INTERNAL COCAINE TRAFFICKING AND ARMED VIOLENCE IN COLOMBIA

Jaime Millán-Quijano*†

Universidad Carlos III de Madrid

Abstract

This paper exploits time variation in international cocaine prices and potential trafficking within Colombia to estimate exogenous changes in municipality homicide rates. I construct the potential internal cocaine trafficking network and exploit the fact that different regions in Colombia have comparative advantage serving different international markets. My results suggest that when the cocaine price increases in either the United States or Europe homicides rates increase in municipalities strategically placed to serve each international market.

JEL: D74, K42, F19

Keywords: Trade, Violent crime, Drug trafficking

*Universidad Carlos III de Madrid. Calle Madrid 126, 28093 Getafe, Spain. jmillan@eco.uc3m.es. +34 91 624 9652.

†I am grateful to Orazio Attanasio and Marcos Vera-Hernández for their supervision and their suggestions for this paper. I also want to thank Daniel Mejía and participants of the 3rd AL CAPONE meeting and the 7th ISSDP meeting for their valuable comments and feedback. Special thanks to Fabio Sanchez who provided me with data on violence. Finally I want to thank Carolina Restrepo for her exceptional help in cleaning data.

There is increasing interest to understand the forces and mechanisms by which war, crime and conflict affect economic institutions. However, these analyses usually deal with large heterogeneity in terms of causes, participants, characteristics and consequences. Each scenario implies different challenges when researchers seek to identify the economic effects of violence on different outcomes. Particularly when researchers look for exogenous variation in violence.

In some cases, when the causes and characteristics of the violent process are clear, it is usually possible to identify how violence affects economic agents. Some authors use specific time/location violent shocks to identify the effect of conflict on household decisions, particularly education, marriage and fertility. Among others Jayaraman et al. (2009), Khlat et al. (1997), Schindler and Brück (2011), Valente (2011), Shemyakina (2013), Abramitzky et al. (2011) use different civil war events in different environments to identify causal effects. However, such shocks are not always available. Thus, a second branch of research uses external shocks that change the incentives of local violent agents. For example, Dube and Vargas (2013) who asses the effect of international commodity shocks on the violence in Colombia. Furthermore, Brückner and Ciccone (2010) use a similar strategy for the case of sub-Saharan civil war. This paper belongs to this second branch.

I propose a strategy to estimate exogenous variation of homicide rates in Colombia. I use the interaction between internal cocaine trafficking networks and international prices of cocaine in the United States (US) and Western Europe (EU) to predict homicide rates at municipality level. Then, I exploit the geographical variation between trafficking zones and time variation among international prices to estimate exogenous changes in homicide rates over different zones of Colombia. Thus, this work enriches the literature on the causes of armed violence and contributes to future research by estimating exogenous shocks on homicides that are orthogonal to local economic outcomes.

Previous literature such as Angrist and Kugler (2008) and Díaz and Sánchez (2004) studied the relationship between cocaine production and violence, however this paper departs from the previous authors focusing on the analysis of cocaine trafficking. Internal trafficking represents 75 percent of the cocaine market added value chain while production adds about 25 percent (Mejía and Rico (2010)). Therefore, one can expect that violence is more prevalent over trafficking routes than production spots.

My strategy follows Dube and Vargas (2013) and parallels the work carried out in Mexico by Dell (2015). Yet unlike previous literature, this paper exploits the comparative advantage of each municipality when serving different cocaine international markets. In spite of the lack of data on the routes that Colombian traffickers use, I construct the potential cocaine trafficking network linking coca leaf crops with municipalities at the country's border using the road network. What is more, using the geographical features of Colombia I divide the network to classify the municipalities according to the international market they have a comparative advantage serving to.

Given the importance of Colombia in the international supply of cocaine there are important threats to my identification strategy. However, the following facts support the validity of my estimations: Firstly, Colombian traffickers compete in regional oligopoly markets where violence is used to gain market shares (Echandia (2013)). Previous literature has shown that when the expected profits increase in illegal markets, competition increases and violence likewise (Kugler et al. (2005)). What is more, this internal competition debilitates the position of Colombian traffickers against international traffickers, reducing their ability to fix prices for final consumers.

Secondly, despite Colombia being the main exporter of cocaine over my period of analysis, I will provide evidence that Colombian traffickers are not able to set final wholesale prices in consuming regions. The main hazard to the validity of my estimations is the possibility of Colombian traffickers to increase the prices in the consumption regions when the internal competition intensifies. As I mentioned above, Colombian traffickers compete in regional oligopoly markets. Over the 1980's Pablo Escobar and the Medellín Cartel had enough market power to set cocaine prices in the main market, the United States. Echandia (2013), describes the changes in internal competition after Pablo Escobar died and the national monopoly was broken. What is more, Mejía and Posada (2007) explained how the power switched from Colombian traffickers to organizations outside of Colombia. For example, illegal groups in countries like Mexico, United States and Europe. Thus, profits of cocaine now concentrate in the consuming regions. I also will show evidence that the international supply of cocaine is more stable than the demand in the US and Europe. Thus, I will exploit switches in cocaine consumption, from EU to US and vice versa, to estimate geographical variation in homicides within Colombia. Then, after controlling for the price of cocaine in Colombia I will show that the variation my estimates capture comes from demand shocks rather than supply shocks.

Finally, I will show that the increase in homicides is the main channel in which changes in cocaine prices affect trafficking areas in Colombia. I will also show evidence that changes in cocaine prices do not create local income effects and do not directly affect the military behavior of guerrilla armies and political competition.

Hence, I found that a one percent increase in cocaine prices in the United States increases homicide rates from 0.41 to 0.72 standard deviations in the regions that serve the American market. Meanwhile, when the price of cocaine increases by one percent in Western Europe the homicide rate increases by 0.43 standard deviations in the region serving the European market.

This paper has the following order. After this introduction, section 1 describes the internal potential trafficking network. Afterwards, section 2 introduces the estimation strategy and discusses the validity of my estimates. Section 3 descriptives the data I use for my estimations and section 4 shows the main results and discusses the potential channels. Section 5 concludes.

1 The potential cocaine trafficking network

The simplest way to understand the network of potential internal cocaine trafficking for the purposes of this work is the following: A cocaine trafficking route is the way that a cocaine parcel is taken from a producer municipality to the Colombian border using the road network, the parcel then being sold at the border to international traffickers who will ship it to its final destination.

It is important to point out that this network explains only trafficking along roads, excluding inland waterway and air trafficking. Despite this limitation I support the validity of my analysis using information from the Colombian Illegal Drugs Observatory (ODC) and the Colombian National Anti-Narcotics Bureau (DNE).[1] By 2009, 54 percent of the cocaine seized in Colombia was at sea and 24 percent was on country roads. Only 3 percent was seized at airports (DNE (2010)). What is more, the number of detected illegal air routes dropped from 639 to 88 between 1990 to 2006. Finally, the number of airplanes confiscated dropped from 33 to 22 while the number of automobiles confiscated increased from 311 to 1233.

Hence, I define the network $N(O, V, D)$, where the set of origins O is composed of the municipalities with coca bushes from 2001 to 2009 using data from yearly reports of SIMCI (2012). V is the set of transit nodes. These are the municipalities crossed by the roads used to transport cocaine. The set of destinations D is formed by municipalities reachable by car at the Colombian border. For sets V and D, I use the network of primary and secondary roads in 2005 using data from the Ministry of Transport.[2]

Furthermore, $z_{ij}(o_i, \bar{v}_{ij}, d_j)$ is the route via which a dealer transports cocaine from a producing municipality o_i to a border municipality d_j using the road network passing through municipalities $\bar{v}_{ij}$. Figure 1 shows the geographical distribution of the inputs to construct

[1] ODC stands for Observatorio de Drogas de Colombia and DNE stands for Dirección Nacional de Estupefacientes

[2] The GIS data is projected using the MAGNA_Colombia_Bógota coordinate system.

the network N.

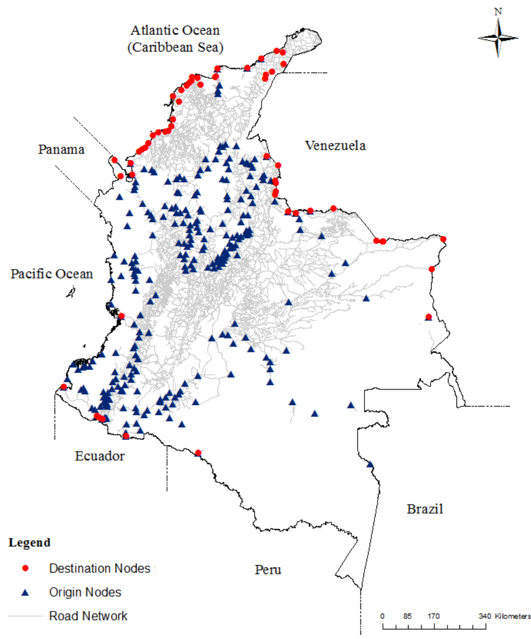


Fig. 1: Inputs to construct the Colombian potential internal cocaine trafficking network

To construct a set of feasible routes for cocaine trafficking, I find the shortest route to link each origin with each destination following two predetermined rules of transit. The first rule prioritizes primary roads over secondary roads. The second rule assumes the reverse order. Using this algorithm I found 12704 routes from 224 origins to 47 destinations. Table 1 summarizes the main features of the network of feasible cocaine trafficking routes.

Table 1:
Cocaine trafficking network descriptive statistics

Main features				
Origins	224			
Ends	47			
Routes	12704			
Descriptive statistics				
	Mean	***S. D.***	***Min***	***Max***
Length (Km)	1516.4	791.8	28	4040
Use of primary Roads (pct.)	37.43	12.34	0	95.42
Shortest route distribution				
	Mean	***S. D.***	***Median***	***p90***
Length (Km)	568.0	338.2	543.1	1098.6

According to this table, the average length of the routes is 1516 km which is around the same driving distance as from New Haven (CT) to Atlanta (GA). The range in length of the routes goes from 40 km to 4040 km which is equivalent to the distance from Los Angeles (CA) to Tampa (FL).[3] Routes mainly follow secondary roads because coca bushes are principally found in areas with poor infrastructure.

The lower panel of table 1 describes the set of routes which link each origin with only the closest destination. The median length of these routes is 543 km. Therefore, for 50 percent of cocaine producing municipalities traffickers need to travel at least 543 km in order to reach the border. I will exploit this feature later in my estimations.

2 Estimation strategy

This paper exploits time variation in international cocaine prices and potential trafficking within Colombia to estimate changes in municipality homicide rates. To link the internal trafficking network with international markets, I group the routes by the border where each route terminates. Each route will belong to one frontier cluster $f \in F =$\{Pacific, Atlantic, Venezuela North, Venezuela South\}.[4] Identification relies on different frontiers having comparative advantage with regard to different international markets. Figure 2 shows the main international trafficking routes.

The map shows that two regions are clearly linked with a specific market. On the one hand, if traffickers sell cocaine on the Colombian Pacific coast the final destination is the United States. On the other hand, if cocaine is sold at the Venezuelan southern frontier, the final destination is Europe. From 2006 to 2008 51 percent of cocaine in Europe came from

[3]Compared with European distances, the average length (1516 km) is similar to the distance between Madrid (Spain) and Bern (Switzerland). The longest route is as long as driving from Lisbon (Portugal) to Kiev (Ukraine)

[4]No route finishes in Panama, Peru or Brazil. Routes finishing at the Ecuadorian border were excluded because taking cocaine to the Pacific coast strongly dominates trafficking through Ecuador. Venezuela North includes municipalities in the Departments of Guajira, Cesar, Norte de Santander and Boyacá. Venezuela South includes municipalities in Arauca, Vichada and Guanía.

Fig. 2: International cocaine trafficking routes

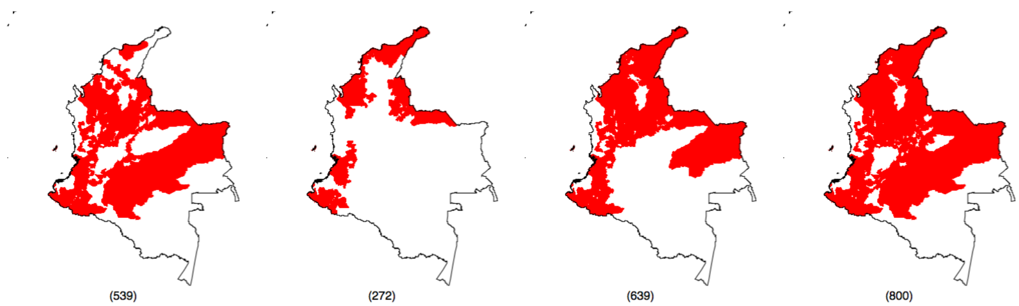
Notes. Routes drawn based on UNODC (2012). GIS data from thematicmapping.org

Venezuela, meanwhile, 67 percent of the cocaine in US came from Mexico (UNODC (2012)). Cocaine taken to the Atlantic coast and to the northern Venezuelan border could potentially serve both international markets.

In addition, distance plays an important role in the traffickers' choice of route because longer routes have a higher probability of being intercepted. Figure 3 shows how the number of municipalities involved in cocaine trafficking changes according to how long the routes used by traffickers are. Panel a shows the trafficking network if drug dealers use only the shortest route that links each origin with its closest destinations.[5] I do not use this strategy because it constrains trafficking to one option by origin implying a higher probability of losing the parcel to police or rival gangs because trafficking is easily detectable.

The trade off when choosing the maximum length of the routes is the following: On the one hand, if I use the whole network for the estimations I would be including some municipalities that are used by routes which are potentially implausible due to their length. Furthermore,

[5]This strategy is used by Dell (2015) for the case of Mexico. She also introduces a congestion cost in some estimations.



(a) Minimum distance (b) 500 Km (c) 1000 Km (d) 1500 Km

Fig. 3: Cocaine network municipalities by maximum length of routes

Notes. Municipalities part of each trafficking network in brackets ( ).

as shown in figure 3.d, when I include very long routes many municipalities will belong to more than one trafficking cluster f. The problem becomes worse if many municipalities belong to the southern Venezuelan border and the Pacific cluster, because they will make the effect of international cocaine prices on these two regions ambiguous.

On the other hand, when I only allow traffickers to use very short routes, like in figure 3.b, I exclude the trafficking from some origin municipalities. For example, if the maximum length is set to 500 km, more than 50 percent of the origins will not be part of the analysis.[6]

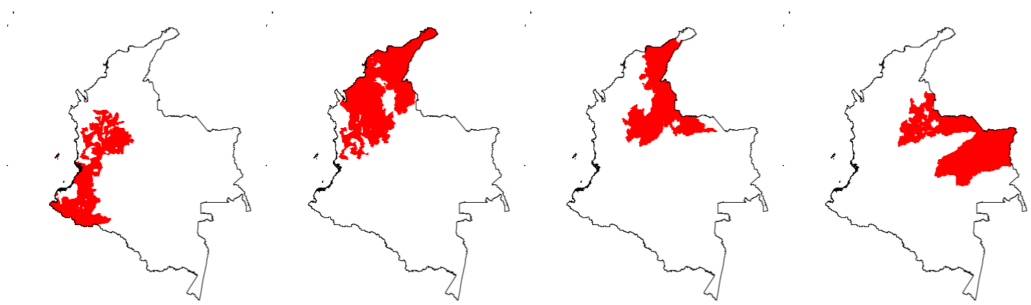
Hence, I allow traffickers to use any route shorter than 1020 km to include 90 percent of the origin municipalities (see table 1). Furthermore, a clear division between trafficking regions is maintained.[7] Figure 4 shows the resulting trafficking clusters.

Even though setting a maximum length seems arbitrary, table A4 in the appendix show the results of the estimations using different maximum lengths. Then, I show that my main results are stable when the maximum length goes from 900Km to 1500Km. For these estimations, the analysis includes more than 90 percent of the origin municipalities.

After setting up the potential cocaine trafficking network, I capture the effect of international cocaine prices on local homicides using the following model. h_{mt} is the homicide rate of municipality m in year t. $D_{mf} = 1$ if the municipality m belongs to a route that fin-

[6]According to table 1 the median of the shortest route is 568 km

[7]Table A4 shows the estimation's results using different maximum lengths.



(a) Pacific (b) Atlantic (c) Venezuela North (d) Venezuela South

Fig. 4: Drug trafficking network by cluster

Notes. Routes' maximum length 1020 Km.

ishes at frontier f and zero otherwise. $P_{\iota f}$ is the wholesale price of cocaine at market $\iota \in \{United\ States\ (US),\ Western\ Europe\ (EU)\}$.[8] X_{mt} are municipality level control variables, M represents municipality fixed effects, T year fixed effects and μ_{mt} is error term. Equation 1 summarizes this approach.

$$h_{mt} = \sum_{\iota} \sum_{f} \beta_{\iota f} Ln\left(P_{\iota f}\right) D_{mf} + \rho X_{mt} + M + T + \mu_{mt} \tag{1}$$

$\beta_{\iota f}$ captures the effect of the price of market ι over the municipalities potentially involved in the cocaine trafficking to frontier f. When $\beta_{\iota f} > 0$ the municipalities in f are serving trafficking to market ι. Contrarily, $\beta_{\iota f} \leq 0$ the municipalities in f have no comparative advantage serving ι. Therefore I expect, at least, that:

$$\beta_{US\ \text{Pacific}} > 0$$

and

$$\beta_{EU\ \text{Venezuela South}} > 0$$

It is important to mention that N includes a large set of possible trafficking routes and not only the routes that drug dealers are really using, which are not observable. Therefore,

[8]The Western European price is the weighted average of the prices in Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom

$\beta_{\iota f}$ may be better interpreted as an *intention to treat estimator* of the effect of changes in international cocaine prices on local violence in Colombia.

2.1 Discussing the validity of the estimation

The aim of this paper is the estimation of exogenous shocks in local violence in Colombia using the interaction between the potential internal cocaine trafficking network and the international prices of cocaine in the two main consuming areas. Thus, identification depends on the idea that changes in prices increase competition within Colombia and that such price variation comes from demand instead of supply shocks.

Despite the importance of Colombia in the supply of cocaine, which introduces important doubts regarding the validity of my estimations, in this section I explain the features of the cocaine market that allow me to estimate such exogenous variation of homicide rates.

2.1.1 Illegal markets and the use of violence

The first question that arises from the estimation I propose is: Why do homicides rise when the price of cocaine increases? The answer of this question is twofold.

Firstly, drug dealers compete in regional oligopolies for control of trafficking routes. Echandia (2013) explains that after the elimination of the great drug cartels in the early 1990s the cocaine market divided into multiple groups, which competed for the regional control of crops and trafficking.

Secondly, previous literature has shown that violence is used to compete in illegal markets (Kugler et al. (2005); Donohue and Levitt (1998); Fiorentini (1995)). What is more, among others, Donohue and Levitt (1998) and Kugler et al. (2005) showed that when the expected illegal profits increase, rates of violence rise because competitors seek larger market shares or incumbents try to deter the entry of new gangs.

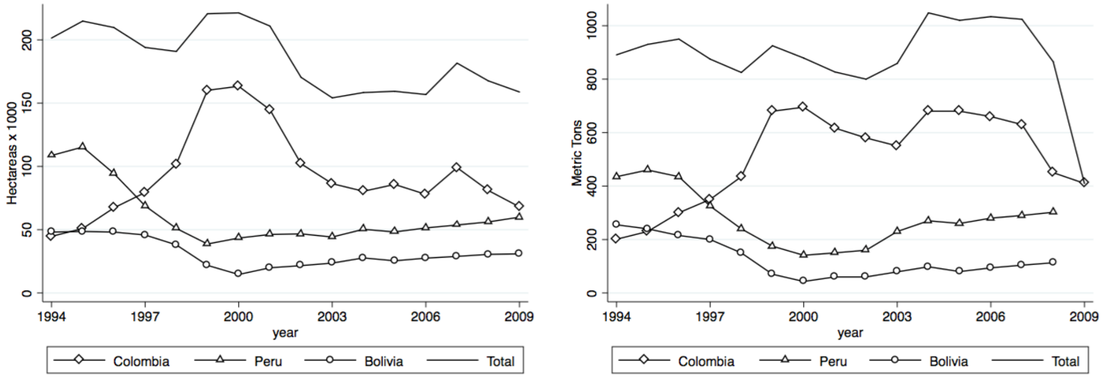
Empirically, Chimeli and Soares (2011) estimate the use of violence in Brazil when the extraction and trade of mahogany was declared illegal, and Dell (2015) analyzes the use of violence in the war of drug cartels in Mexico. In the case of Colombia Angrist and Kugler (2008) and Mejía and Restrepo (2011) estimate the effect of cocaine production on local violence.

2.1.2 Reverse causality

Cocaine is mainly produced in three South American countries: Colombia, Peru and Bolivia. By 2000, Colombia accounted for 73 percent of total coca crops. Therefore, one could assume that Colombian drug dealers have enough market power to increase the price in consuming regions when the cost of production or trafficking increases. However, there are some features of the cocaine market that show that Colombian drug dealers do no have such market power. Firstly, regional competition reduces traffickers' power to set final prices. As I mentioned above, after the death or incarceration of the principal drug lords in the early 1990s the control of production and trafficking in Colombia scattered into many small gangs. According to Mejía and Posada (2007), this competition lowered the profits of the new gangs and the prices in the final markets. What is more, Echandia (2013) also claims that after the elimination of the main drug cartels the market power shifted from Colombian gangs to international groups such as Mexican drug cartels. By 2009, according to UNODC, the profits made by South American cocaine traffickers selling to the US were 3 billion USD while the gross profits for North American traffickers were 34 billion USD. Meanwhile, South American gross profits selling to Europe were 9 billion USD and the profits made by European traffickers were 23 billion USD. This indicates the switch in market power over the cocaine trafficking chain. Hence, in order to avoid the period where Colombian drug lords controlled the market I do not use information previous to 1994 in my estimations.

Secondly, international cocaine supply is more stable than demand. Figure 5 shows the evolution of coca leaf plantations in hectares and cocaine production in metric tons. Meanwhile, figure 6 shows the trends of cocaine consumption in the United States and Europe.

On the one hand, figure 5.a shows that total area of coca fields was steadily around 200

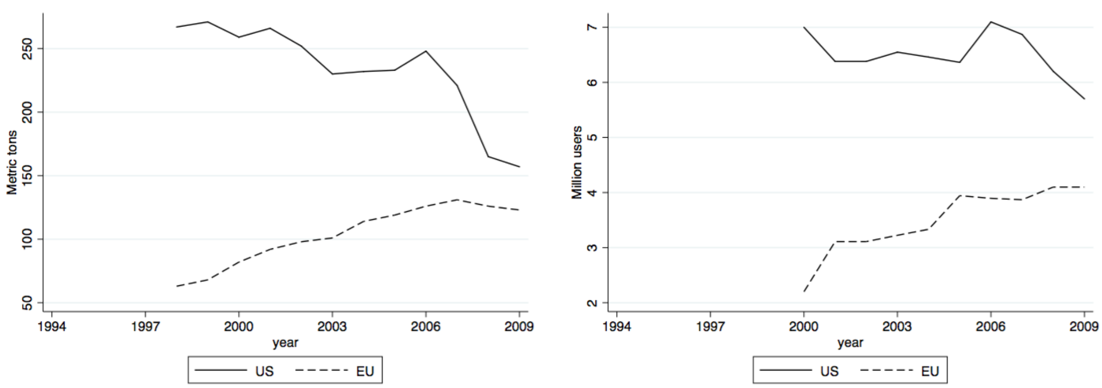


(a) Hectares of coca fields (b) Potential cocaine production

Fig. 5: Coca and cocaine production by producing country

Notes. Estimations by UNODC.

thousand hectares over the 1990s while the area in each producing country varies significantly. Cropping of coca in Peru and Bolivia was gradually replaced by fields in Colombia. After 2000, due to the fall in Colombian plantations, the total area of coca crops falls. However, according to Mejía and Posada (2007), better technology in the growth of coca bushes and cocaine production avoids total supply of cocaine falling, as is shown in figure 5.b.



(a) Cocaine consumption in metric tons (b) Cocaine consumers

Fig. 6: Cocaine consumption and consumers by region

Notes. Estimations by UNODC.

On the other hand, one can observe inverted trends in consumption in the United States and Europe. While consumption in the United States has been falling since 2000, European consumption has constantly increased. As I claim earlier, this paper relies on the fact that some areas in Colombia have a comparative advantage serving different international markets. This last point is indirect evidence of the effect that specific demand shocks could have on different prices, and therefore on homicides in different areas of Colombia. Mejía and Restrepo (2016) also describe the limited scope that supply reduction policies have on changing final quantities and prices. The last fact is the opposite of the findings of Kuziemko and Levitt (2004), which show the important effect that imprisonment had on cocaine prices in the US.

Nevertheless, I do not neglect the possibility that supply shocks can affect the final prices. Hence, I use the price of cocaine in Colombia, which represents the reservation price of native drug dealers, to account for effects of supply shocks on final prices. Thus, the international price in equation 1 is $P_{\iota f} = p_{\iota t} - p_{COLt}$, $p_{\iota t}$ is the wholesale price of cocaine in each market $\iota \in \{\text{US, EU}\}$ and p_{COLt} is the wholesale price of cocaine in the Colombian cities. Figure 7 shows the American, European and Colombian wholesale prices of cocaine.

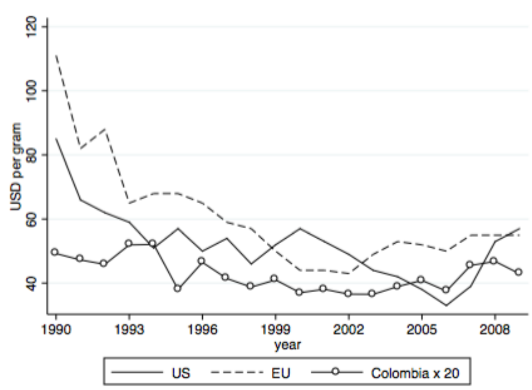


Fig. 7: Wholesale price of cocaine

Notes. UNODC and DNE. Col × 20 = Colombian price × 20. Prices in constant US dollars (2009 = 100) and adjusted by purity.

As shown in figure 7, the three prices do have some periods with common trends but also have periods when their behaviors differ from each other. Initially, from 1990 to 1993 the price in Europe and the US fell sharply as the big cartels lost power and the internal competition between smaller gangs began. This behaviour follows Echandia (2013)'s description and supports my assumption than competition reduced local traffickers' power and their capability to set prices in the final destinations. The figure also shows that the American price continuously fell from 2000 to 2006 while the European price had a slight positive slope. However, from 2006 to 2008 the three prices increased. This may in part be the result of better interception policies in Colombia (common supply shock). However, the increase is stronger in the United States which in part is the result of anti-drug policies in Mexico that increased the cost of trafficking on that specific route (Castillo et al. (2013)).

2.1.3 Omitted variables

As shown in figure 4, equation 1 exploits variation in homicides rate at regional level. Therefore, one may think that there could be unobservable variables that affect the evolution of homicides. For this reason, I control for an extensive set of variables at municipality and departmental level. I include variables about population composition, infrastructure, illegal armies and public accounts. What is more, I also include year and municipality fixed effects in order to control for other unobservable characteristics at municipality level that can threat identification.

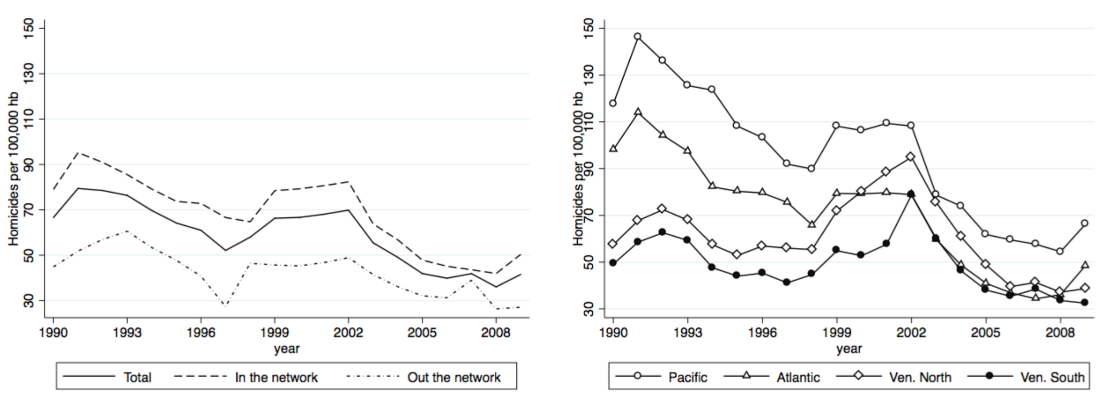
2.1.4 Other possible channels

Finally, in this paper I claim that internal trafficking and cocaine international prices mainly affect local economies as a consequence of the violence used by dealers. Specifically, I will show that changes in international prices of cocaine do not create significant local income effects nor explain the behavior of Guerrilla and Paramilitary Armies. I also show evidence that changes in cocaine prices do not strongly affect political outcomes at municipality level. Angrist and Kugler (2008) showed the effect of coca production on violence and local economies. Therefore, in all my estimations I control for the effect that international prices of cocaine have on the producing municipalities of each trafficking zone f. I also control for the effect of international cocaine prices on destination municipalities D. Thus, if drug traffickers are based at the origin or exit municipalities, my estimation will control for the effect prices have on both, origin and exit municipalities. As result, coefficients $\beta_{\iota f}$ will not include the income effect of producers or final sellers.

However, gang members in trafficking points may get better payments when the prices rise in cocaine consuming regions. Nevertheless, gangs are usually very small firms and their income shock does not affect the regional labor market. I do not observe the black economy's income but I will show that this possible income effect is not large enough to change consumption or wealth in a given municipality.

3 Data

In the previous section I described the data I use to measure the shock of potential cocaine trafficking at municipality level. To measure h_{mt} I use yearly data from the Colombian Vital Statistics[9] from 1990 to 2009 for 1122 municipalities. Figure 8.a shows the annual evolution of the homicide rate in Colombia.[10]



(a) Total homicide rate in municipalities inside and outside the trafficking network

(b) Homicide rate in each trafficking cluster

Fig. 8: Homicide rate by trafficking cluster (1990 - 2009)

The homicide rate moves from 80 to 40 with an average of 50 kills for every 100 thousand habitants. At the beginning of the 1990s the Colombian homicide rate was at its largest

[9]Information from the National Statistics Bureau - DANE.

[10]Table A1 describes the different data sources used in this work.

value (80) when the country was at war against the great drug cartels (Medellín and Cali). Afterwards, the rate fell almost 30 points from 1991 to 1995. From 1996 to 2003 the violence increased again to reach a new high by 2002, 69.6 homicides per 100 thousand habitants. This increase was the consequence of the war that involved left wing guerrillas, right wing paramilitary armies and State forces. After 2003 the violence in Colombia showed a sharp reduction to reach a minimum rate of 35 by 2008. The latest effect has been the result of multiple policies including strong military investment (with funds from the US government) and a peace process with the paramilitary armies (Mejía and Restrepo (2008)). Figure 8.a also shows that homicides are more prevalent in the municipalities which are part of the potential trafficking network than in municipalities outside the network.

Figure 8.b shows the evolution of homicide rates for each trafficking cluster. The Pacific cluster has the highest homicide rate over the period of analysis and the southern border with Venezuela the lowest. It is important to point out the different trends each region presents. From 1990 to 1998 homicides in the Pacific and Atlantic clusters were falling every year while the rates remained constant in the municipalities linked with the Venezuelan border. From 1998 to 2002 homicides stabilized on the Pacific and Atlantic but increased on the Venezuelan border. After 2002 homicides rates fell in all the trafficking regions.

In my estimations I control for different municipality level variables listed in table A2. As discussed in the previous section I also control for the effect of international cocaine prices on coca producing municipalities and destination municipalities. I include as well the interaction of the coffee and oil intensity and the international price of each commodity following Dube and Vargas (2013). Finally, I control for the attacks made by the two main guerrilla armies (FARC and ELN), and the attacks of the right wing paramilitary armies (AUC).[11]

[11]FARC stands for the Spanish acronym of Colombian Revolutionary Armed Forces, ELN for National Liberations Army and AUC for United Self-Defense Groups of Colombia.

4 Results

Table 2 reports the resulting $\beta_{\iota f}$ estimates for equation 1 and the joint significance F test over them. Columns 1 to 4 use all the interactions between the trafficking clusters and both international cocaine prices. Columns 5 to 7 only exclude the interaction between the Pacific with the European price and the southern Venezuelan border with the American price, because these interactions represent trafficking that is not plausible. Finally, columns 8 and 9 only include the interaction between each trafficking cluster and the price of its most likely destination.

Table 2:
OLS: Internal cocaine trafficking on homicide rates

P_ι	D_f	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
US	Pacific	0.393***	0.402***	0.750***	0.718***	0.755***	0.727***	1.041***	0.720***	1.005***
		(0.112)	(0.110)	(0.109)	(0.110)	(0.103)	(0.102)	(0.142)	(0.102)	(0.141)
	Atlantic	0.651***	0.644***	0.549***	0.463***	0.554***	0.472***	0.730***	0.467***	0.702***
		(0.102)	(0.101)	(0.114)	(0.111)	(0.110)	(0.106)	(0.127)	(0.099)	(0.123)
	Ven. North	0.241	0.240	0.140	0.141	0.144	0.141	0.446***	0.096	0.372**
		(0.153)	(0.150)	(0.139)	(0.144)	(0.112)	(0.116)	(0.155)	(0.110)	(0.147)
	Ven. South	-0.123	-0.181	-0.003	-0.020					
		(0.132)	(0.130)	(0.119)	(0.123)					
EU	Pacific	-0.419**	-0.337*	-0.079	-0.067					
		(0.202)	(0.198)	(0.243)	(0.228)					
	Atlantic	0.307	0.289	0.017	-0.008	0.058	0.024	0.004		
		(0.196)	(0.196)	(0.247)	(0.233)	(0.245)	(0.232)	(0.248)		
	Ven. North	-1.264***	-1.258***	-0.599	-0.584*	-0.575*	-0.563*	-0.589*		
		(0.318)	(0.318)	(0.365)	(0.341)	(0.349)	(0.326)	(0.325)		
	Ven. South	1.015***	0.956***	0.458*	0.392	0.512**	0.434*	0.401	0.135	0.176
		(0.253)	(0.255)	(0.262)	(0.244)	(0.260)	(0.241)	(0.252)	(0.145)	(0.180)
Network controls		N	N	Y	Y	Y	Y	Y	Y	Y
Mun. controls		N	Y	Y	Y	Y	Y	Y	Y	Y
Illegal armies		N	N	N	Y	N	Y	Y	Y	Y
F Test on $\beta_{\iota f}$		9.34	9.62	11.78	10.21	16.01	13.73	12.34	19.89	17.47
R^2		0.50	0.51	0.51	0.54	0.51	0.54	0.56	0.53	0.55
Municipalities		1110	1092	1092	1092	1092	1092	641	1092	641
N		17220	17130	17130	17130	17130	17130	10086	17130	10086

Notes. Homicide rates standardized, mean = 48.83, Std. Dev = 60.65. All estimations include year and municipality fixed effects. Estimations also include trafficking cluster fixed effect and control for the period Alvaro Uribe Velez was the president of Colombia (2002-2010), and Hugo Chavez Frías was the president of Venezuela (1999-2013). Municipality controls are described in table A2. The F test is the standard joint significance test over all $\beta_{\iota f}$. Standard errors clustered by municipality in parentheses.
* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$

The effect of the American price on the municipalities in the Pacific and Atlantic is clear. As expected, a one percent increase in the price of cocaine of the United States increases homicide rates in the Pacific and Atlantic respectively by 0.393 and 0.651 standard deviations (column 1). When I control for the characteristics of the municipalities, the impact of the cocaine price on the origin and the destination municipalities, and the participation of illegal armies, the effect rises to 0.718 for the Pacific cluster and drops to 0.463 for the Atlantic trafficking region.

The effect of European cocaine prices focuses on the Southern Venezuelan border. After controlling for municipality characteristics, a one percent increase of European prices increases homicides in this region by 0.458 standard deviations (column 3). However, when I include the effect of illegal armies such as guerrillas or paramilitary armies, the effect of European is reduced to 0.392 and is no longer statistically significant (column 4). This could be the result of the strong influence that FARC historically has over this region. It is important to point out the negative effect that European prices have over homicide rates in the Venezuela North cluster. The positive effect on the south and negative on the north shows that some trafficking organizations working by the Venezuelan border may switch their interest from north to south when the price in Europe increases.

From column 3 to 9 the joint significance test over $\beta_{\iota f}$ is always above 10. Therefore, internal cocaine trafficking will be a strong instrument when researchers would like to analyze the effect of homicides on other local economic outputs. What is more, when I exclude the municipalities that are not part of the trafficking network, the coefficients related to the American price increase. This suggests that the impact of cocaine prices in the United States is stronger between trafficking regions than between trafficking and non trafficking municipalities.

I estimate the same specification of table 2 column 6 for homicide rates by gender and age group. Table 3 shows the main statistics of such regressions.[12] The table shows that cocaine

[12] The details of the $\beta_{\iota f}$ estimates are in table A5

trafficking dramatically increases violence against men, especially men between 15 to 44 years old. The joint significance of $\beta_{\iota f}$ estimates on male homicides is 14.10 while the test on female homicides is 2.72. What is more, the R^2 in the male homicides estimations is 0.53 and for the female homicides is only 0.26. Young male homicides are closely related with inter-gang violence which responds to latent profits in the cocaine market.

Table 3:
OLS: Internal cocaine trafficking on homicide rates by gender and age.

	Male					Female				
	All	5 to 14	15 to 44	45 to 64	65 or more	All	5 to 14	15 to 44	45 to 64	65 or more
F Test on $\beta_{\iota f}$	14.10	1.38	12.04	6.26	2.58	2.72	1.49	2.77	0.99	0.91
R_2	0.53	0.09	0.51	0.30	0.14	0.26	0.07	0.23	0.11	0.08
Hom. rate mean	87.44	3.22	154.47	97.08	43.65	8.63	1.81	13.30	10.19	7.15
Hom. rate s.d.	108.50	18.00	201.88	163.36	132.17	18.12	13.95	32.38	43.27	56.64
Municipalities	1092	1092	1092	1092	1092	1092	1092	1092	1092	1092
N	17130	17130	17130	17130	17130	17130	17130	17130	17130	17130

Notes. Homicide rates standardized. All the estimations control for all the variables in table 2 column 6.

4.1 Other potential effects

This work claims that the main direct impact drug trafficking has on local economies is to increase homicides, which then sparks other effects. As discussed in section 2.1 when the price of cocaine rises in the international market ι the municipalities serving that international market will experience a rise in violence because incumbent gangs may want to gain a bigger share of the new profits or deter the entrance of new participants.

However, local economies may experience other changes when the international price of cocaine increases. In this section I prove that those other shocks are not substantial enough to affect the behaviour of local households or firms. Therefore, in this section I estimate equation 1, as in table 2 column 6, using local tax revenues, property crimes, illegal army attacks and kidnapping as dependent variables. Then, I show that the main channel in which the fluctuations in international cocaine prices affect local economies is through the rise in homicides due to the competition between drug dealers. Figure 9 shows that the joint significance F test of $\beta_{\iota f}$ of such estimations is always below 6 compared to 13.73 (dashed line) which is the value of the test when the outcome variable is the municipality homicide rate.[13]

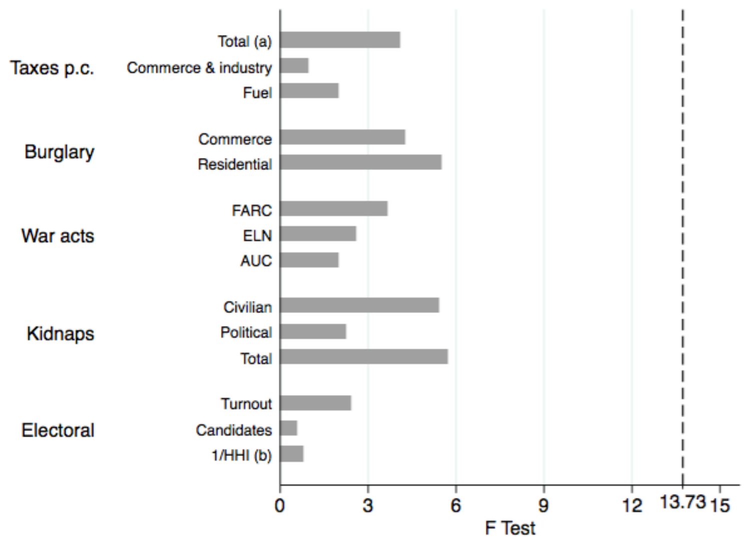


Fig. 9: OLS: Internal cocaine trafficking on tax revenues, burglary, kidnaps, illegal army war acts and electoral competition - F Test on $\beta_{\iota f}$

Notes. $^{(a)}$ Without land taxes.
$^{(b)}$ $\frac{1}{HHI}$ represents the number of equivalent candidates, using votes by candidate to compute shares.

The latest figure highlights the following. Firstly, cocaine trafficking does not have a significant effect on local tax revenues. This implies that changes in cocaine trafficking do not have an effect on the legal economy. Despite some local gangs gaining larger profits when the price of cocaine increases, they cannot affect local labor markets and local consumption. For example, if the shock in prices is large enough, one can expect people to switch from legal to illegal firms, reducing tax revenues, specifically local revenues from taxes to industry and commerce. What is more, if the shock in total income is large enough one can expect consumption to increase and local tax revenues to rise as well. According to my results these last effects do not happen.

Secondly, Kelly (2000) argues that poverty and inequality have an impact on crime. Therefore, if changes in cocaine prices will reduce (increase) poverty I would expect that they can explain changes in property crimes such as commerce and residential burglary. However

[13]Details of these estimations are in table A6

figure 9 shows that the joint significance of $\beta_{\iota f}$ in the case of burglary is below 6, which is less than half of the value of the test for the case of homicides.

It is important to remember that in all the estimations I control for the effect that international cocaine prices have over the producing areas and the municipalities on the border. Hence, the findings on taxation and burglary already control for the likely change in income in the origin and destination areas.

Thirdly, my estimations suggest that illegal armies such as guerrillas and paramilitaries seem not to be attacking municipalities following the rents of cocaine trafficking. Previous works showed the relationship between these groups and cocaine production. But, according to my results these illegal armies do not use war actions to control cocaine trafficking.

Fourthly, cocaine trafficking does not explain the evolution of kidnapping. Civilian kidnapping is usually related to income shocks, because illegal organizations seek the rents of wealthy families. Political kidnapping is commonly used by illegals to affect political outcomes and get further control over local resources.

Finally, electoral competition in mayoral elections does not respond to changes in cocaine prices. As shown in the lower part of the graph, the turnout, the number of candidates competing and the competition among them do not change significantly when competition on trafficking routes rises. Therefore, trafficking gangs seem to prefer to compete using violence, rather than directly intervening in political outcomes at municipality level.[14]

4.2 Magnitude of the results

Summarizing the results, based on my preferred specification (table 2 column 6), a one percent increase in cocaine prices in the United States increases homicide rates at the Pacific and Atlantic border trafficking clusters by 0.727 and 0.472 standard deviations respectively. Furthermore, a one percent increase in the price of cocaine in Europe increases homicide

[14] Acemoglu et al. (2013), show evidence that Paramilitary armies in Colombia do have significant influence on elections at senate and presidential level.

rates by 0.434 standard deviations in the municipalities used to ship cocaine at the southern part of the Colombian border with Venezuela. Moreover, the effect of international prices on the cocaine trafficking network include further interactions that make understanding the magnitude of the results more complex. For instance, one municipality can be used by traffickers that ship cocaine to different borders (one municipality can be used as transit by traffickers that will sell their product at the Pacific border and traffickers that will sell at the Atlantic border). What is more, following previous literature, in my estimations I control for the effect that international cocaine prices have over different segments of the internal cocaine trafficking network (origin, transit and destination municipalities). Thus, when cocaine prices change, the effect on one municipality would be a combination of the different coefficients that are related to its position in the cocaine trafficking network.

Table 4:
Change in the average homicide rate by a 1 USD increase in the international price of cocaine by trafficking cluster and position in the trafficking network (percent)

	Full Network		Trafficking Cluster							
			Pacific		Atlantic		Ven. North		Ven. South	
Network part	US	EU	US	EU	US	EU	US	EU	US	EU
All	1.30	-0.18	1.20	-0.03	1.72	-0.25	1.29	-1.31	0.76	0.30
Origins	1.15	-0.23	0.69	-0.06	1.84	-0.32	1.49	-1.45	0.95	0.16
Transit	1.43	-0.14	1.50	-0.01	1.66	-0.22	1.05	-0.88	0.59	0.23
Destinations	0.58	-0.08	-0.88	0	1.17	-0.52	0.92	-2.96	0.17	1.74

Notes. The calculations are based on the estimates at table 2 column 6 and table A3 column 6 in the appendix. The average prices in the US and EU are 46.37 USD and 52.12 USD respectively.

Table 4 shows the effect of a one dollar increase in international prices on the producing municipalities, transit municipalities[15] and destination municipalities at the country's frontier. A one dollar increase in the American price increases the homicide rate by 1.3 percent over the entire network. However, the effect is stronger on transit municipalities than on origin and destination municipalities. This difference is larger in the Pacific cluster where a one dollar increase in the American cocaine price increases 1.5 percent the homicide rate in transit municipalities and only 0.69 percent in producing municipalities. Moreover, in the

[15]Transit municipalities are municipalities that belong to the trafficking network but are not producers nor border municipalities

Atlantic and Venezuela North clusters violence increases more in producing municipalities than transit municipalities.

When the average price of cocaine increases by one dollar in Europe, homicides fall over the trafficking network except in the Venezuela South cluster, the area specialized on this market. In this zone, the effect concentrates in the destination municipalities where a one dollar increase in the price of cocaine in Europe increases the homicide rate 1.74 percent. These effects may seem small, nevertheless, it is important to point out that the standard deviation of both prices is around 7 dollars and the yearly change in the price moves in a range from -7.8 to 13.9 dollars in the American market and -7.11 to 6 dollars in the European market.

Dube and Vargas (2013) estimated the effect of changes in international prices of coffee and oil on violence in Colombia. In an effort to give more context to my results I carry out an exercise to compare the impact of changes in the international price of cocaine with changes in the international price of coffee.[16] Using the estimations of Dube and Vargas (2013) I compute the increase in war casualties as result of a drop in the coffee price equivalent to a change in international prices of cocaine.[17] According to my calculations the increase in war casualties would be 0.47 percent. Thus, the impact of an increase in the American cocaine price over the municipalities in the trafficking network is about three to four times the impact of a similar reduction in the coffee price. Likewise, the effect of an increase in the European cocaine price is marginally lower than the impact of a similar shock in the international coffee price. Nevertheless, as I showed above, the effect of the European price on the Venezuela South cluster focuses on the border where the effect of the European cocaine price is more

[16] I do not compare with changes in the international price of oil because in the work of Dube and Vargas (2013) the effect of changes in coffee price over the number of casualties is not statistically significant

[17] According to the authors the effect of the coffee price crises was a drop of 0.68 log points in the coffee price between 1997 and 2003. The estimated effect of such a fall in the coffee price is a 14 percent increase in war casualties in the coffee producing regions. A 1 USD increase in the average price of cocaine is around a 0.02 log points increase. Therefore, a 0.02 log points reduce in the price of coffee increases war casualties by 0.41 percent.

than four times the effect of the coffee price.

It is important to point out that the latest comparison has some important limitations. On the one hand, in Dube and Vargas (2013) the authors only take into account casualties by illegal armies such as guerrillas or paramilitary armies. On the other hand, in my estimations I add up all intentional homicides. Hence, if there is a positive correlation between killings done by illegal armies and others types of homicides, it is possible that the final effect of a fall in the price of coffee is larger than the one shown in the paper. Nevertheless, given that cocaine is an illegal commodity, one can expect that international shocks in the price of cocaine have a greater impact on violence than the effect of international shocks in a legal commodity such as coffee.

5 Conclusions

As part of the rising literature on understanding the causes and consequences of crime and armed violence, this paper presents a strategy to estimate exogenous variation in homicides in Colombian municipalities. I exploit the time variation in cocaine international prices and regional variation in the geographical comparative advantage different municipalities have serving different international markets to estimate changes in the homicide rate at the municipality level.

In summary, my estimations suggest that a one percent increase in cocaine prices in the United States increases homicide rates in the municipalities that could be used to traffic cocaine to the Pacific and Atlantic border by 0.727 and 0.472 standard deviations respectively. Moreover, a one percent increase in European cocaine prices increases homicide rates by 0.434 standard deviations in the municipalities connected with the southern part of the Colombian border with Venezuela. I also estimate the effect of international cocaine prices on different segments of cocaine trafficking. Wrapping up the results, a 5 dollar increase in the cocaine price in the United States may cause around 4 extra homicides in a municipality that could be used to traffic cocaine to the American market, adding up to around 1100 more violent deaths in Colombia. What is more, the 5 dollar increase in the European cocaine price could lead to 30 more deaths in the Venezuela South trafficking cluster, which is the area with comparative advantage serving Europe.

Therefore, this paper also contributes to the extensive literature that quantifies the cost of the illegal drug markets in Colombia (i.e. Steiner (1998); Angrist and Kugler (2008)), and the implications of the anti-drug policies (i.e. Mejía and Restrepo (2008); Gaviria-Uribe et al. (2011)). These studies are also common in trafficking countries such as Mexico (i.e. Dell (2015); Castillo et al. (2013); Robles et al. (2013)). What is more, Adda et al. (2014) analysed the impact of changes in the illegal drug control policy in a consumer country like the United Kingdom. These works provide quantitative evidence to the international debate about the legalization of production, trafficking and consumption of illegal narcotics. Academics are getting more involved in this international debate expecting to illuminate politicians with evidence of the direct cost and the international spillovers of the so called *war on drugs*.

Finally, I also provided evidence that homicides are the main channel in which international cocaine prices affect municipalities along posible cocaine trafficking routes. Hence, using internal cocaine trafficking researchers can study the causal effect of homicides on a wide variety of economic outcomes such as investments choices of firms, households or political parties.

References

Abramitzky, R., Delavande, A., and Vasconcelos, L. (2011). Marrying up: the role of sex ratio in assortative matching. *American Economic Journal: Applied Economics*, pages 124–157.

Acemoglu, D., Robinson, J. A., and Santos-Villagran, R. J. (2013). The monopoly of violence:

Evidence from colombia. *Journal of the European Economic Association*, 11:5–44.

Adda, J., McConnell, B., and Rasul, I. (2014). Crime and the depenalization of cannabis possession: Evidence from a policing experiment. *Journal of Political Economy*, 122(5):1130–1202.

Angrist, J. D. and Kugler, A. D. (2008). Rural windfall or a new resource curse? coca, income, and civil conflict in colombia. *The Review of Economics and Statitistics*, 90(2):191–215.

Brückner, M. and Ciccone, A. (2010). International commodity prices, growth and the outbreak of civil war in sub-saharan africa*. *The Economic Journal*, 120(544):519–534.

Castillo, J. C., Mejía, D., and Restrepo, P. (2013). Illegal drug markets and violence in mexico: The causes beyond calderón. *Versión electronica: http://cie.itam.mx/SEMINARIOS/Marzo Mayo_2013/Mejia.pdf*, 3(10):2013.

Chimeli, A. and Soares, R. R. (2011). The use of violence in illegal markets: Evidence from mahogany trade in the brazilian amazon.

Dell, M. (2015). Trafficking networks and the mexican drug war. *American Economic Review*, 105(6):1738–79.

Díaz, A. M. and Sánchez, F. (2004). Geografía de los cultivos ilícitos y conflicto armado en colombia. *Documentos CEDE*, (18).

DNE (2003, 2005-2010). Observatorio de drogas de colombia: Acciones y resultados. Technical report, Dirección Nacional de Estupefacientes - Colombia.

Donohue, J. J. and Levitt, S. D. (1998). Guns, violence, and the efficiency of illegal markets. *The American Economic Review*, 88(2):463–467.

Dube, O. and Vargas, J. (2013). Commodity price shocks and civil conflict: Evidence from colombia. *The Review of Economic Studies*.

Echandia, C. (2013). Narcotráfico: Génesis de los paramilitares y herencia de bandas criminales. Serie de informes 19, Fundación Ideas para la Paz.

Fiorentini, G. (1995). Oligolistic competitions in illegal markets. In Fiorentini, G. and

Peltzman, S., editors, *The Economics of Organized Crime*, pages 274–292. Cambridge University Press: Cambridge.

Gaviria-Uribe, A., Mejía-Londoño, D., and Wills-Otero, L. (2011). *Políticas antidroga en Colombia: éxitos, fracasos y extravíos*. Universidad de los Andes.

Jayaraman, A., Gebreselassie, T., and Chandrasekhar, S. (2009). Effect of conflict on age at marriage and age at first birth in rwanda. *Population Research and Policy Review*, 28:551–567. 10.1007/s11113-008-9116-3.

Kelly, M. (2000). Inequality and crime. *Review of economics and Statistics*, 82(4):530–539.

Khlat, M., Deeb, M., and Courbage, Y. (1997). Fertility levels and differentials in beirut during wartime: An indirect estimation based on maternity registers. *Population Studies*, 51(1):82 – 97.

Kugler, M., Verdier, T., and Zenou, Y. (2005). Organized crime, corruption and punishment. *Journal of Public Economics*, 89(9-10):1639 – 1663.

Kuziemko, I. and Levitt, S. D. (2004). An empirical analysis of imprisoning drug offenders. *Journal of Public Economics*, 88(9):2043–2066.

Mejía, D. and Posada, C. E. (2007). Cocaine production and trafficking: What do we know? BORRADORES DE ECONOMIA 444, Banco de la República.

Mejía, D. and Restrepo, P. (2008). The war on illegal drug production and trafficking: An economic evaluation of plan colombia. *HiCN Working Papers*, (53).

Mejía, D. and Restrepo, P. (2011). Do illegal drug markets breed violence? evidence for colombia. Technical report.

Mejía, D. and Restrepo, P. (2016). The economics of the war on illegal drug production and trafficking. *Journal of Economic Behavior & Organization*, 126:255–275.

Mejía, D. and Rico, D. M. (2010). La microeconomía de la producción y tráfico de cocaína en colombia. *Documentos CEDE*, (19).

Robles, G., Calderón, G., and Magaloni, B. (2013). The economic consequences of drug trafficking violence in mexico. Economic Consequences of Drug Trafficking Violence. Poverty and Governance, Stanford University Economic Consequences of Drug Trafficking Violence Poverty and Governance, Stanford University.

Schindler, K. and Brück, T. (2011). The effects of conflict on fertility in rwanda. *DIW Berlin Discussion Paper*, (1143).

Shemyakina, O. (2013). Patterns in female age at first marriage and tajik armed conflict. *European Journal of Population/Revue européenne de Démographie*, 29(3):303–343.

SIMCI (2001 - 2012). Colombia, censo de cultivos de coca. Technical report, United Nations Office on Drug and Crime - UNODC.

Steiner, R. (1998). Colombia's income from the drug trade. *World Development*, 26(6):1013 – 1031.

UNODC (2000 - 2012). World drug report. Technical report, United Nations Office on Drug and Crime.

Valente, C. (2011). What did the maoists ever do for us? education and marriage of women exposed to civil conflict in nepal. *World Bank Policy Research Working Paper Series.*

A Supplementary tables

Table A1:
Data sources

Variable	Source	Period
Trafficking network		
Coca crops in Colombia (origins)	SIMCI (2012)	2001 - 2009
Road network (Transit and destinations)	Colombian Ministry of Transport	2005
International cocaine market		
Wholesale cocaine prices - EU and US	UNODC (2012)	1990 - 2009
International cocaine production and consumption	UNODC (2012)	1990 - 2009
Violence		
Homicides	Estadísticas vitales - DANE	1985 - 2010
	CEDE - Human Rights Observatory - Colombian Vice-presidency office	1990 - 2010
Illegal army attacks	CEDE - Human Rights Observatory - Colombian Vice-presidency office	1990 - 2009
Burglary	Municipality level panel - CEDE	1993 - 2014
Kidnapping	Municipality level panel - CEDE	1993 - 2014
Other variables		
Population	DANE	1990 - 2015
Coffee intensity	Dube and Vargas (2013)	1990 - 2009
Oil intensity	Dube and Vargas (2013)	1990 - 2009
Familias en Acción	Acción Social - DPS	1985 - 2015
Departmental GDP	DANE	1990 - 2009
Municipality level taxation	Municipality level panel - CEDE	1993 - 2014
Municipality level public expenditure	Municipality level panel - CEDE	1993 - 2014

Table A2:
Control variables descriptive statistics. For municipalities inside and outside the trafficking network

	All		Inside the network		Outside the network	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Population	36668.49	221880.08	39809.09	138808.33	32376.11	300264.00
Male proportion	0.51	0.02	0.51	0.02	0.51	0.02
Urban proportion	0.40	0.24	0.42	0.24	0.37	0.22
Department capital city	0.03	0.17	0.03	0.17	0.02	0.16
Roads (Km)	334.13	556.51	377.67	625.94	274.64	437.49
Primary roads (Km)	23.41	34.22	26.06	32.20	19.79	36.50
Proportion of primary roads	0.10	0.12	0.10	0.12	0.10	0.12
Area (Km^2)	1018.96	3209.54	757.10	2896.98	1376.86	3562.20
Road density (Roads/area)	0.81	0.47	0.83	0.40	0.79	0.55
Population density (hb per Km^2)	134.16	589.62	159.26	724.56	99.85	321.36
Destination municipality (at international border)	0.05	0.22	0.08	0.27	0.01	0.10
Coca producer municipality	0.25	0.44	0.32	0.47	0.17	0.37
Price of oil in US × oil intensity (gallons 1988)[a]	0.12	2.27	0.17	2.95	0.04	0.51
Price of coffee in NY × coffee intensity (hct 1997)[a]	80.32	169.88	86.32	173.70	72.11	164.17
FARC attack rate [b]	4.94	19.54	4.13	17.54	6.07	22.01
AUC attack rate [b]	0.55	4.15	0.56	4.18	0.54	4.10
ELN attack rate [b]	1.37	8.37	1.81	8.18	0.74	8.60
Municipality in Familias en Acción [c]	0.24	0.43	0.24	0.43	0.23	0.42
Departmental GDP per capita [d]	5533.61	3767.64	5330.51	3535.76	5821.84	4056.96
Total taxes per capita [d]	52.75	75.36	45.48	63.87	63.03	88.12
Total public expenditure per capita [d]	502.58	722.70	448.27	516.90	579.48	934.62

Notes.
[a] From Dube and Vargas (2013).
[b] Attacks per 100 thousand habitants. Attacks include ambush, confrontation with the Police or National Army, harassment and terrorism.
[c] Familias en Acción is the largest CCT social welfare program in Colombia.
[d] 1000 COP per year (2009 = 100)

Table A3:
OLS: Internal cocaine trafficking on homicide rates - coefficients on other internal trafficking variables

P_ι	D_f	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Producing municipalities										
US	Pacific			-0.933***	-0.728***	-1.017***	-0.804***	-0.767***	-0.803***	-0.764***
				(0.210)	(0.194)	(0.200)	(0.182)	(0.180)	(0.182)	(0.180)
	Atlantic			0.330	0.415*	0.549**	0.664***	0.586***	0.692***	0.626***
				(0.253)	(0.245)	(0.229)	(0.221)	(0.226)	(0.228)	(0.236)
	Ven. North			0.396	0.560	-0.037	0.050	-0.002	-0.010	-0.056
				(0.430)	(0.407)	(0.203)	(0.197)	(0.197)	(0.193)	(0.194)
	Ven. South			-0.637	-0.739*					
				(0.422)	(0.394)					
EU	Pacific			-0.585*	-0.465					
				(0.349)	(0.326)					
	Atlantic			1.276***	1.345***	1.029**	1.138***	1.173***		
				(0.443)	(0.429)	(0.433)	(0.419)	(0.420)		
	Ven. North			-2.321***	-2.291***	-2.259***	-2.217***	-2.224***		
				(0.840)	(0.786)	(0.842)	(0.782)	(0.771)		
	Ven. South			2.180***	2.141***	1.999**	1.960***	1.984***	-0.211	-0.200
				(0.822)	(0.770)	(0.807)	(0.749)	(0.742)	(0.242)	(0.245)
Destination municipalities										
US	Pacific			-0.213	-0.338	-0.169	-0.298	-0.235	-0.302	-0.248
				(0.301)	(0.308)	(0.301)	(0.317)	(0.319)	(0.316)	(0.316)
	Atlantic			-0.317*	-0.377**	-0.310*	-0.365**	-0.307*	-0.316*	-0.285
				(0.184)	(0.180)	(0.174)	(0.168)	(0.180)	(0.172)	(0.182)
	Ven. North			0.124	0.068	0.107	0.054	0.052	-0.068	-0.078
				(0.308)	(0.315)	(0.308)	(0.321)	(0.338)	(0.225)	(0.245)
	Ven. South			0.213	0.064					
				(0.160)	(0.285)					
EU	Pacific			0.239	0.138					
				(0.271)	(0.286)					
	Atlantic			0.524**	0.415*	0.587**	0.465*	0.324		
				(0.267)	(0.252)	(0.270)	(0.253)	(0.265)		
	Ven. North			-1.439	-1.377	-1.377	-1.327	-1.342		
				(1.388)	(1.285)	(1.375)	(1.276)	(1.259)		
	Ven. South			0.280	1.283	0.350	1.299	1.521	1.400*	1.625*
				(0.863)	(0.991)	(0.858)	(0.945)	(1.012)	(0.835)	(0.910)
Municipality controls		N	Y	Y	Y	Y	Y	Y	Y	Y
Illegal armies		N	N	N	Y	N	Y	Y	Y	Y
R^2		0.50	0.51	0.51	0.54	0.51	0.54	0.56	0.53	0.55
N		17220	17130	17130	17130	17130	17130	10086	17130	10086

Notes. As table 2

Table A4:
OLS: Internal cocaine trafficking on homicide rates by routes' maximum length

			Maximum length (Km)												
P_ι	D_f	Min. Dist.[a]	100	300	500	700	900	960	980	1000	1020	1060	1100	1300	1500
US	Pacific	0.275***	1.443	-0.195	-0.188	0.115	0.697***	0.714***	0.717***	0.717***	0.727***	0.763***	0.676***	0.623***	0.474***
		(0.101)	(0.919)	(0.255)	(0.117)	(0.117)	(0.107)	(0.105)	(0.102)	(0.102)	(0.102)	(0.103)	(0.099)	(0.096)	(0.084)
	Atlantic	1.024***	0.019	-0.230	-0.379***	-0.074	0.442***	0.455***	0.446***	0.432***	0.472***	0.443***	0.475***	0.294***	0.332***
		(0.222)	(0.116)	(0.150)	(0.112)	(0.102)	(0.119)	(0.118)	(0.110)	(0.108)	(0.106)	(0.098)	(0.098)	(0.088)	(0.101)
	Ven. North	-0.137	-0.466	-0.264	-0.440***	-0.133	-0.057	0.035	0.054	0.123	0.141	0.161	0.152	0.161*	0.020
		(0.092)	(0.417)	(0.300)	(0.142)	(0.121)	(0.110)	(0.114)	(0.113)	(0.118)	(0.116)	(0.114)	(0.114)	(0.094)	(0.092)
EU	Atlantic	-0.140	0.871***	0.113	-0.110	0.170	-0.190	-0.129	0.010	0.044	0.024	-0.003	0.001	-0.063	-0.057
		(0.530)	(0.169)	(0.212)	(0.225)	(0.175)	(0.282)	(0.277)	(0.259)	(0.238)	(0.232)	(0.228)	(0.225)	(0.192)	(0.232)
	Ven. North	0.188	1.336	0.567	0.317	-0.257	-0.256	-0.277	-0.317	-0.572*	-0.563*	-0.552*	-0.560*	-0.212	-0.065
		(0.116)	(1.346)	(0.486)	(0.218)	(0.223)	(0.254)	(0.262)	(0.261)	(0.327)	(0.326)	(0.322)	(0.325)	(0.281)	(0.203)
	Ven. South	-0.032	1.655**	-2.154	-2.140	-1.883	0.344*	0.285	0.344*	0.467*	0.434*	0.412*	0.425*	0.318	0.147
		(0.256)	(0.772)	(2.183)	(2.175)	(1.768)	(0.201)	(0.205)	(0.205)	(0.241)	(0.241)	(0.242)	(0.245)	(0.243)	(0.189)
F Test on $\beta_{\iota f}$		7.40	6.37	1.17	3.87	1.33	11.32	11.61	13.31	12.52	13.73	13.59	12.39	9.02	7.58
R^2		0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54	0.54	0.54	0.54	0.53	0.53
Pac. & Ven. S.[b]		0	0	0	0	0	1	7	7	9	10	12	13	75	128
Origins prop.[c]		100	5.33	26.22	43.56	70.22	89.33	90.66	91.11	91.11	91.11	91.11	92.45	96.01	100
Municipalities		1092	1092	1092	1092	1092	1092	1092	1092	1092	1092	1092	1092	1092	1092
N		17130	17130	17130	17130	17130	17130	17130	17130	17130	17130	17130	17130	17130	17130

Notes. As table 2 column 6.

[a] Min. Dist. uses only the shortest route to the closest destination from each origin municipality.

[b] Municipalities that belong to the Pacific and Venezuela South cluster.

[c] Origins prop. (percent) is the proportion of coca leaf producing municipalities that belong to the analysis. The total network includes 224 producing municipalities.

Table A5:
OLS: Internal cocaine trafficking on homicide rates by gender and age

		Male					Female				
P_ι	D_f	All	5 to 14	15 to 44	45 to 64	65 or more	All	5 to 14	15 to 44	45 to 64	65 or more
US	Pacific	0.750***	0.266**	0.718***	0.523***	0.413***	0.340***	0.053	0.341***	0.138	0.190*
		(0.103)	(0.124)	(0.106)	(0.112)	(0.126)	(0.111)	(0.144)	(0.123)	(0.131)	(0.103)
	Atlantic	0.478***	0.102	0.438***	0.383***	0.190	0.236**	0.141	0.307***	-0.038	-0.014
		(0.104)	(0.105)	(0.099)	(0.112)	(0.118)	(0.111)	(0.098)	(0.118)	(0.094)	(0.099)
	Ven. North	0.115	0.140	0.101	-0.012	0.162	0.286**	0.155	0.279*	0.212*	-0.040
		(0.113)	(0.157)	(0.117)	(0.111)	(0.153)	(0.141)	(0.166)	(0.145)	(0.118)	(0.110)
EU	Atlantic	0.069	0.057	0.121	-0.063	-0.161	-0.247	-0.040	-0.183	-0.273	0.012
		(0.229)	(0.163)	(0.202)	(0.223)	(0.220)	(0.220)	(0.203)	(0.210)	(0.191)	(0.186)
	Ven. North	-0.507	-0.307	-0.463	-0.320	-0.347	-0.604	-0.659	-0.602	-0.136	-0.150
		(0.312)	(0.212)	(0.300)	(0.303)	(0.241)	(0.373)	(0.406)	(0.380)	(0.252)	(0.187)
	Ven. South	0.422*	0.200	0.427*	0.368	0.162	0.237	0.425	0.350	-0.038	-0.168
		(0.231)	(0.261)	(0.227)	(0.259)	(0.211)	(0.301)	(0.355)	(0.298)	(0.262)	(0.234)
F test on $\beta_{\iota f}$		14.10	1.38	12.04	6.26	2.58	2.72	1.49	2.77	0.99	0.91
R^2		0.53	0.09	0.51	0.30	0.14	0.26	0.07	0.23	0.11	0.08
Hom. rate mean		87.44	3.22	154.47	97.08	43.65	8.63	1.81	13.30	10.19	7.15
Hom. rate s.d.		108.50	18.00	201.88	163.36	132.17	18.12	13.95	32.38	43.27	56.64
Municipalities		1092	1092	1092	1092	1092	1092	1092	1092	1092	1092
N		17130	17130	17130	17130	17130	17130	17130	17130	17130	17130

Notes. As table 2

Table A6:

OLS: Internal cocaine trafficking on tax revenues, burglary, kidnaps, illegal army war acts and electoral competition

		Taxes p.c.			Burglary		War acts			Kidnaps			Mayoral elections		
P_ι	D_f	Total[a]	C&I	Fuel	Commerce	Residential	FARC	ELN	AUC	Civilian	Political	Total	Turnout	Candidates	1/HHI[b]
US	Pacific	-0.151**	-0.059	-0.187**	0.363**	0.344***	0.027	0.196*	0.038	-0.222*	-0.136*	-0.248**	0.085	0.367	0.138
		(0.070)	(0.064)	(0.078)	(0.143)	(0.124)	(0.223)	(0.117)	(0.060)	(0.118)	(0.070)	(0.110)	(0.157)	(0.247)	(0.171)
	Atlantic	0.081	-0.002	0.082	0.309***	0.471***	0.209	0.402***	0.160**	0.604***	-0.044	0.520***	-0.096	-0.200	0.044
		(0.060)	(0.054)	(0.071)	(0.119)	(0.110)	(0.156)	(0.120)	(0.063)	(0.143)	(0.086)	(0.137)	(0.174)	(0.265)	(0.167)
	Ven. North	0.017	0.023	0.111	0.158	0.194	-0.056	0.036	0.065	0.468***	0.445**	0.580***	-0.198	0.176	0.232
		(0.074)	(0.071)	(0.149)	(0.191)	(0.169)	(0.284)	(0.252)	(0.073)	(0.176)	(0.202)	(0.182)	(0.227)	(0.316)	(0.213)
EU	Atlantic	0.171**	0.021	0.106	-2.343***	-2.164***	0.377***	-0.161	0.056	0.057	-0.030	0.039	0.299**	-0.105	0.311
		(0.075)	(0.074)	(0.193)	(0.629)	(0.617)	(0.098)	(0.180)	(0.134)	(0.228)	(0.141)	(0.216)	(0.148)	(0.242)	(0.287)
	Ven. North	0.203	-0.026	0.762*	0.527	-0.092	0.020	-0.153	0.025	-0.337	-0.608*	-0.524	-0.122	-0.095	-0.462
		(0.130)	(0.154)	(0.405)	(0.897)	(0.709)	(0.124)	(0.237)	(0.148)	(0.350)	(0.316)	(0.329)	(0.182)	(0.282)	(0.405)
	Ven. South	0.043	0.144	-0.051	-0.206	1.134	0.455***	0.010	0.255	0.346	0.126	0.354	-0.250	-0.121	0.577
		(0.133)	(0.143)	(0.361)	(1.209)	(0.924)	(0.153)	(0.237)	(0.177)	(0.284)	(0.276)	(0.272)	(0.172)	(0.291)	(0.469)
F Test on $\beta_{\iota f}$		4.13	1.00	2.03	4.29	5.55	3.70	2.60	2.00	5.44	2.28	5.75	2.44	0.60	0.83
R^2		0.74	0.74	0.81	0.54	0.50	0.31	0.27	0.15	0.23	0.12	0.24	0.82	0.57	0.49
y var. mean		32.12	13.10	14.27	11.48	19.05	4.94	1.37	0.55	2.43	0.36	2.80	0.36	3.39	2.77
y var. s.d.		58.46	38.85	18.99	20.43	38.10	19.54	8.37	4.15	7.32	3.05	8.25	0.12	1.75	1.33
Municipalities		1092	1092	1092	1092	1092	1092	1092	1092	1088	1088	1088	1092	1092	1092
N		17130	17130	10491	7616	7616	17130	17130	17130	14912	14912	14912	4901	4901	4898

Notes.

Continuous variables standardized. All the estimations control for all the variables in table 2 column 6.

$^{(a)}$ Without land taxes.

$^{(b)}$ $\frac{1}{HHI}$ represents the number of equivalent candidates, using votes by candidate to compute shares. The F test is the standard joint significance test over all $\beta_{\iota f}$.

Standard errors clustered by municipality in parentheses.

* $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.