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Using discarded packs collection to estimate illicit trade in Colombia

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ABSTRACT

Background: The last time tobacco taxes increased in Colombia was in 2017. After this increase, the tax burden on the most-sold brand has decreased. In the meantime, Colombia has undergone significant changes in its political context.
Methods: This study employed a litter-pack methodology in Colombia to estimate the prevalence of illicit cigarette trade in five cities (Bogotá, Medellín, Cali, Cartagena, and Cúcuta), which represent 37 % of the total urban population and 56.1 % of the urban smoking population in the country. A weighted probabilistic sampling approach with two stages was utilised. Smoking rates for each city in census areas were estimated using data from the 2019 National Substance Use Survey and the 2018 Census, applying logistic regression. Census areas were grouped by the density of people who smoke tobacco, and random starting points were selected. Structured analyses identified key attributes of cigarette packs for both legal and illicit products, including brand, health warnings, and origin.
Results: Illicit trade accounted for 16.9 % of total cigarette consumption across the five cities. Levels varied significantly, ranging from 6.6 % in Bogotá to 73.7 % in Cúcuta (on the border with Venezuela). Over half of the illicit cigarette packs lacked country-of-origin information, with leading brands, like Rumba or Carnival, often displaying inconsistent or missing country details.
Conclusions: Contrary to industry claims, the variations in illicit trade penetration across cities suggest that common factors, such as taxes, cannot fully account for the growth of illicit trade. Other variables, such as security and political issues, may decisively affect such a penetration.

Introduction

Colombia was, until 2016, one of the countries in Latin America with the lowest cigarette prices (WBG Global Tobacco Control Program, 2019). After December 2016, tobacco taxes were increased, with the specific component per 20-cigarette pack rising by 99.7 % to Colombian Pesos (COP) 1400 in January 2017 (about USD 0.5 at the January 1, 2017 exchange rate) and to COP 2100 in January 2018 (about USD 0.7 at the January 1, 2018 exchange rate). As of January 2019, the automatic annual adjustment of the tax rate was established at the previous year's inflation plus four percentage points to address increases in consumers' purchasing power.

Consequently, the average price for the most-sold brand of 20-cigarette packs (Rothmans) rose from COP 2780 (about USD 0.9 at the January 1, 2016 exchange rate) in 2016 to COP 3964 (about USD 1.3 at the January 1, 2018 exchange rate) in 2018, and to COP 5159 (about USD 1.6 at the January 1, 2020 exchange rate) in 2020 (Departamento Administrativo Nacional de Estadísticas (DANE), 2018, 2020, 2024). The specific tax share on this brand increased from 25.7 % in 2016 to 52.8 % in 2018 (World Health Organization, 2023). The relative income-price ratio (i.e., the percentage of the per capita Gross Domestic Product (GDP) required to purchase 100 packs of the most sold brand) rose from 1.5 % in 2016 to 2.7 % in 2022 (World Health Organization, 2025a).

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The proportion of people who report heavy tobacco smoking (more than ten cigarettes per day) decreased from 37 % in 2016 to 26 % in 2017, and smoking prevalence fell from 8.3 % in 2016 to 5.7 % in 2024 (Departamento Administrativo Nacional de Estadísticas (DANE), 2024). Despite these advancements, Colombia still has one of the lowest levels of tobacco taxation in the region and one of the lowest tobacco prices in the Americas measured in comparable international dollars (Drope et al., 2024).

The tobacco industry's (TI) interference in undermining tobacco control measures is a global issue (World Health Organization, 2009). Standard practices include both direct and indirect political lobbying—often through front groups, such as trade chambers—exaggerating the industry's economic significance, discrediting independent studies, and funding studies on illicit trade using questionable methods, typically overestimating the problem (Gallagher et al., 2019; Paraje et al., 2022).

Colombia is not immune to this influence. In 2009, Philip Morris International (which acquired Coltabaco in 2005, one of the largest tobacco companies in the country) and the Republic of Colombia signed a cooperation and investment agreement whereby the TI would provide funds and technical collaboration for efforts against illicit trade (WBG Global Tobacco Control Program, 2019). The recipient of these funds is the Federación Nacional de Departamentos (FND), which legally receives and manages revenues from excise taxes (tobacco, alcohol, gambling, among others). Paradoxically, under the agreement, the TI's influence extends to budget allocation and the FND's decisions regarding the control of illicit cigarette trade (WBG Global Tobacco Control Program, 2019). Additionally, an annual report on illicit trade is produced collaboratively by the FND, the TI, and a consulting firm (INVAMER, for its Spanish acronym), utilising funds from the agreement. The media extensively covers these reports, which are disseminated among high-ranking government officials (WBG Global Tobacco Control Program, 2019).

Colombia has conducted two previous independent studies on illicit trade, both involving cross-sectional surveys of people who smoke tobacco in Bogotá, Medellín, Cali, Cartagena, and Cúcuta (the five cities with the highest number of people who smoke tobacco at the time of the studies) (Maldonado, Llorente, Escobar et al., 2020; Maldonado, Llorente, Iglesias et al., 2020). The first was conducted in 2016, three months before the 2017 excise tax increase, while the second was a follow-up study nine months after the tax reform was implemented. The results indicated that the illicit cigarette trade increased from 3.4 % to 6.4 %, a considerably lower estimate than the industry data (18 % in 2017) (Maldonado, Llorente, Escobar et al., 2020).

Tobacco taxes have remained relatively unchanged since the last increase in 2017. The average specific tax share for the most-sold brand has remained around 50 %, ranging from 45.5 % in 2019 to 54.9 % in 2025. In the meantime, Colombia has undergone significant changes in its political context, which could affect the penetration of illicit trade. One notable change is the worsening security conditions at the border with Venezuela. In 2019 alone, the number of Venezuelan immigrants rose by 49 %, reaching approximately 1.8 million (Organización Internacional para las Migraciones (OIM), 2022). Additionally, in 2021, the country experienced widespread social unrest that persisted for several months (Consejo de Derechos Humanos, 2022).

This study reports the results of collecting littered cigarette packs, a method never utilised in Colombia, to estimate the penetration of the illicit cigarette trade in the five cities with the highest number of people who smoke tobacco (Bogotá, Medellín, Cali, Cartagena, and Cucuta). The study also provides information on the brands and countries of origin for both licit and illicit cigarettes.

Methods

Sample design

The study population consists of discarded cigarette packs (as a proxy for consumption) from five Colombian cities, selected to maintain comparability with previous independent studies (Maldonado, Llorente, Escobar et al., 2020; Maldonado et al., 2018; Maldonado, Llorente, Iglesias et al., 2020). These cities—Bogotá (36.4 % of the urban smoking population), Medellín (10 % of the urban smoking population), Cali (6.4 % of the urban smoking population), Cartagena (1.9 % of the urban smoking population), and Cúcuta (1.5 % of the urban smoking population)—account for 56.1 % of urban smoking population and represent 37 % of the total urban population in the country.

A two-stage probabilistic sample was collected. In the first stage, clusters were selected using probability proportional to size (PPS) sampling, an unequal-probability method whereby the probability of selecting a cluster is proportional to its estimated number of people who smoke tobacco (Lohr, 2021). The smoking population data from the 2019 National Survey of Psychoactive Substances (ENCSPA, by its Spanish acronym) were combined with microdata from the 2018 National Household and Population Census using a method similar to that employed in previous studies (Departamento Administrativo Nacional de Estadísticas (DANE), 2019, 2023a; Szklo et al., 2022). Since the ENCSPA does not provide information at the city-subarea level, a logistic regression model was developed for each city to estimate the probability of being a person who smoked at least one cigarette in the last month based on educational level, occupation, marital status, socioeconomic status, age, and household size. The estimated regression coefficients were then applied to the microdata from the 2018 Census, enabling the estimation of the number of people who smoke tobacco per census tract. Clusters were formed by grouping census tracts, with cluster size determined by the aggregated number of people who smoke tobacco within each cluster. To prioritise data quality and ensure the safety of enumerators, clusters frequently visited by tourists or those with high homicide rates were excluded. In specific cases where the number of people who smoke tobacco was low, clusters were merged to ensure balanced variance. The results of the logistic model estimations for each city are presented in Table A1 of the Appendix.

For the second stage of sampling, a random initial point was selected within each cluster using the open-source software QGIS (Qgis Development Team, 2025). From there, the enumerators followed a pre-established walking protocol to collect the discarded cigarette packs, as suggested elsewhere (Stoklosa, 2020). The walking protocol involved covering a fixed distance, turning right, and repeating this process until a square was completed. This pattern was repeated four times around the initial point within the cluster, as shown in Figure A1 in the Appendix. In some clusters, the route was modified to ensure that the enumerators could physically traverse the entire route while remaining within the cluster boundaries. The minimum sample size was determined using a standard approach (Kish, 1965). A more detailed description of the formula is provided in the appendix.

The fieldwork took place from September to October 2023. It was conducted primarily by teams of trained volunteers (additional personnel were hired where necessary), who were monitored in real time through a bespoke application. Discarded cigarette packs were gathered from the streets and litter bins. The collected packs were photographed and stored in individually labelled bags for further analysis.

Analysis

A team at Universidad ICESI used a structured form to record the characteristics of the collected packs. These included brand, country of origin, the presence of Colombian health warnings, among others. A complete list of variables is provided in Table A2 of the appendix.

Reviewers from Universidad Adolfo Ibáñez, Fundación Anáas, Universidad del Rosario, and Universidad de Antioquia validated each entry using the photographs taken from each pack.

The researchers considered four criteria to classify packs as licit or illicit, based on what is mandated by Colombian law for the sale of cigarettes. First, the pack design and brand were among those approved by the Colombian Ministry of Health (CMH). Each year, tobacco firms propose designs for the packages that the CMH must approve (Congress of Colombia, 2009; Ministry of Health of Colombia, 2012).

Second, the CMH-approved health graphic warnings were present (Congress of Colombia, 2009; Ministry of Health of Colombia, 2009). In the case that health graphic warnings of rounds previous to the current one at the time of collection were present, they were still considered as licit. Third, the pack had the mandatory text "Imported for Colombia" (in Spanish) (Congress of Colombia, 2009). As Colombia has no domestic production, all licitly imported cigarette packs must contain that text. Fourth, the country of origin of the cigarettes must be clearly indicated on the packs, as mandated by Law (Congress of Colombia, 2009). Packs were classified as licit if all four conditions were visible in packs. In cases of deteriorated packs where it was not possible to observe one or more characteristics, they were considered licit packs where all the visible ones fulfilled the criteria. Otherwise, they were classified as illicit.

The following ratio was used to estimate the Penetration of Illicit Cigarette Trade (PICT):

$$PICT = \frac{\sum_{i=1}^{I} q_i * w_i}{\sum_{t=1}^{T} q_t * w_t} \times 100$$

Where I is the total number of illicit packs collected, T is the total number of packs collected, q is the number of 10-stick equivalent packs collected, and w is the weight based on the inverse of probability of selection. The exact calculation of weights is explained in the Appendix.

The precision of estimators was calculated using coefficients of variation (CV) for two-stage sampling designs. All statistical analyses were conducted using Stata 18.

Results

Table 1 displays the number of clusters initially considered for each city, the number of those excluded for security and/or tourism reasons, and the number of selected clusters for each city. It also contains information on the number of packs targeted for collection in each cluster chosen and the total number of 10-stick packs targeted for collection in each city, as determined by (A).

Fig. 1 illustrates the distribution of clusters selected within each city examined in the study.

A total of 3515 cigarette packs were collected, comprising 2463 10-stick packs, 1046 20-stick packs, and 6 18-stick packs. When converted to 10-stick equivalents, the total rises to 4567 packs, which is 231 % greater than the initial target, as shown in Table 1. These packs were distributed across the following cities: Bogotá (1250), Cúcuta (1144), Medellín (968), Cartagena (690), and Cali (515).

Fig. 2 illustrates the estimated PICT in the five cities and within each cluster. It reveals considerable variation among them, ranging from 6.6 % (95 % CI: 4.6 %, 9.4 %) in Bogotá to 73.7 % (95 % CI: 66.7 %, 79.7 %) in Cúcuta. The PICT across the five cities is 16.9 % (95 % CI: 13.4 % to 21.1 %).

Despite the potential deterioration of the packs collected, criterion 1 (brand and design approved by the national authority) could be identified in all cases, making it sufficient on its own to determine whether a pack was licit or illicit. Among licit packs, all four criteria could be assessed in 83.8 % of cases, at least three criteria in 89 %, at least two in 94.7 %, and only criterion 1 in 5.3 %. Among illicit packs, all four criteria could be assessed in 59.5 % of cases, three in 88.1 %, at least two in 95.5 %, and only criterion 1 in 4.5 %. A detailed breakdown of the full distribution according to the established criteria is provided in Figure A2 of the Appendix.

Clusters situated on the periphery or near the downtown areas of each city tend to exhibit a higher PICT. A Marascuilo procedure, which allows for the simultaneous comparison of PICT across all cluster pairs, shows that border clusters in most cities are generally statistically distinct from other clusters (results for each pairwise comparison available upon request) (Marascuilo, 1966). Furthermore, this procedure also reveals that PICT values differ statistically across cities (see Table A3 of the Appendix).

Table 2 illustrates the distribution of cigarette brands across the licit and illicit markets by city. Rothmans and Starlite are the dominant brands in the licit market, commanding nearly 60 % of the market share and particularly dominant in Bogotá (69 % of the licit market) and Cúcuta (64.2 % of the licit market). In contrast, the illicit market showcases a wider variety of brands, with Rumba, Carnival, M1, and Ultima collectively representing about 60 % of this market. Carnival accounts for 87.0 % of the illicit market in Cartagena, while Rumba holds a significant position in Medellín (52.3 % of the illicit market) and Cali (37.3 % of the illicit market).

The "Others" category encompasses an additional 30 brands, highlighting the diversity within the illicit market, which features 43 distinct brands compared to only eight in the licit market. This category accounts for a significant portion (20.6 %) of illicit packs across the five cities, with high concentrations noted in Medellín (22.5 %), Cúcuta (29.7 %), and Cali (50.9 %).

The Herfindahl-Hirschman Index (HHI), a standard measure of market concentration that ranges from 0 (indicating low market concentration) to 1 (indicating a monopoly market), for licit and illicit cigarette markets by city shows a high overall concentration levels for the licit market, with HHI values exceeding 0.50 in Cúcuta and Bogotá, indicating dominance by a few brands (see Table A4 in the Appendix) (Department of Justice & Federal Trade Commision, 2010). In contrast, the illicit market is generally more fragmented, except in Cartagena, where a single brand, Carnival, accounts for the majority of the illicit market, as reflected by a notably high HHI of 0.76. The lower HHI values in the illicit markets of other cities, particularly Cúcuta (0.19) and Bogotá (0.36), highlight the greater brand diversity and reduced dominance by individual brands in these markets.

Table 3 illustrates the distribution of licit and illicit cigarette packs by city, categorised by the country of origin displayed on the pack. As mentioned before, the inclusion of the country of origin is a mandated requirement for imported licit cigarettes. As authorities authorise such imports, they verify that the information on the origin is accurate. In the case of illicit cigarettes, the reported country of origin on the pack (if

Table 1
Summary of the two-stage random sampling design.

City	Initial clusters	Excluded - Tourism / security	Merged	Final clusters	Selected clusters	Packs per cluster	Packs to collect
Bogotá	76	11	4	61	20	21	420
Medellín	64	7	2	55	16	22	352
Cali	88	13	2	73	13	17	221
Cartagena	59	3	0	56	12	16	192
Cúcuta	38	4	0	34	12	16	192
Total	**325**	**38**	**8**	279	**73**	**–**	**1377**

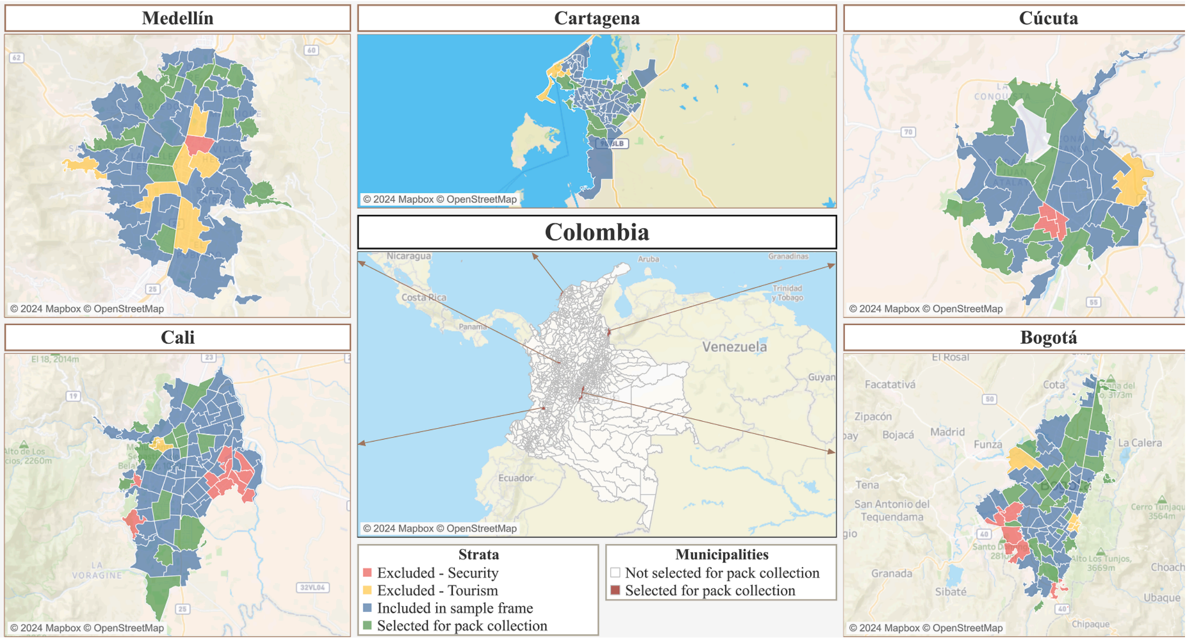

Fig. 1. Cities selected and clusters for each city.

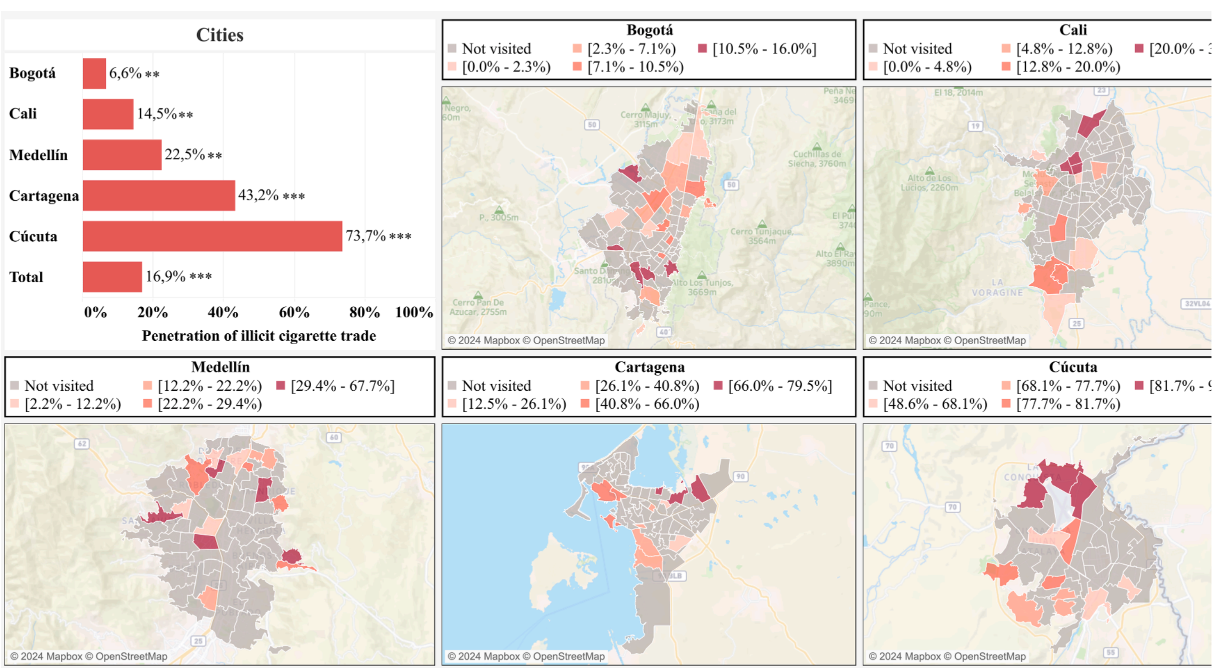

Fig. 2. Penetration of illicit cigarettes by city and clusters.

any) may not be exact, as manufacturers may choose to conceal the true origin of the cigarettes. A strong correlation exists between the country of origin and brands, particularly within the licit market. Brazil, Mexico, and Chile dominate the licit market; however, notable differences arise across cities. In Bogotá, most licit packs originated from Chile, likely due to the prevalence of the Rothmans brand. In contrast, Cali and Cartagena showed a greater share of licit packs from Mexico, reflecting the distribution of the L&M brand in these cities.

Over half (53.7 %) of the illicit packs lacked origin information. The leading illicit brand, Rumba, lists the USA as its country of origin. However, the true origin of these cigarettes still remains unclear, as this information is inconsistent with most press releases or other sources, which indicates that Paraguay or Uruguay might be their country of origin (Calvás, 2023; Las2orillas, 2025; M24, 2024; South Carolina Office of the Attorney General, 2023). Where information was available, the relationship between brand and country of origin was less consistent in the illicit market than in the licit one, as the same brand sometimes displayed a country of origin on specific packs but omitted it on others. For instance, in Cartagena, Carnival accounted for 87.0 % of the illicit market; however, only 53.6 % of the Carnival packs indicated Korea as the origin, while 39.9 % lacked any country-of-origin information. Additionally, in Cúcuta, 35.6 % of illicit packs lacked this information, likely due to the dominance of the D&J brand in the market. This brand does not have a verified country of origin. However, press releases from

Table 2
Proportion of cigarette packs by brand and city.

Brand	City					Total
	Bogotá	Medellín	Cali	Cartagena	Cúcuta	
Licit	100 %	100 %	100 %	100 %	100 %	100 %
(number of equivalent 10-stick packs)	(1168)	(733)	(436)	(379)	(260)	(2976)
Rothmans	69.0 % ***	0.4 % *	2.9 % *	14.9 % **	64.2 % ***	37.6 % ***
Starlite	–	52.8 % ***	20.4 % ***	–	–	21.2 % **
Lucky Strike	14.9 % ***	3.8 % **	20.3 % ***	30.3 % ***	33.7 % ***	11.6 % ***
L&M	7.9 % ***	12.4 % ***	25.5 % ***	33.4 % **	0.5 %	11.3 % ***
Chesterfield	0.6 % *	22.4 % ***	19.7 % **	14.4 % **	–	10.4 % **
Marlboro	7.2 % ***	8.1 % **	10.4 % **	5.2 % **	0.3 %	7.6 % ***
Piel Roja	0.4 %	–	0.4 %	1.7 %	1.3 %	0.3 %
Caribe	–	–	0.4 %	–	–	0.0 %
Ilicit	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**
(number of equivalent 10-stick packs)	**(82)**	**(235)**	**(79)**	**(311)**	**(884)**	**(1591)**
Rumba	10.4 %	52.3 % **	37.3 % *	2.7 %	10.6 % **	33.7 % **
Carnival	–	2.8 %	–	87.0 % ***	4.3 % *	8.9 % *
M1	40.0 % **	–	1.7 %	–	–	7.4 % *
Ultima	–	13.0 % *	3.4 %	–	–	7.1 % *
Gold Seal	21.5 % *	–	–	–	1.2 % *	4.1 % *
Marshal	19.3 % *	–	–	0.9 %	–	3.6 % *
Ultra Buy	–	3.9 %	6.7 %	7.5 %	2.6 % *	3.5 % *
D&J	–	–	–	–	20.5 % **	2.9 % *
Milton	–	5.5 % *	–	–	–	2.9 % *
Empire	–	–	–	–	17.3 % **	2.5 % *
Golden Lions	–	–	–	–	13.7 % **	2.0 % *
Others	8.8 %	22.5 % *	50.9 % **	2.0 %	29.7 % ***	21.5 % **

*** CV < 15 %.
** CV < 25 %.
* CV < 50 %.

Table 3
Proportion of cigarette packs by origin country (as printed on the packs) and city.

z	City					Total
	Bogotá	Medellín	Cali	Cartagena	Cúcuta	
Licit	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**
(number of equivalent 10-stick packs)	**(1168)**	**(733)**	**(436)**	**(379)**	**(260)**	**(2976)**
Brazil	18.5 % ***	47.5 % ***	28.1 % ***	24.5 % ***	37.9 % ***	30.3 % ***
Mexico	18.9 % ***	38.1 % ***	49.0 % ***	46.1 % ***	6.4 % *	28.7 % ***
Chile	44.8 % ***	1.6 % *	1.8 % *	9.1 % **	42.9 % ***	24.9 % ***
Honduras	0.6 % *	0.7 % *	0.3 %	0.3 %	0.5 %	0.6 % *
Trinidad and Tobago	0.2 %	0.1 %	1.4 %	0.4 %	2.3 % *	0.3 % *
Not observable	16.9 % ***	11.9 % **	19.3 % ***	19.7 % **	9.8 % **	15.2 % ***
Ilicit	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**	**100 %**
(number of equivalent 10-stick packs)	**(82)**	**(235)**	**(79)**	**(311)**	**(884)**	**(1591)**
USA	12.6 % *	34.3 % **	42.3 % **	5.5 % *	7.4 % **	24.6 % **
Korea	–	0.8 %	–	53.6 % ***	3.3 % *	5.1 % *
UAE	6.1 %	–	15.6 %	–	19.9 % ***	4.9 % *
Germany	10.3 %	–	–	–	15.8 % ***	4.2 % *
China	15.8 % *	–	2.2 %	–		3.0 % *
Vietnam	–	–	–	–	14.7 % **	2.1 % *
Switzerland	–	0.7 %	2.5 %	0.4 %	3.2 % *	1.0 % *
Paraguay	–	0.8 %	8.5 % *	0.4 %		0.9 %
Not observable	53.6 % **	63.4 % ***	28.9 % **	39.9 % **	35.6 % ***	53.7 % ***
Brazil	1.5 %	–	–	–		0.3 %
Mexico	–	–	–	–	0.1 %	0.0 %

*** CV < 15 %.
** CV < 25 %.
* CV < 50 %.
UAE: United Arab Emirates; USA: United States of America.

Mexico's tax administration have linked it to the United Arab Emirates (Servicio de Administración Tributaria (SAT) and Secretaría de Hacienda y Crédito Público, 2019). Appendix Table A5 displays the proportion of country of origin by brand for the full sample.

An alternative estimate was carried out by considering all packs labelled "For duty-free sales only" as licit. In this scenario, the average PICT for the five cities decreased by 2.7 percentage points, reaching 14.2 %. The results are shown in Table A6 of the appendix. This estimate was conducted due to the uncertainty surrounding these types of cigarettes. Such products could have been legally purchased and consumed at authorised points of sale, resold illegally for tax evasion purposes, or used as labels to disguise illicit products by manufacturers seeking to avoid fiscal controls. Accordingly, our main results represent an upper bound for the PICT, whereas this alternative provides a lower bound under the assumption that all such cigarettes were legally purchased.

Discussion

This study provides independent estimates of the illicit cigarette trade in Colombia for 2023, using a littered pack collection method, and finds an average penetration rate of 16.9 %. Compared to previous independent studies conducted in 2016 and 2017 based on surveys of people who smoke tobacco, which estimated illicit trade levels at 3.4 % and 6.4 %, respectively, the results presented here indicate a higher level (Maldonado, Llorente, Escobar et al., 2020; Maldonado, Llorente, Iglesias et al., 2020). In comparison to the last available measure, the cities with the highest absolute increases were Cúcuta (37.6 % to 73.7 %) and Cartagena (8.9 % to 43.2 %). Conversely, smaller increases were observed in Bogotá (from 2 % to 6.6 %), Cali (from 5.3 % to 14.5 %), and Medellín (from 8.6 % to 22.5 %).

Although the method used in this study differs from earlier studies in Colombia that relied on surveys of people who smoke tobacco, in countries where both methods were used, the results showed no statistically significant differences. For instance, in Brazil, a 2019 study in Rio de Janeiro compared these two methodologies, yielding similar estimates: 30.4 % from discarded packs and 29.1 % from surveys (Szklo et al., 2022). A study conducted in Mexico in 2017 across eight cities also found comparable overall figures—7.6 % from surveys and 8.8 % from pack collection—though some city-specific differences emerged (Saenz de Miera Juarez et al., 2021). Likewise, a 2011 study in Poland reported estimates of 14.6 % from surveys and 15.7 % from data collection (Stoklosa & Ross, 2014). Given this evidence reported in the literature, it is highly unlikely that the higher estimates for illicit trade found in this study are due to the use of a different method.

The pack collection method used here does not provide information on the socioeconomic characteristics of people who smoke tobacco or why they buy the brands (licit or not) they choose. The evolution of illicit trade has to be analysed using contextual information. As observed in other Latin American countries, the rise in illicit trade is attributed to a complex combination of factors, including border vulnerabilities, inadequate enforcement mechanisms, socio-economic conditions, porous borders, and deficiencies in tax administration (WBG Global Tobacco Control Program, 2019). For instance, studies from Brazil, Argentina and Bolivia have documented subnational disparities in illicit trade, with substantially higher levels in border regions (Arteaga et al., 2024; Pizarro et al., 2022; Szklo & Drope, 2024; Szklo et al., 2022). In line with these findings, Cúcuta, which borders Venezuela, and Cartagena, located near smuggling hubs such as La Guajira, experienced the most significant increases in illicit trade. Meanwhile, cities with stronger control and farther from borders (such as Bogotá, Cali, and Medellín) witnessed a lower illicit trade penetration and a lower growth of it.

Following the 2016 tobacco tax reform, the total tax burden initially rose from 49.5 % of the price of the most-sold brand in 2016 to 78.8 % in 2018. After that, it steadily declined, reaching 65.2 % in 2022 (last available year) (World Health Organization, 2025b). Licit tobacco prices rose above the inflation rate and even surpassed the inflation rate plus the four percentage points included in the automatic annual adjustment mechanism (after 2019). While the consumer price index (CPI, which includes tobacco) increased by 30.3 % between 2016 and 2022, the tobacco consumer price index (a component of the CPI) increased by 116 % (Banco de la República, 2025).

The evolution of the price of the most sold brand of cigarettes, net of taxes, shows two distinct stages. Between 2016 and 2018, such a price decreased by 38.8 % in nominal terms and 43.2 % in real terms, indicating a likely compression of the tobacco industry's profits caused by the initial tax increase (Banco de la República, 2025; The World Health Organization, 2025). However, between 2018 and 2022, such a price increased by 195 % in nominal terms and 143.8 % in real terms, indicating that, if the cost structure of the tobacco industry remained the same (there is no reason to believe otherwise), its profit margin rose notably. Overall, the price net of taxes increased by 38.5 % in real terms (80.5 % in nominal terms) between 2016 and 2022. This growth is not explained by the four percentage points above inflation, which the tobacco tax was automatically adjusted from 2018 onwards. It is against the most basic economic rationale to attribute the increase in tobacco illicit trade to tobacco taxes, when the tobacco tax share decreased over time and when the tobacco industry increased tobacco prices to augment their profits.

In addition to the rise in tobacco prices for reasons other than taxes, the increase in illicit trade occurred during a challenging period for Colombia, characterised by a severe economic and humanitarian crisis in Venezuela (straining border control), the COVID-19 pandemic, and prolonged social unrest in 2021 following a proposed general tax reform (unrelated to tobacco). All these factors may have resulted in a potential diversion of enforcement priorities.

The results also show different brand concentrations across cities, as measured by the HHI. A high brand concentration (ie, high HHI) may suggest the presence of organised crime networks that dominate the illicit market, while a low brand concentration (ie, low HHI) may suggest a multiplicity of actors involved in the illicit trade. While Cúcuta has the lowest HHI among the studied cities, Cartagena showed the highest HHI. These findings demonstrate the complexity of illicit trade and its regional differences that may involve different actors and different *modus operandi*.

In addition, it is important to note that this increase in illicit trade also occurred in a context where tobacco control policies have been yielding positive effects: smoking prevalence has declined from 8.3 % in 2016 to 5.7 % in 2024, indicating that the aforementioned rise in illicit trade took place within a shrinking market (Departamento Administrativo Nacional de Estadísticas (DANE), 2023b). This decline in the number of people who smoke tobacco may suggest a shift in market composition, with the decrease being more pronounced among those who consume legal (and more expensive) cigarettes. Therefore, an increase in taxation, coupled with more vigorous enforcement against illicit trade, could further advance Colombia's progress in tobacco control.

As in previous studies, this analysis finds that the extent of illicit trade is significantly lower than tobacco industry estimates, which report a national rate of 35 % (Maldonado, Llorente, Escobar et al., 2020; Maldonado, Llorente, Iglesias et al., 2020). This overestimation is also evident at the subnational level. For instance, the industry estimates illicit trade at 10 % in Bogotá, 26 % in Valle del Cauca (Cali), 74 % in Norte de Santander (Cúcuta), 40 % in Antioquia (Medellín), and 74 % in Bolívar (Cartagena) (Federación Nacional de Departamentos, 2023). Except for Cúcuta, the industry's figures are 1.5 to 2 times higher than those found in this study (Federación Nacional de Departamentos, 2023).

Policy implications

This study has numerous policy implications. First, strengthening border controls, particularly in regions like Cúcuta, should be a priority, as it must involve discussions of collaborative measures with neighbouring countries. Second, ratifying and fully implementing the Protocol to Eliminate Illicit Trade in Tobacco Products should also be a political priority. Such implementation, along with a more vigorous enforcement of the WHO Framework Convention for Tobacco Control, should eliminate the tobacco industry's interference in matters related to illicit trade. At present, the tobacco industry directly influences policies enacted by Departments, which contradicts recommended practices (World Health Organization, 2005).

Conclusions

This study reveals an illicit cigarette trade penetration of 16.9 % in Colombia. Such penetration varies significantly across the five cities, ranging from 6.6 % in Bogotá to 73.7 % in Cúcuta. These findings indicate an increase compared to previous independent studies (3.5 % in

2015 and 6.4 % in 2017) in the context of worsening conditions of prevention and enforcement due to national social unrest and political circumstances in neighbouring countries. Public policy should prioritise addressing illicit trade through collaborative efforts with neighbouring countries, adopting The Protocol to Eliminate Illicit Trade in Tobacco Products, and implementing track and trace systems. Continued independent monitoring studies are essential to provide policymakers with reliable data and counteract industry influence.

Data statement

All the data, including photographs, that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics approval

The authors declare that the work reported herein did not require ethics approval because it did not involve animal or human participation.

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CRediT authorship contribution statement

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.drugpo.2025.105032.

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