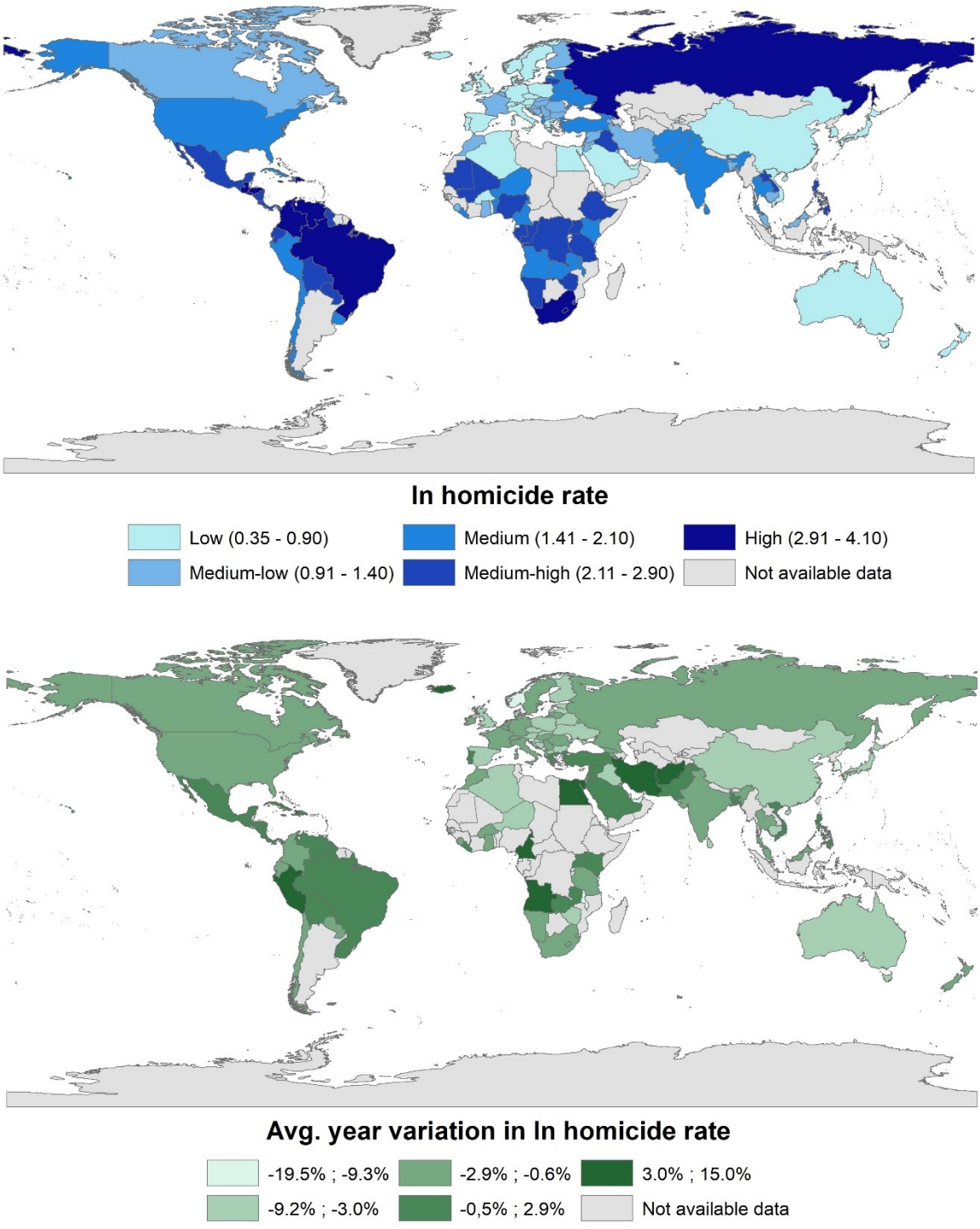
[Table 1 about here]

Table 1. Descriptive statistics of the dependent variables, years 1999-2013

Dependent Variable	Countries	N. Obs	Mean	Std. Dev.	Min	Max	Source
ln Homicide rate	144	1,554	1.66	1.00	0	4.46	UNODC (2019a)
ln Homicide rate in most violent countries	68	653	2.63	0.71	0	4.46	

[Figure 1 about here]

Figure 1. Average homicide rate, 1999-2013—above—and average year by year variation in homicide rate in, 1999-2013—below



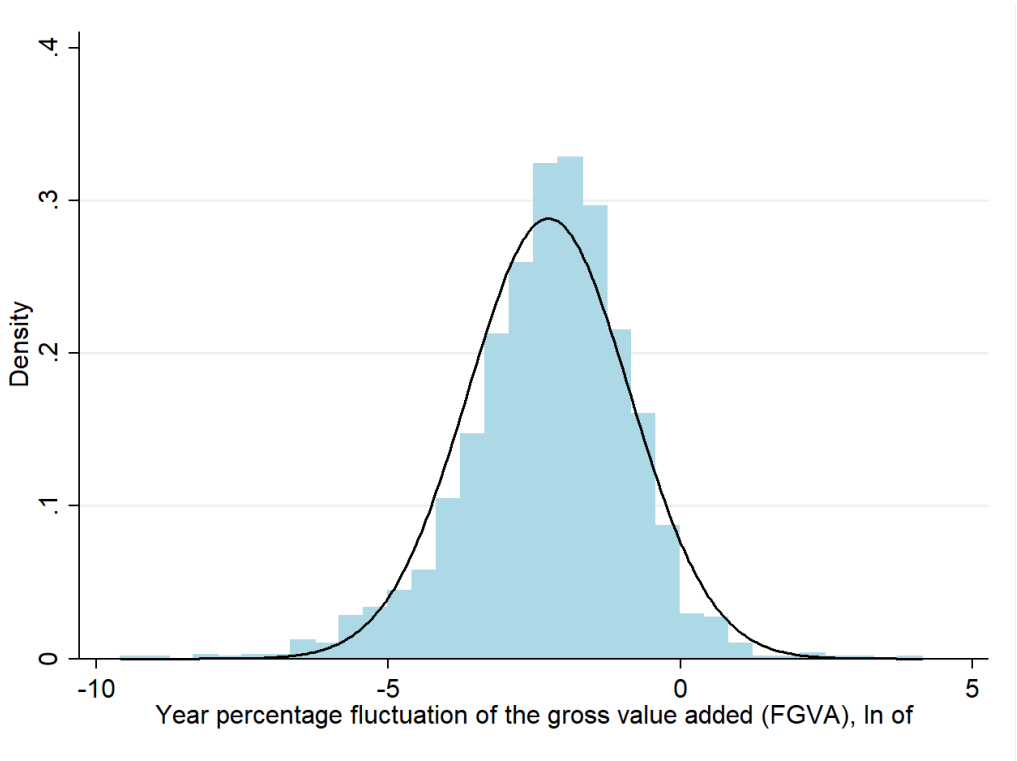
Note: five classes; data clustered with the Jenks natural breaks classification method.

Fluctuation in the value of the cocaine market and seizure rates

The absolute value of the year percentage variation of the gross value added in a country is adopted as a proxy for fluctuations in the value of the cocaine market (*Cocaine FGVA*) (see Figure 2). The use of the absolute value allows for the isolation of the intensity of the change from its direction, whereas the percentage better depicts the actual change occurring in the market, rather than the simple difference between two yearly estimates. Moreover, it enables isolation of the effect of the change in the value of the market from its size. As a first robustness check, the variable without its outliers (*Cocaine FGVA_no*) is used as alternative regressor. As a second robustness check, use is made of a dummy variable that take value 1 when fluctuations are more intense—i.e., first or fourth quartile of the distribution of yearly percentage changes—and 0 otherwise (*Cocaine FGVA extremes*) (see Table 2). By focusing only on more intense fluctuations—both positive and negatives—the use of this dummy allows for a further check on whether increases and decreases in the gross value added trigger violence.

[Figure 2 about here]

Figure 2. Distribution of frequency of the year percentage variation of the gross value added, 1999-2013



Our estimation of the fluctuation of the value of cocaine markets relies on an approach developed in the field of macro-level network studies (Berlusconi et al. 2017; Boivin 2011, 2013, 2014; UNODC 2015) and fully detailed in all its calculi, assumptions, limits, and data sources by Aziani (2018). This method yields a longitudinal and cross-sectional estimate of the gross value added generated by drug trafficking and dealing at national and international level in each country considered. Specifically, the approach conceives transnational cocaine trafficking as a network of trading relationships among countries, and national cocaine distribution as a series of transactions through which cocaine passes from transnational/large-scale drug traffickers to final consumers. The resulting estimate is not without its shortcomings, but nevertheless it is a functional instrument with which to investigate the relationship between the profitability of cocaine trafficking and the recourse to lethal violence.

In this context, the expression 'gross value added' denotes the revenues stemming from the international trade, national distribution, and retail sales of cocaine minus the cost of goods sold, which

includes the costs incurred by purchasing the cocaine that traffickers resell within the supply chain, as well as losses due to interceptions by law enforcement agencies. Labor costs are not included in the estimate of gross value added. However, the distribution of the gross value added between illicit entrepreneurs and salaried criminals is not fundamental when examining the effects of fluctuations in the value of the market on lethal violence. Both categories of actors are expected to react to variations in the profitability of the cocaine business. The potential costs related to drug interception and incarceration, which are important for investigating the relationship between the value of the cocaine market and the overall level of lethal violence (Reuter and Kleiman 1986; Reuter and Greenfield 2001), are instead indirectly included in the analysis. Indeed, the estimate of the value of cocaine markets incorporates the value of seizures, while the econometric model designed to investigate this relationship includes controls for the level of enforcement in each country, thus eradicating this potentially confounding factor from the analysis.

Operationally, the methodology underpinning the estimate of gross value added moves through four steps. The first of them involves identifying the cocaine trafficking flows among countries by using information on seizure cases gathered from the UNODC (2017) individual drug seizure (IDS) dataset, as originally introduced by Boivin (2011). The basic intuition is that, on certain occasions, law enforcement agencies are able to identify the countries from which the cocaine that they intercept comes and/or for which it is bound. This information is valuable because it gives clear evidence of the existence of drug shipments between the identified pairs of countries. Then, the global trafficking network, in each year, is reconstructed by matching multiple pairs of countries and the importance of each connection is estimated on the basis of the amount of the intercepted drug loads moving along it (Berlusconi et al. 2017).

The second step consists of sizing each national market by combining estimates of consumption and seizures. The third step involves calculating the quantity of cocaine trafficked between any pair of countries by combining the estimates which emerged from conducting the first two steps. More schematically, the mass of cocaine entering and remaining in each country is calculated by assuming it to be equal to the quantity of the drug consumed (C), and seized (S) in each country (Paoli et al. 2009; UNODC 2015). In fact, the actual flow of cocaine targeting any country is larger than the sum of consumption and seizures because of the amount of cocaine transiting into the country to be re-exported (E) to other markets (L). Cocaine shipments may start from many different countries (K), and cocaine with different origins (O) may move along each path. All cocaine flows can be bilateral, so that exports from a given country may be mirrored by imports from all other countries, and vice versa. Well-established methodologies to estimate consumption and seizures are available (Everingham and Rydell 1994; Kilmer et al. 2014; Prinzleve et al. 2004; Pudney et al. 2006), and necessary data are available in open-access repositories (EMCDDA 2015; UNODC 2019b) and in institutional reports and academic publications (Aziani 2018; EMCDDA 2016; Everingham and Rydell 1994; Kilmer et al. 2014; Kilmer and Pacula 2009; Trautmann et al. 2013). The relative magnitudes of different flows entering the same country are known ($\dot{\gamma}$)—we can calculate them according to the amount of cocaine seized along each dyad. Therefore, to estimate the size of each flow of cocaine it suffices to solve a system of equations describing the relationship between internal demand and international flows for all the countries part of the trafficking network:

$$(1)\begin{cases} \sum_{k=1}^{K}\sum_{o=1}^{O} I_{\mathrm{o,i}\leftarrow k} = \left(\sum_{o=1}^{O} \dot{C_{o,\iota}} + \sum_{o=1}^{O} \dot{S_{o,\iota}}\right) + \sum_{l=1}^{L}\sum_{o=1}^{O} E_{o,i\rightarrow l} \\ \sum_{l=1}^{L}\sum_{o=1}^{O} E_{o,i\rightarrow l} = \sum_{l=1}^{L}\sum_{o=1}^{O} I_{o,l\leftarrow i} \\ \frac{I_{\mathrm{o,i}\leftarrow k}}{I_{\mathrm{o,i}\leftarrow l}} = \dot{\gamma} \end{cases}$$

Once the volumes of national markets and transnational flows have been established, the fourth step then combines volumes with cocaine prices—which are eventually costs for other actors—at different stages of the supply chain. UNODC's online databases (2019b) provide six levels of prices per country (i.e. minimum, typical, and maximum price at both street and wholesale levels) for most of the countries in the world; the opportune combination—and interpolation—of these data allows a final estimate to be made of the fluctuation of gross value added per year and per country (Aziani 2018). By exploiting the estimate of the imported quantities of cocaine and the data on seizures, it is possible to estimate the amount of cocaine which is intercepted by law enforcement authorities as a proportion of the total imported quantity—i.e. (2) $Seizure\ rate_i = S_i/I_i$ (see Table 2).

[Table 2 about here]

Table 2. Descriptive statistics of the dependent variables, years 1999-2013

Variable	N. Obs	Mean	Std. Dev.	Min	Max	Source
ln Cocaine FGVA	2,160	-2.25	1.38	-9.58	4.14	Author's elaboration on multiple sources
ln Cocaine FGVA_no	1,906	-2.53	1.20	-9.58	-0.73	
Cocaine FGVA extremes	2,160	0.50	0.50	0	1	
ln Seizure rate	2,115	-3.95	2.63	-14.83	1	

Structural explanatory variables

Interpersonal lethal violence is not merely a matter of drug trafficking. The structural characteristics of countries influence the level of violence within them. Moreover, *systemic violence* in drug markets does not concern only monetary values and economic dynamics; it is also shaped by the political, and social context of the environment in which it emerges (J. J. Collins 1990; Dickinson 2015). Therefore, the inclusion in the econometric model of variables representing structural factors is crucial both for understanding the determinants of lethal violence and for reducing the omitted variable bias. Accordingly, the control variables for our analysis are selected on the basis of the extant literature on structural theories of violence and cross-national studies on homicides. In particular, the baseline model

includes the factors suggested by Rogers and Pridemore (2017) as the most efficient combination of variables with which to investigate the effect of additional potential determinants of violence. Rogers and Pridemore (2017) identified the combination of these factors as optimum after carrying out an extensive review of the empirical literature on cross-national studies on homicides and a series of tests based on data for the years 1999–2004 from a sample of 55 nations. In particular, the suggested models include *poverty*, *total population*, *education*, and *unemployment*. Differently from Rogers and Pridemore (2017), our analysis uses data on the *international migrant stock* to proxy ethnic heterogeneity, instead of the fractionalization index produced by Alesina and colleagues (2003). This adjustment is due to the lack of longitudinal data with which to operationalize the ethnic heterogeneity of countries directly.

The hypothesis was tested also by models including a larger number of regressors. A measure of *income inequality*, one of the level of *political violence,* the World Bank (2019) *rule of law* index, the degree of *urbanization*, and the *share of young males* were introduced into richer models, by referring to social disorganization theories, inequality theories, and developmental life-course theories. These variables have been included in statistical analyses by scholars investigating the determinants of homicide rates in macro-level studies (e.g. Cole and Gramajo 2009; Fajnzylber et al. 2002; LaFree and Tseloni 2006; Neapolitan 1994). All these structural variables enter the regression in the form of natural logarithms. Table 3 provides a summary of descriptive statistics, source, and exact operationalization of these variables.

Other factors often mentioned in the empirical literature are the frequency of firearm possession in the population, and the consumption of alcohol (e.g. Briceño-León et al. 2008; Hepburn and Hemenway 2004; Miron 2001; Rossow 2001). It is difficult to consider such factors in longitudinal and cross-national studies because of the lack of reliable and comparable data for a large enough sample of countries (Cole and Marroquín Gramajo 2009; Pridemore 2011). The econometric models proposed

make use of macro-regional fixed effects to mitigate the potential biases stemming from the omission of these factors from the analysis.

[Table 3 about here]

Table 3. Descriptive statistics of structural determinants of homicides for the countries included in the econometric analysis, years 1999-2013

Variable	Operationalization	N. Obs.	Mean	Std. Dev.	Source	Proposing author(s)
Poverty	Infant mortality rate	2,850	2.99	1.08	WHO (2019)	Pridemore (2008); Rogers and Pridemore (2017)
Unemployment	Unemployed share of total labor force	1,841	1.92	0.78	WB (2019)	Jacobs and Richardson (2008); Rogers and Pridemore (2017)
Education	Education Index Human Development Data	2,626	4.02	0.36	UNDP (2015)	Cole and Gramajo (2009); Rogers and Pridemore (2017)
Population size	Total population	3,133	15.19	2.33	WB (2019)	Rogers and Pridemore (2017)
Ethnic heterogeneity - Migrants	International migrant stock, both sexes, as share of the total population. Interpolated for missing years	3,072	3.62	1.59	UNDESA (2019)	Neapolitan (1994); Rogers and Pridemore (2017)
Rule of Law	Perceptions of agents' confidence in the rules of society, contract enforcement, property rights, the police, the courts, the likelihood of crime and violence.	2,987	1.23	0.29	WB (2019)	Adelman (2015); Briceño-León et al. (2008)
Urbanization	Urban population share	3,105	3.91	0.53	WB (2019)	Cole and Marroquín Gramajo (2009), Fajnzylber et al. (2002)
Males 15-24	15-24 males share of the total population	2,818	-2.42	0.20	WB (2019)	McCall and Nieuwbeerta (2007); McCall et al. (2008); Moeller and Hesse (2013)
Political violence	Magnitude score of episode(s) of any form of political violence involving a state	2,270	0.20	0.51	Marshall (2016)	Gartner (1991)
Income inequality	Gini Index, interpolated	1,628	3.63	0.24	UNDP (2015)	Chamlin and Cochran (2006); Pare and Felson (2014); Pridemore (2011); Rivera (2016)

Note: all variables are log transformed.

Econometric approach

The research problem presented above suggests that an instrumental variables procedure should be applied to panel data in order better to assess the direction of the causality. Therefore, in our analysis all the estimates of the effects are obtained using the System Generalized Method of Moments (system

GMM) developed by Arellano and Bover (1995), Blundell and Bond (1998). In recent years, the GMM estimators have grown in popularity; hence, it is now possible to find studies making use of them across the most disparate of disciplines, including criminology. A first strength of this econometric technique is that, by controlling for country-specific effects, it limits the estimation bias from the under-reporting of crimes and, more generally, mitigates against any unobserved unit-specific and time-invariant heterogeneity. Secondly, by exploiting the dynamic properties of the data, system GMM enables the generation of proper instrumental variables, thus reducing the biases stemming from the (weak) joint endogeneity of the explanatory variables (Fajnzylber et al. 2002; Greene 2011). An assumption for the validity of GMM is that the instruments are exogenous. To verify whether the instruments are exogenous, Hansen's J-test (1982) is performed for each model. A second test is conducted to assess the validity of the estimates performed with the system GMM; this consists of the Arellano and Bond (1991) test, which reveals if serial correlation in the disturbance is present.

The estimation models reported below are organized into three sets. In the I set (Table 4**Error! Reference source not found.**), first produced is a baseline model (model M1.1, 126 countries); then, the fluctuation of the gross value added generated by cocaine trafficking (*Cocaine FGVA*) is introduced (model M1.2,); finally, the complete set of potential explanations of homicides is progressively added (Models M1.3 to M1.8). The II set performs the system GMM estimates for the models presented in the I set with robust standard errors clustered at the country level (see Table 5). The III set presents a series of robustness checks; in particular, models M3.1 to M3.5 exploit different operationalizations of the main explanatory variable and different combinations of controls; models M3.6 to M3.8 concentrate on the subsample of the most violent countries—i.e., countries with homicide rates above the average. All models include year dummies to remove eventual trends from the time series.

4. Results

As hypothesized, the fluctuation in the gross value added generated by cocaine trafficking is significantly and positively correlated with the homicide rate at the country level. This result is stable across all the econometric models performed. The magnitude of the estimated correlations between the fluctuation of the gross value added and homicide rates is not negligible, although lower than that of other significant regressors, as indicated by the standardized beta coefficients. Indeed, beta coefficients range from about 0.03 (M1.8) to 0.24 (M1.2) in models with standard errors robust to heteroscedasticity and autocorrelation (I set). When robust standard errors are clustered at the country level (II set), the correlation coefficient ranges from 0.15 (M2.8) to 0.26 (M2.2). On considering the different standard deviations of the fluctuations of the gross value added in the various samples of countries, it is possible to assert that a 1 percent increase in the fluctuation in the gross value added is related to an increase in the homicide rate ranging between 0.02 and 0.19 percent with respect to models in the I set. With respect to the II set of models, the increase in homicide rates related to a 1 percent increase in the fluctuation ranges between 0.11 and 0.20 percent. Not surprisingly, the magnitude of the correlation of interest is higher in more parsimonious models and tends to diminish when controlling for a larger number of structural variables. In regard to the GMM specification tests, all regressions are supported by a Hagan test that confirms that the instruments are not correlated with the error terms. As expected, there is evidence of first-order serial correlation AR(1), whereas there is no evidence of second-order serial correlation AR(2).

All statistically significant relationships between countries' structural characteristics but education and homicide rates, have the signs hypothesized by the majority of the literature, and their statistical significance is fairly stable across the different specifications, models M2.7 and M2.8 being

exceptions. As expected, poverty is positively correlated with homicide rates at the country level (see Fajnzylber et al. 2002; Pridemore 2011); a more effective rule of law is negatively correlated with homicide rates (see Adelman 2015; Briceño-León et al. 2008); countries afflicted by higher levels of political violence suffer also from higher rates of interpersonal violence (see Gartner 1991). In the majority of the regressions performed, also a higher education index is significantly correlated with a higher homicide rate. Results of previous cross-national studies on this are mixed. For instance, Cole and Marroquín Gramajo (2009) found that increases in female education tend to increase homicides, while increases in male education tend to reduce homicide rates. Pridemore (2011) obtained both positive and not significant correlations between education and homicides in his cross-national studies, depending on the features of the models performed; this correlation is usually not significant in the models developed by Rogers and Pridemore (2017). The degree of urbanization, the relative size of the young male population, and income inequality are not significantly correlated to the homicide rate in any of the models performed. Among others, Cole and Gramajo (2009) and Fajnzylber and colleagues (2002)—with respect to urbanization—Rogers and Pridemore (2017)—with respect to the relative size of a young population—did not find any correlation between these structural variables and national homicide rates. In regard to inequality, Pare and Felson (2014) and Pridemore (2011) showed that when inequality and poverty are included together in the same model, the inequality/homicide correlation disappears, while the poverty/homicide association remains.

[Table 4 about here]

Table 4. I Set. Effect of fluctuations in cocaine trafficking and structural characteristics of a country on homicide rates, years 1999-2013, unbalanced panel

	Dep. Var. ln Homicide rate							
	M1.1	M1.2	M1.3	M1.4	M1.5	M1.6	M1.7	M1.8
Cocaine FGVA		0.24***	0.21***	0.19***	0.19***	0.18***	0.14***	0.03*
		(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.088)
Structural variables								
Poverty	0.77***	0.76***	0.68***	0.69***	0.66***	0.69***	0.40*	0.34**

	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.056)	(0.021)
Unemployment	0.01	0.05	0.09*	0.08*	0.06	0.07	0.03	0.01
	(0.767)	(0.405)	(0.073)	(0.090)	(0.186)	(0.105)	(0.527)	(0.773)
Education	0.29**	0.29**	0.39***	0.37***	0.35***	0.36***	0.31***	0.29***
	(0.010)	(0.027)	(0.001)	(0.001)	(0.002)	(0.000)	(0.010)	(0.005)
Population size	-0.06	-0.01	0.10	-0.04	-0.05	-0.12	0.10	-0.27**
	(0.777)	(0.962)	(0.523)	(0.829)	(0.777)	(0.434)	(0.527)	(0.036)
Ethnic heterogeneity (migrants)	-0.19*	-0.18	0.03	0.00	0.04	0.02	0.12	0.00
	(0.078)	(0.117)	(0.807)	(0.984)	(0.777)	(0.851)	(0.391)	(0.966)
Rule of Law			-0.36***	-0.36***	-0.32***	-0.35***	-0.65***	-0.65***
			(0.009)	(0.006)	(0.007)	(0.002)	(0.000)	(0.000)
Seizure rate				-0.00	-0.02	-0.00	0.04	0.03
				(0.990)	(0.772)	(0.984)	(0.501)	(0.207)
Urbanization					-0.08	-0.04	0.06	0.15
					(0.520)	(0.703)	(0.739)	(0.184)
Males 15-24						0.03	0.03	0.05
						(0.640)	(0.700)	(0.288)
Political violence							0.15***	0.13***
							(0.003)	(0.000)
Income inequality								0.00
								(0.976)
Additional controls								
Year control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1171	1171	1171	1168	1168	1165	1035	842
N. of countries	126	126	126	124	124	121	116	90
N. of instruments	45	50	55	60	65	70	74	67
F	19.0	18.6	30.4	27.5	27.3	33.5	27.3	61.4
F test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(1) test	0.009	0.000	0.000	0.000	0.000	0.000	0.001	0.002
AR(2) test	0.775	0.285	0.181	0.119	0.108	0.091	0.233	0.113
Hansen J test	0.128	0.608	0.762	0.744	0.811	0.834	0.977	0.700
Wald test F		13.0	14.7	12.5	15.0	13.0	10.9	3.0
Wald test p		0.00	0.00	0.00	0.00	0.00	0.00	0.09
MMSC-BIC	-69.45	-94.55	-113.00	-127.82	-145.08	-160.47	-177.91	-127.30

Note: the table reports the standardized beta coefficients of system GMM regressions of the fluctuation of the value of the gross value added generated by cocaine trafficking and structural determinants of violence on the homicide rate in all countries for which data are available between the period 1999-2013. All specifications include time dummies. All continuous variables enter the regression in the form of natural logarithm. The results of the F test, AR(1) and AR(2) test, the Hansen J-test and the Wald test for the comparison of the full and reduced models are presented in the bottom part of the table, after the number of observations, countries, and instruments. The GMM Bayesian information criterion (MMSC-BIC) developed by Andrews and Lu (2001) provides a measure of the relative quality of the models. Robust standard errors—with small-sample adjustments—are in parentheses; *, **, and ***, indicate coefficients significantly different from zero at the 95.0%, 99.0%, and 99.9% confidence level, respectively.

[Table 5 about here]

Table 5. II Set. Effect of fluctuation in cocaine trafficking and structural characteristics of a country on homicide rates, years 1999-2013, unbalanced panel, standard errors clustered at the country level

	Dep. Var. ln Homicide rate							
	M2.1	M2.2	M2.3	M2.4	M2.5	M2.6	M2.7	M2.8
Cocaine FGVA		0.26***	0.22***	0.19***	0.20**	0.19**	0.15**	0.15**
		(0.003)	(0.000)	(0.006)	(0.010)	(0.016)	(0.013)	(0.039)
Structural variables								

Poverty	0.79***	0.76***	0.64**	0.67***	0.64**	0.66**	0.46	0.47
	(0.001)	(0.002)	(0.016)	(0.005)	(0.015)	(0.027)	(0.211)	(0.308)
Unemployment	0.01	0.04	0.07	0.08	0.06	0.07	-0.02	0.05
	(0.886)	(0.491)	(0.266)	(0.162)	(0.350)	(0.346)	(0.697)	(0.576)
Education	0.29**	0.32*	0.40**	0.41***	0.34	0.34*	0.26	0.37
	(0.048)	(0.079)	(0.019)	(0.003)	(0.129)	(0.077)	(0.224)	(0.460)
Population size	-0.04	-0.03	0.09	-0.01	-0.03	-0.14	0.06	0.14
	(0.871)	(0.864)	(0.704)	(0.962)	(0.922)	(0.618)	(0.767)	(0.681)
Ethnic heterogeneity (migrants)	-0.20	-0.20	-0.02	-0.03	-0.05	-0.11	0.04	0.13
	(0.253)	(0.155)	(0.875)	(0.862)	(0.825)	(0.575)	(0.867)	(0.648)
Rule of Law			-0.39**	-0.37**	-0.32*	-0.37*	-0.65***	-0.49**
			(0.029)	(0.018)	(0.074)	(0.070)	(0.000)	(0.019)
Seizure rate				0.03	0.01	-0.01	0.04	0.02
				(0.810)	(0.936)	(0.966)	(0.617)	(0.907)
Urbanization					0.00	0.07	0.19	-0.06
					(0.988)	(0.759)	(0.577)	(0.865)
Males 15-24						0.02	0.01	0.08
						(0.890)	(0.945)	(0.624)
Political violence							0.12*	0.05
							(0.067)	(0.527)
Income inequality								-0.16
								(0.586)
Additional controls								
Year control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1171	1171	1171	1168	1168	1165	1035	842
N. of countries	126	126	126	124	124	121	116	90
N. of instruments	45	50	55	60	65	70	74	67
F	10.7	11.0	24.6	20.1	15.4	17.4	18.0	42.1
F test	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR(1) test	0.010	0.002	0.000	0.001	0.003	0.003	0.006	0.015
AR(2) test	0.832	0.293	0.164	0.142	0.126	0.080	0.210	0.252
Hansen J test	0.110	0.575	0.655	0.560	0.502	0.313	0.951	0.841
Wald test F		9.1	12.9	7.7	6.8	6.0	6.4	4.4
Wald test p		0.00	0.00	0.01	0.01	0.02	0.01	0.04
MMSC-BIC	-68.75	-93.99	-110.92	-124.10	-138.24	-148.03	-175.49	-130.77

Note: the table reports the standardized beta coefficients of system GMM regressions of the fluctuation of the gross value added generated by cocaine trafficking and structural determinants of violence on the homicide rate in all countries for which data are available between the period 1999-2013. All specifications include time dummies. Robust standard errors—with small sample adjustment and clustered at the country level—are in parentheses; *, **, and ***, indicate coefficients significantly different from zero at the 95.0%, 99.0%, and 99.9% confidence level, respectively.

As a measure of the robustness of the findings, the III set of models replicates the analyses of the baseline model by changing the operationalization of the fluctuations of the cocaine market (*Cocaine FGVA extremes* and *Cocaine FGVA_no*) and the considered set of countries (see Table 6). Results of robustness checks are qualitatively similar to the ones obtained by previous models; they confirm a positive and significant correlation between the fluctuation of the gross value added and the homicide rates both in the largest sample of countries (M3.1 to M3.5) as in the reduced one (M3.6 to M3.8). M3.3, M3.4, and M3.5 show that *Cocaine FGVA* has a stronger correlation with homicide rates—in terms of

both statistical significance and magnitude—than the *Cocaine FGVA extremes* and *Cocaine FGVA_no*. When modelling fluctuations in a dichotomous manner (M3.4) and when eliminating most severe fluctuation (M3.5), the relationship with changes in homicide rates attenuates. This finding corroborates the finding that the relationship with violence is stronger, the broader are the fluctuations.

The subsample of countries where homicides are more widespread provides similar results, being fluctuations always correlated to homicide rates. Similarly, also the relationship between the adopted measure of economic deprivation (i.e., infant mortality) and violence continues to be strongly significant. The magnitude of the correlation between *Cocaine FGVA* and the homicide rate is slightly higher when focusing on the full sample of countries (M1.2) than on the sub sample of the most violent ones (M3.8), in terms of both standardized and non-standardized coefficients. In most violent countries—as in the full sample—poverty is the most influential variable on homicide rates; the correlation between the two variables is significant at the 99.0% confidence level when cocaine market dynamics are included among the regressors (M3.7 and M3.8).

[Table 6 about here]

Table 6. III Set. Robustness checks: different operationalization of the gross value added, controls, and set of countries, years 1999-2013, unbalanced panel, standard errors clustered at the country level

	Dep. Var. ln Homicide rate							
	M3.1	M3.2	M3.3	M3.4	M3.5	M3.6	M3.7	M3.8
	Different measures of the FGVA and controls					Most violent countries only		
Cocaine FGVA		0.18**	0.26***				0.17**	0.22*
		(0.049)	(0.003)				(0.047)	(0.050)
Cocaine FGVA extremes				0.08*				
				(0.095)				
Cocaine FGVA_no					0.08*			
					(0.092)			
Structural variables								
Poverty	0.80**	0.90***	0.76***	0.61**	0.99***	0.86***	0.73**	0.90**
	(0.015)	(0.000)	(0.002)	(0.022)	(0.000)	(0.004)	(0.012)	(0.029)
Unemployment	0.00	-0.06	0.04	-0.05	-0.05	-0.06	-0.00	0.01
	(0.927)	(0.458)	(0.491)	(0.632)	(0.470)	(0.739)	(0.985)	(0.954)
Education	0.44*	0.50**	0.32*	0.23	0.46**	0.65**	0.50**	0.40
	(0.063)	(0.017)	(0.079)	(0.446)	(0.014)	(0.033)	(0.041)	(0.206)
Population size	0.12	0.04	-0.03	0.10	0.01	0.15	0.04	-0.10

	(0.797)	(0.893)	(0.864)	(0.804)	(0.944)	(0.699)	(0.936)	(0.814)
Ethnic heterogeneity (migrants)	-0.17	-0.09	-0.20	-0.15	-0.09	-0.19	-0.28	-0.29
	(0.369)	(0.549)	(0.155)	(0.584)	(0.453)	(0.768)	(0.519)	(0.480)
Additional controls								
Year control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region control	No	No	Yes	Yes	Yes	No	No	Yes
Observations	1171	1171	1171	1171	1039	469	469	469
N. of countries	126	126	126	126	123	58	58	58
N. of instruments	44	38	50	73	50	34	44	43
F	3.5	4.4	11.0	9.8	15.7	2.6	1.7	13.3
F test	0.000	0.000	0.000	0.000	0.000	0.003	0.070	0.000
AR(1) test	0.010	0.014	0.002	0.001	0.006	0.134	0.072	0.033
AR(2) test	0.765	0.208	0.293	0.158	0.552	0.412	0.773	0.843
Hansen J test	0.129	0.351	0.575	0.686	0.196	0.227	0.372	0.122
Wald test F		4.0	9.1	2.8	2.9		4.1	4.0
Wald test p		0.05	0.00	0.09	0.09		0.05	0.05
MMSC-BIC	-87.83	-67.37	-93.99	-185.48	-85.83	-42.18	-71.81	-47.98

Note: the table reports the standardized beta coefficients of system GMM regressions of various measures of the fluctuation of the gross value added by cocaine trafficking—i.e., *Cocaine FGVA*, *Cocaine FGVA extremes*, *Cocaine FGVA_no*—and structural determinants of violence as identified by Rogers and Pridemore (2017) on the homicide rate in all countries for which data are available (i.e., M3.1 to M3.5). Models M3.6 to M3.8 replicates the analysis focusing on the 58 countries whose average homicide rate between 1999-2013 is higher. All specifications include time dummies. Robust standard errors—with small-sample adjustments and clustered at the country level—are in parentheses; *, **, and ***, indicate coefficients significantly different from zero at the 95.0%, 99.0%, and 99.9% confidence level, respectively.

5. Main limitations

Both the econometric analysis and the underlying estimates of the gross value added have specific limitations, which must be taken into account when interpreting the results. Firstly, the illegality of cocaine market itself makes it difficult to collect reliable information on a variety of features crucial for estimation of the gross value added, such as the number of users or prices (Aziani 2018; Kilmer et al. 2015). Data collection and validation issues are amplified when extended to cross-country analyses. Hence, although estimates may truly reflect differences in cocaine markets between countries, this may also be a consequence of countries' idiosyncratic data collection methods (Kilmer et al. 2015). Even if UNODC closely supervises data collection and performs several checks to improve data reliability, much of the data collected are subject to limitations and biases that UNODC are unable to fully solve. These issues undoubtedly affect the reliability, quality, and comparability of the available information (Aziani

2018; Caulkins 2007). The construction of the trafficking network and the estimate of the related gross value added in this study is indebted to Boivin (2011) and Aziani's (2018) work, and thus shares their limitations, which are discussed extensively in the description of each step of their estimation methodologies.

With respect to the econometric analysis, despite developing a strategy to reduce the burden stemming from omitting key variables, with fixed effects, the numerosity of the potential determinants of violence suggests that they may be omitted variables that are not stable in the period under analysis. A second relevant issue concerns the capacity of the model itself to identify the direction of the causality in each of the relationships analyzed by constructing instrumental variables based on previous values of the variable under analysis. System GMM is likely to be effective in solving this issue for the variables representing fluctuation in the value of the cocaine market, because their evolution depends on supply shortages, changes in trafficking routes, and others factors that can change in a relatively short span of time. This issue, on the contrary, might be more important for certain structural determinants of violence, such as poverty.

6. Discussion

In an attempt to verify that both expansions and contractions of the value of the cocaine markets are correlated with increases in the recourse to interpersonal violence, this study uses a panel-data based system GMM methodology to estimate a model of national homicide rates among samples of 58 to 126 countries, for which it is possible to estimate of fluctuations and to operationalize socio-structural determinants of violence. The system GMM estimator controls for unobserved country-specific effects potentially correlated with the explanatory variables, the joint endogeneity of some of the explanatory

variables, and measurement errors which undermine data on homicides. Ancillary regressions are designed to test both the robustness of the core results and to investigate in greater depth specific issues concerning the structural determinants of violence.

The econometric analyses proposed by this study indicate the existence of a relationship between fluctuations in the gross value added generated by cocaine trafficking and homicide rates in the countries considered. The finding presents a certain stability against fluctuation in the specifications of the model. Even when taking different variables representing the fluctuation in the gross value added by cocaine trafficking, when changing the set of the other explanatory variables, and when modifying the sample of countries, the correlation between fluctuations and homicide rates remains significant and positive in all econometric models. The stability of the significance of the correlation between the main explanatory variables and the level of homicides suggests a certain robustness in the results, at least among the countries analyzed. Relying on the statistical theories which underpin the system GMM methodology, the results of the AR(2) and the Hansen J-tests performed for the proposed models suggest that the direction of the causality goes from the fluctuation in gross value added to the level of homicides. Even if it were possible to argue that long-lasting phenomena ultimately determine the series of continuous increases or contractions in the gross value added, these dynamics are quite specific. Consequently, they are unlikely to determine the results of the econometric exercise. That said, the results of the econometric analyses prudently support the hypothesis of this study. Variations, both increases and contractions, in the economic value generated by cocaine trafficking are likely to cause an increase in the use of violence. Further analysis based on longer time-series of gross value added, and other indicators of the economic value of cocaine markets, should be conducted when new data become available so that more rigorous investigation can be conducted into the direction of the causality between the fluctuations in the value of cocaine market and violence.

The proposed interpretation of the results relies on several theories developed to explain the spread of drug-related *systemic violence*. Reasoning in terms of monetary values makes it possible to merge them into an integrated perspective from which to examine the nexus between cocaine markets and violence. The first step in interpretation of the results involves consideration of the motivations behind participation in drug trafficking. The literature is concordant in considering economic profits to be the main driving force behind participation in cocaine trafficking (Chi et al. 2013; Desroches 2007; Kenney 2007); the yearning of traffickers for social recognition and political power does not invalidate the reasoning, but instead corroborates it. Indeed, economic success also acts a source of power and social recognition, or at least we may say that the two go hand-in-hand, both within high-level drug trafficking and at a local retail level (Levitt and Venkatesh 2000). A corollary to this fact that participation in drug trafficking is economically motivated is that people active in drug markets aim to maximize their profits and minimize their risks; to do so, they must modify their behavior in accordance with external stimuli (J. S. Benson and Decker 2010; Che and Benson 2014; Reuter and Kleiman 1986).

Arrests, drug seizures, increases in demand, modification of trafficking routes, spikes in the production of drugs, and shifts in consumption to other substances are only some of the numerous factors that may cause variations in cocaine traffickers profits (Castillo et al. 2018; Kleiman et al. 2011). There are manifold potential simultaneous combinations of several of these different factors, and their overall effect is usually complex to evaluate (Kilmer et al. 2015). These variations in the value of drug markets are likely to modify the competitive environment in which traffickers operate, regardless of the specific drivers causing the change (Castillo et al. 2018; Miron 2001; Robles et al. 2013). A reduction in the overall supply of drugs reaching a country, for example, may cause some operators to seek new contacts in source countries; alternatively, an increase in the demand for a drug in a new area or in different social environments may provide an opportunity to expand the business. In these new scenarios, depending on

the specific evolution of the market, drug traffickers can either increase their gains or risk losing part of their income. Instabilities in the value of the market and the consequent change in the balance between anticipated rewards and costs for criminals make the recourse to violence more appealing than it was previously.

Moreover, the illegality of the business itself imposes constraints upon peacefully adapting to the new realities of the market. Firstly, due to their criminal status, drug traffickers cannot rely upon the institutions of the legal system to settle their disputes and enforce their contracts (Castillo et al. 2018; Caulkins and Reuter 1998; Goldstein 1985; Jacques and Wright 2011; Mejía and Restrepo 2013; Robles et al. 2013). Secondly, businesspeople who operate in illicit markets cannot utilize important levers available to legal entrepreneurs (Che and Benson 2014; Gambetta 2009). Finally, during hard times for the cocaine industry, it is difficult for traffickers to liquidate their businesses and find alternative employment which would offer a similar income, hence making them more likely to persist in cocaine trafficking (J. J. Collins 1990; Reuter et al. 1990). The fact that gains are invariably not large for most of those who participate in the trafficking industry (Levitt and Venkatesh 2000), allied with the fact that that economic profit is the primary driving force behind drug trafficking, provides still further incentive to resort to violence. As a consequence of these dynamics, violence becomes a potential substitute for legal practices in response to changes in the value of drug markets (Desroches 2007; Kleiman 1989; Moeller and Hesse 2013; Rios 2013). Since changes in market opportunities influence the use of violence, both expansions and contractions in drug trafficking profits are likely to exacerbate the recourse to interpersonal violence.

This interpretation is in line with a series of observations proposed by scholars with respect to market equilibria, both before and after law enforcement interventions (B. L. Benson et al. 2001). These authors posit that increases in the intensity of drug law enforcement tend to modify the established

hierarchies among criminals active within the same market. The disruption of these equilibria generates an increase in the use of violence and in homicides. Other scholars, whose attention has focused on the evolution of the crack-cocaine and amphetamine markets in America, have also identified in the stability of the market an important factor for the reduction of *systemic violence* (Brownstein and Taylor 2007). The rationale of these authors is not centered on the value of the markets, but, rather, on their size and on the entry and exit of new actors.

At the same time, the proposed rationale does not ignore recent findings on the relationship between the size and value of drug trafficking and violence. Rather, the proposed approach tries to make previous results more general by reasoning in terms of fluctuations in the value of the cocaine market. In particular, the findings of Angrist and Kugler (2008), who posited that the expansion of the coca and cocaine industries led to an expansion in conflicts in Colombia, is coherent with the rationale proposed here. The same applies to the results of Mejía and Restrepo (2013), who also showed that increases in coca cultivation generate increases in the level of violence. The results by Rios (2015), concerning the fact that drug dealing and violence emerge together as a consequence of a fragmented political milieu, can also be integrated within the approach adopted here. Castillo, Mejía, and Restrepo (2018) maintained that shortages in cocaine supply cause an increase of violence in illicit drug markets by increasing the value of the market. Despite some doubts regarding the possibility of assuming an increase in the value of a drug market due to a reduction in the availability of the substance, these results are not necessarily in contradiction with the notion that both reductions and contractions in the value of the market are likely to cause an increase in the level of violence.

Conclusion

The interaction between cocaine market and violence appears to leave policy makers in a trap from which it is difficult to escape. On the one hand, large and profitable drug markets constitute a grave threat to society for a number of reasons, including the extent of violence that they generate. On the other hand, measures which aim to curtail them have may have the pernicious effect of causing the illicit markets to become even more violent by altering market equilibria. As demonstrated by the results of this study, in fact, discontinuity in the level of profits is likely to exacerbate the recourse to violence further. When considering this complex and problematic situation, policy interventions should thus aim to be as non-disruptive and measured as possible. The curtailment of cocaine consumption and cocaine trafficking has to be viewed as a long-term process, in order to reduce the exogenous shocks to the equilibria of illicit markets. Doing so will help to improve social welfare as a whole, rather than merely reducing drug consumption and the power of criminality at the cost of escalating levels of violence.

Furthermore, the paradigmatic role of economic patterns in determining drug *systemic violence*, as identified in this study, advocates the development of new and more robust approaches to estimating illicit revenues, which, ultimately, can be utilised within large-scale criminological studies. Given that the main strength of this approach is its capacity to translate complex dynamics like competition, incentives, constraints into quantities and numbers, interpretations of illicit markets driven by economic and monetary elements can thus extend beyond the confines of studying the cocaine industry. Theories concerning *systemic violence* within other illicit markets, such as those for heroin, firearms, tobacco, among many others, are capable of being translated into economic/monetary values as well.

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