

Discrepancies in the Brazilian tobacco production chain: raw inputs, international trade and legal cigarette production

Livio Santos de Leite Ribeiro , Vilma da Conceição Pinto

Correspondence to

Livio Santos de Leite Ribeiro,
Brazilian Institute of Economics,
Getúlio Vargas Foundation, Rio
de Janeiro, Brazil;
livioribeiro@gmail.com

This paper is submitted as part
of the Economics Capacity
Building supplement organised
by Dr Frank Chaloupka.

Received 6 August 2019
Revised 21 October 2019
Accepted 28 October 2019

ABSTRACT

Background The significant market share of illicit cigarettes in Brazil is well established in the literature, nonetheless lacking clarity in terms of its actual size. Paraguay has a paramount role in this discussion, acting both as a supplier of illegal tobacco products to Brazil and as buyer of inputs from Brazil. A proper analysis of the illicit cigarette market in Brazil necessarily involves a deeper discussion of the Paraguayan production chain and its interaction with the Brazilian market.

Methods International data were used to establish the bilateral legal trade pattern of tobacco-related products between Paraguay and Brazil, including inputs and final outputs. Inspired by the technical requirements methodology, available unmanufactured tobacco within Brazil was obtained by adding-up domestic production with net imports. Its historical behaviour was compared with legal cigarette production patterns within Brazil. Supposing rational agents, these two links of the Brazilian cigarette production chain should behave similarly: for lower final usage, less domestically available supply. Any discrepancies would suggest something abnormal in the production chain.

Results Brazil is a relevant legal supplier of intermediate goods for the Paraguayan tobacco complex and has an irrelevant position as legal buyer of Paraguayan tobacco-related goods (either inputs or final goods). Paraguayan net imports of production inputs seem to be abnormally high for their legal needs. In Brazil, a clear discrepancy between domestically available unmanufactured tobacco (input) and tax-based cigarette production (output) emerged throughout the years and, even more striking, has been growing over the years.

Conclusions Excessive cigarette production inputs in Paraguay suggest a potential oversupply of cigarettes in that country—likely diverted to illicit trade. Likewise, discrepancies in the Brazilian tobacco production chain are also evidence of illicit tobacco trading in Brazil—not necessarily of final products. A deeper analysis of the Brazil/Paraguay tobacco supply chain would be welcomed given the likely operation of these two countries as a single ‘production/consumption hub’ of both legal and illegal products (either inputs or final tobacco products). Public policies should foster controls not only on cigarettes but also on raw inputs for their production.

INTRODUCTION

Illicit tobacco trade seems to be a worldwide phenomenon. According to Joossens and Raw,¹ one out of nine cigarettes smoked globally are illicit, representing a significant source of income for

criminal activities and corruption, besides representing cheaper tobacco products that are more accessible to lower income populations, infants and other vulnerable groups. On that sense, it comes with no surprise that curbing the illicit tobacco trade has become an agenda on its own with the creation of the protocol to eliminate illicit trade in tobacco products (ITP) (According to WHO-FCTC website, ‘*The new treaty aims at eliminating all forms of illicit trade in tobacco products. It provides tools for preventing illicit trade by securing the supply chain, including by establishing an international tracking and tracing system, by countering illicit trade through dissuasive law enforcement measures and a suite of measures to enable international cooperation.*’), the first protocol to the WHO Framework Convention on Tobacco Control (WHO FCTC).

Tobacco control policies implemented in Brazil have led to significant decreases in the prevalence rate and had even stronger effects in other tobacco-related variables. Over the last decade, prevalence has fallen by 5.5 percentage points, but both cigarette’s production (Source: Secretariat of Federal Revenue of Brazil (Secretaria da Receita Federal do Brasil, SRFB).) and per capita apparent consumption (Legal cigarette consumption (production + net legal imports) over population older than 18 years. For further details, please see National Cancer Institute (*Instituto Nacional de Cancer, INCA*) (2017), available at <https://bit.ly/2Lnvr74>), measured on ‘legal’ basis, were halved (Production has decreased by 49.9% and apparent consumption by 58.3%).

Estimating the size and dynamics of the illicit market is obviously a difficult task. Nonetheless, it is a centrepiece of tobacco control policy design and evaluation as illicit trade undermines the impact of taxation and increases health-related costs of tobacco consumption and jeopardises tax collection efforts. In the case of Brazil, there is mounting evidence of consumption spillover to illicit products and to a rising share of illegal cigarettes in the domestic tobacco consumption basket—a result not only relatively established in the Brazilian literature but also supported by anecdotal evidence.^{2–5}

Nonetheless, its actual size lacks clarity. Several methodologies and actors have attempted to do so in recent years, with significant shortcomings related to data issues and the Brazilian context. Results have varied widely, not only due to different methodologies and analytical preferences but also due to vested interests of the tobacco industry. Yet so, all estimates confirm that illicit market shares have been rising despite falling smoking prevalence,



© Author(s) (or their employer(s)) 2020. No commercial re-use. See rights and permissions. Published by BMJ.

To cite: Ribeiro LSdL, Pinto VdC. *Tob Control* Epub ahead of print: [please include Day Month Year]. doi:10.1136/tobaccocontrol-2019-055265

something also suggested by the decoupling between prevalence and tobacco-related tax revenues.^{4 6}

A relevant idiosyncrasy of the Brazilian illicit tobacco discussion is the importance of Paraguay, both as a supplier of final tobacco products and buyer of intermediate inputs. Best-selling brands in Brazil, such as Eight and Gift (Tobacco industry media reports by Fórum Nacional contra a Pirataria e a Ilegalidade (FNCP) stated that 2017 top selling brand in Brazil was Eight and, in certain locations such as São Paulo and Rio de Janeiro, another strong selling brand was Gift. The first brand is produced by TABESA in Paraguay, owned by former Paraguayan Ex-President Horácio Cartes.), are legally produced in Paraguay, but official trade data do not show exports to Brazil. Also, illegal cigarette seizures by the Federal Police, irrespective of the brand, are highly concentrated in fiscal areas bordering that country.

Even more interesting, Brazil is a paramount supplier of inputs for Paraguayan production of cigarettes. Above all, international trade data show that Brazil has had a significant market share of Paraguayan imports of unmanufactured tobacco and tobacco refuse throughout the years. Moreover, the volume of inputs imported by Paraguay seems to be in clear excess of their potential legal demand (domestic consumption plus accounted exports), suggesting an oversupply that means unrealistic inventories or, much more likely, production illicitly diverted elsewhere.

Therefore, a proper analysis of the illicit cigarette market in Brazil necessarily involves a deeper discussion of the Paraguayan production chain and its interaction with the Brazilian market. This is precisely the goal of this study, focusing on the discrepancies observed between raw inputs, international trade patterns (of both inputs and final products) and legal cigarette production (final output).

Besides this brief introduction, the article is organised as follows. The Scoping the actors involved in the illicit activity in Brazil section provides a scope of the actors involved in the illicit activity in Brazil, championing the Paraguayan role. The Methodology section briefly describes the methodology used to map Paraguayan tobacco-related trade flows (specifically accounting for the Brazilian role), on both inputs and outputs, at to account for the unmanufactured tobacco available in Brazil—in both cases, accounting only for legal (licit) figures.

The Results section outlines our main findings in terms of trade structure and available inputs, highlighting production chain discrepancies observed in both countries. At last, our conclusion summarises the main findings and sets the ground for their policy implications.

SCOPING THE ACTORS INVOLVED IN THE ILLICIT ACTIVITY IN BRAZIL

This article understands Illicit trade as ‘any practice or conduct prohibited by law and which relates to production, shipment, receipt, possession, distribution, sale or purchase, including any practice or conduct intended to facilitate such activity’.⁷ That said, it is worth highlighting the structure through which illegal trading is organised in Brazil. Pinpointing the actors involved and their behaviour should foster the understating of the growing scale of smuggling operations, their relationship with organised crime and the social impact of such activities.

Smuggling activities have been changing and evolving. Iglesias described a pattern, common in the 1990s, through which exported Brazilian cigarettes returned (illegally) to the country.⁸ After the adoption of a 150% export tax on Brazilian cigarettes, this pattern changed, diverting production to the neighbouring countries, especially to Paraguay.^{9 10}

According to Biz,³ Paraguayan and Uruguayan factories went from 5 to 47 between 1993 and 2000, a growth explained not only by the gap left by Brazilian exports but also by the great demand of illegal distributors. Neumann noted that the registered tobacco companies in Paraguay exploded from 3 to 33 between 1993 and 2004 (a 900% growth). Ramos estimated that the value-added by Paraguayan installed capacity in 2004 would be about 13 times the ‘official’ value-added estimated in Paraguayan National Accounts.¹¹

In Brazil, illicit trade is facilitated by the large international land-border, with poor surveillance and scarce infrastructure: controls are made by random sampling.¹² Brazil borders ten countries, distributed within 11 states of the federation. According to tobacco-industry reports, all these regions are potential backdoors for smuggling, Paraguayan borders are clearly the busiest, given the apparent ease that smugglers face to acquire products in that country.⁶

From border to inner-Brazil, there is a *plethora* of actors involved. According to Joossens *et al* and WHO,^{13 14} although high levels of taxation may provide the initial incentive for smuggling—as they create huge differences of relative prices between regions—other factors also play a role, including how well criminal networks are organised.

For Brazil, an overview of the actors involved was provided by Instituto de Desenvolvimento Econômico e Social de Fronteiras (IDESF), conducting field interviews both at the border (Ciudad del Este/ Foz do Iguaçu) and at one of the potential final destinations (São Paulo) for smuggled goods. Among other things, it shows that the very high profitability of the illicit trade activity could be explained, besides tax evasion, by the high degree of human labour exploitation (Noteworthy is that IDESF research was funded by the tobacco industry. Its results should be interpreted with caution. Nonetheless, there are no other available reports or articles that give a broad picture of the actors involved in the illicit trade activity in Brazil.)^{6 14} Yet accounting for the potential bias of tobacco-industry reports, it suggests that tobacco smuggling is a far-reaching activity: 15 000 people were directly involved in the smuggling network just in the Foz do Iguaçu region and ‘illegality-hubs’ had importance as regional wealth generator, fostering local economies’ dependency of illegal activities.

Lastly, consumers are the closing linkage of the illegal chain. Illicit trade makes tobacco products cheaper and more accessible, especially for low-income classes, youth and even children. Not surprisingly, these are the usual targets of tobacco smugglers.¹⁴ The main actors involved could be summarised below (figure 1).

METHODOLOGY

As noted by Merriman,¹⁵ international trade statistics contain a substantial amount of information about global legal flows of tobacco-related products. These data could be used as a way to gauge illicit tobacco trade, both in its simple form (just cross-checking reported trade flows between two certain countries) or in more sophisticated (on which foreign trade data are used as part of the construction of total supply and demand series) ones.

In theory, exports from ‘A’ to ‘B’ should match imports of B to A. In practice, differences emerge due to reasons that go far beyond illicit trading: different accounting methods, mishaps when reporting or fiscal benefits that could bias trade flows. These jitters in bilateral trade appear in the Brazil versus Paraguay tobacco flows in a rather remarkable way: Paraguayan brands are easily found in Brazil and apparently have a relevant market share, yet there are no accounted cigarette imports from Paraguay ever since 2002 (figure 2).

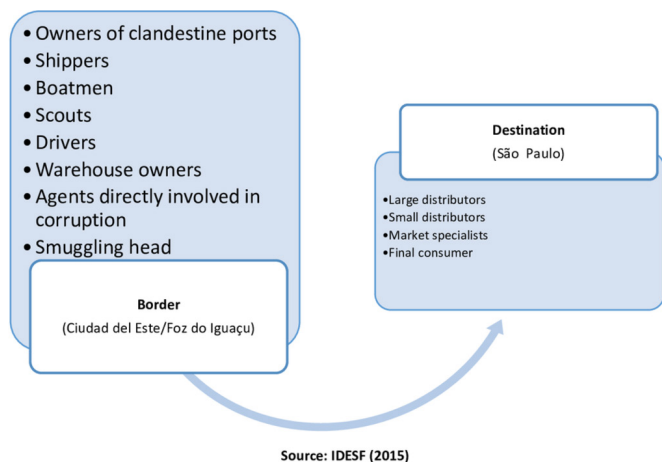


Figure 1 Smuggling actors—border x destination.

Despite their limitations (As in any source of information, trade statistics are subject to mistakes and omissions. According to the World Bank, discrepancies between official export and import data derive from: (1) imports are usually recorded CIF (cost, insurance and freight) whereas exports are FOB (free on board)—implying differences of as much as 20% in values; (2) data quality may vary across countries; (3) imports are usually recorded with greater accuracy because they are taxed; and (4) there are methodological issues that would imply on the same good being classified differently by exporters and importers.),¹⁶ trade statistics can still be used to analyse tobacco supply chain integration. In fact, a proper analysis should go much deeper than simply scoping cigarette trade between Brazil and Paraguay, which is clearly dubious.

According to National Research Council and Institute of Medicine,¹⁷ there are very specific raw materials required to produce cigarettes, whether they are legal or illegal. Key inputs go further beyond tobacco and include certain types of paper and chemicals applied to filters, which are unique and trackable through their international trade codes.

At first, tobacco-related trade linkages between Paraguay and Brazil were mapped using COMTRADE (a harmonised international database provided by the United Nations) in order to enhance replicability and comparability (Discrepancies between international and domestic datasets were minor over the last decade, yet grew for older data in certain specific goods. Even

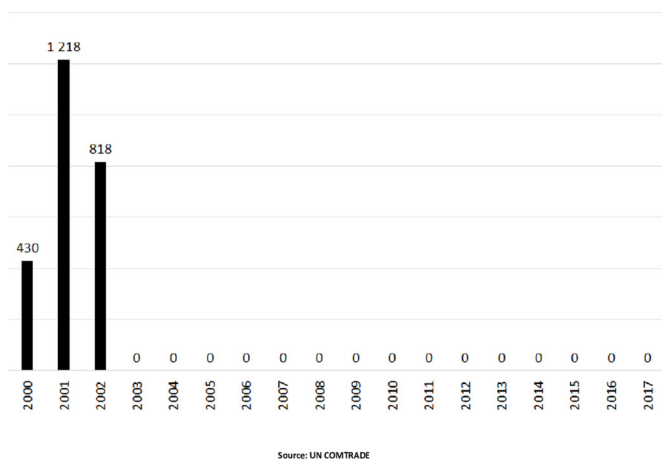


Figure 2 Paraguayan legal exports of cigarettes to Brazil (2000–2017, ton).

so, international databases are easier to manipulate and are readily available, therefore being championed as data sources.). Datasets comprised annual figures from 2000 to 2017, and cover both inputs and outputs:

1. Tobacco and tobacco products: HS/NCM Harmonized System / Nomenclatura Comum do Mercosul(HS/NCM) heading 24 (*tobacco and manufactured tobacco substitutes*), comprising both final products and industrial inputs. Paraguayan trade is tracked by four-digit codes 24.01 (*tobacco, unmanufactured; tobacco refuse*), 24.02 (*cigars, cheroots, cigarillos and cigarettes; of tobacco or of tobacco substitutes*) and 24.03 (*manufactured tobacco and manufactured tobacco substitutes*). 24.02 is opened in two further categories, six-digit code 24.02.20 (*cigarettes; containing tobacco*) and a residual that accounts for other final tobacco products within code 24.02 that are not cigarettes
2. Cigarette filters: HS/NCM four-digit code 55.02 (*artificial filament tow*), split into six-digit codes 55.02.00 (*fibres; artificial filament row of cellulose acetate*) and 55.02.90 (*fibres; artificial filament row other than cellulose acetate*)
3. (iii) Cigarette papers: HS/NCM four-digit code 48.13 (*cigarette paper*), further split in six-digit codes 48.13.10 (*paper; cigarette; in the form of booklets or tubes*), 48.13.20 (*paper; cigarette; in rolls of a width not exceeding 5 cm*) and 48.13.90 (*paper; cigarette; other than in rolls of a width not exceeding 5 cm or in booklets or tubes*).

Given anecdotal roles of Paraguay as a supplier of final tobacco products and of Brazil as an input supplier for the Paraguayan production, datasets were constructed from the Paraguayan perspective—that is, exports and imports from that country to/from partners. Any clear biases on international trade between the two countries would suggest suspicious linkages within the (joint) production chain.

Going beyond the international trade itself, and focusing on raw tobacco as an input, the technical requirements literature (Such as in Biz and ACT.²³ Albeit being simple and replicable, the technical requirements approach has results that are very sensitive to the chosen data and ad hoc hypothesis. Nonetheless, it provides a useful guide to tackle the illicit market debate by underpinning the importance of each link of the tobacco industrial transformation chain, from raw materials to the final tobacco vessel (usually cigarettes).) inspired the construction of the available (legal) unmanufactured tobacco statistic in Brazil, by simply adding-up (legal) domestic production and (legal) net imports. External trade came from COMTRADE (COMTRADE was used to enhance international comparability. The same information is available in Brazilian external trade systems such as SISCOMEX.), while domestic production of raw tobacco came from regional (South Region) data from the *Levantamento Sistemático da Produção Agrícola* (LSPA) agricultural survey by *Instituto Brasileiro de Geografia e Estatística* (IBGE).

These figures were compared with yearly cigarette production figures that came from the Secretariat of Federal Revenue (*Secretaria da Receita Federal do Brasil*, SRFB) database. Obviously, SRFB number relate to tax-based cigarette production. As legal cigarette production has been trending downwards in Brazil, available legal raw tobacco within the country should behave on a similar fashion—any discrepancies would suggest, once again, something abnormal happening in the production chain.

RESULTS

Brazil is a relevant supplier of intermediate goods for the Paraguayan tobacco complex and has an irrelevant position as demander of Paraguayan tobacco-related goods (either inputs or final goods). Obviously, that accounts only for legal trade—the clearest absence is of cigarette exports to Brazil, but most likely other effective trade flows (in both exports and imports) are also missing.

In terms of tobacco and tobacco products, table 1 summarises the Paraguayan trade. On global flows (ie, Paraguayan trade with the world), it is clear that the pattern is unbalanced, with imports consistently bigger than exports. That happens especially in the HS/NCM heading 24.01, which accounts for raw materials.

The same pattern is observable in flows with Brazil, especially in raw materials. Noteworthy is that there are no recorded exports of finished tobacco goods under heading 24.02, in spite of the significant presence of Paraguayan cigarettes in our country (In late 2018, the Paraguayan government has said it would ratify the FCTC protocol on illicit trade, aiming several measures to curb that activity. The implied measures, whenever signed, ratified and put in practice, would have the strength to potential change the landscape of illicit cigarette between Paraguay and Brazil, especially those legally produced cigarettes in Paraguay that are smuggled into our country. Likewise, tobacco-related trade patterns would also, and most likely, be affected by FCTC implementation.). More recently, exports of manufactured tobacco have been rising, yet still representing a small share of trade flows.

Inconsistencies in the tobacco trade between Brazil and Paraguay are not limited to raw tobacco and final products. The most usual type of cigarette filter is made of a pulp-based fibre called cellulose acetate. Despite being an input of several other products (Such as highlighters, pens, markers oil filters and medical devices. According to National Research Council and Institute of Medicine,¹⁷ >80% of global production of acetate tow is reportedly used in the manufacture of all cigarettes. Furthermore, several research reports as Neumann and Joossens *et al*,¹⁸ find that acetate tow is largely oversupplied (given accounted legal demand), suggesting diversion to illicit (cigarette) manufacturers in huge amounts.), its primary use is as an input of cigarette filters on its transformed form of acetate filament tow¹⁸—obtained using a very sophisticated industrial process only mastered by a handful of global companies organised under GAMA (Global Acetate Manufacturers Association) (Celanese Corporation (USA), Eastman Chemical Company (USA), Rhodia Acetow (Germany), Daicel Corporation (Japan), Mitsubishi Chemical Corporation (Japan) and Sichuan Push Acetate Co (China).).

Paraguayan external trade of the 55.02 heading is presented in table 2. As in the case of raw tobacco, global flows show an unbalanced trade pattern, with irrelevant exports and huge imports. The Brazilian role is once again significant, although not as much as with tobacco and tobacco products.

Finally, National Research Council and Institute of Medicine¹⁷ indicates that papers used in the production of individual cigarettes are highly specialised goods, designed to control factors such as density, porosity and burn rate of cigarettes. As it happened with cellulose tow, just a few global companies are able to produce and supply this input to cigarette manufacture. Unlike cellulose tow, however, cigarette-related papers are more easily replaceable, what tends to happen in counterfeit products at the expense of quality.

Paraguayan external trade of such goods, clustered in the digit heading 48.13, is presented in table 3. As previously, global flows

show significant trade deficits throughout the years. Brazilian trade shares are once again significant, on this turn not only on the imports side but also on the export side. As the latter is almost irrelevant, cigarette paper flows are another piece of information that suggests Brazilian preeminence as supplier of the Paraguayan production complex.

Brazil's importance goes beyond absolute numbers: the country is ranked as one the biggest suppliers throughout the sample. Table 4 summarises Brazil's rank in Paraguayan imports for each of the major cigarette components (tobacco, filter and paper) discussed previously.

Furthermore, Paraguayan net imports of each one of the intermediate goods seem to be abnormally high. Supposing (1) Paraguayan production technology comparable to global standards; (2) no excessive domestic consumption of cigarettes; (3) no inventory build-up (on average); and using reported legal trade flows, then Paraguayan input patterns strongly suggest an oversupply of cigarettes in that country—implied cigarette production would be much higher than their legal needs (domestic consumption (There are no official data on Paraguayan domestic consumption of cigarettes. An estimate is suggested by Ng *et al*: for the period 2000–2017, Paraguayan total consumption is estimated to be, on average, of 4 billion sticks/year, rising at the end of the sample to around 5 billion sticks/year.)+legal exports).¹⁹

There is also evidence of misbehaviour that comes from the comparison of (legal) unmanufactured tobacco available and the (legal) production of cigarettes within Brazil. Given that legal production has been trending downwards, then available raw tobacco should behave on a similar fashion supposing rational farmers/producers: for lower final usage, less domestically available supply.

Figure 3 shows precisely the opposite. There is a clear discrepancy between domestically available inputs and final outputs trends in Brazil. Even more, their difference has been growing over the years, with increasing available inputs and decreasing final output.

The two most basic links of the Brazilian tobacco production chain are at odds. Either unrealistic inventories built-up, or something else is happening. Without running any technical requirement simulations, these numbers suggest an excessive amount of inputs given final legal needs in Brazil, supporting findings of Biz and ACT.²³ Furthermore, the growing difference between these two series is also a soft evidence of the increasing share of illicit cigarettes in our country—in a very indirect way, also confirming the broad trends shown by Iglesias *et al* and Szklo *et al*.⁴⁵

CONCLUSIONS AND POLICY IMPLICATIONS

International trade statistics were used to map Paraguayan cigarette-related trade flows, comprising not only final outputs but also production inputs. There is a clear oversupply of inputs flooding into that country, suggesting excessive cigarette production given their needs (domestic legal consumption plus legal exports)—likely diverted to illicit trade.

Brazil has a decisive role on Paraguayan production chain, being a relevant (and usually top) supplier of inputs such as unmanufactured tobacco, acetate tow for cigarette filters and specific cigarette papers. Legal trade is highly biased, unbalanced and incomplete: in spite of the evident availability of Paraguayan brands in the Brazilian market, legal exports of cigarettes from Paraguay to Brazil are inexistent since 2002.

Discrepancies in the Brazilian tobacco production chain are also evident. The upward pattern of available unmanufactured

Table 1 Paraguayan trade balance—tobacco and tobacco products (kilograms)

	2000		2005		2010		2015		2016		2017	
	Exports (to)	Imports (from)	Exports (to)	Imports (from)	Exports (to)	Imports (from)	Exports (to)	Imports (from)	Exports (to)	Imports (from)	Exports (to)	Imports (from)
Paraguay=>World												
Tobacco and manufactured tobacco substitutes	6 114 076	31 939 151	4 621 502	37 730 276	9 875 706	51 871 581	9 064 631	41 013 038	9 746 186	41 140 788	8 696 734	43 612 122
Tobacco, unmanufactured tobacco refuse	2 352 063	15 007 455	3 212 786	32 746 597	4 831 698	45 956 263	6 658 700	34 966 247	7 044 215	35 339 371	5 680 970	38 478 837
Cigars, cheroots, cigarillos and cigarettes of tobacco or of tobacco substitutes	3 752 013	10 368 624	1 252 911	3 204 945	3 988 310	2 779 108	2 302 521	2 863 531	2 294 409	2 577 315	2 340 818	2 563 224
Cigarettes, containing tobacco	3 739 960	10 320 961	1 250 165	3 199 533	3 963 942	2 772 965	2 231 697	2 859 157	2 294 409	2 552 340	2 340 818	2 552 925
Others	12 053	47 663	2 746	5412	24 368	6143	70 824	4374	0	24 975	0	10 299
Manufactured tobacco and manufactured tobacco substitutes n.e.c.; homogenised or reconstituted tobacco; tobacco extracts and essences	10 000	6 563 072	155 805	1 778 734	1 055 698	3 136 210	103 410	3 183 260	407 562	3 224 102	674 946	2 570 061
Paraguay=>Brazil												
Tobacco and manufactured tobacco substitutes	471 963	11 731 312	228 944	1 077 519	672 066	15 922 021	22 825	16 081 140	293 496	16 039 730	450 068	14 183 251
Tobacco, unmanufactured tobacco refuse	41 410	6 727 911	228 944	862 345	672 066	15 489 520	9600	15 984 210	56 485	15 510 730	17 800	14 177 000
Cigars, cheroots, cigarillos and cigarettes of tobacco or of tobacco substitutes	430 553	73 331	0	0	0	0	0	0	0	0	0	5051
Cigarettes, containing tobacco	430 400	45 041	0	0	0	0	0	0	0	0	0	5051
Others	153	28 290	0	0	0	0	0	0	0	0	0	0
Manufactured tobacco and manufactured tobacco substitutes n.e.c.; homogenised or reconstituted tobacco; tobacco extracts and essences	0	4 930 070	0	215 174	0	432 501	13 225	96 930	237 011	529 000	432 268	1200
Brazilian share on Paraguayan trade (%)												
Tobacco and manufactured tobacco substitutes	7.7%	36.7%	5.0%	2.9%	6.8%	30.7%	0.3%	39.2%	3.0%	39.0%	5.2%	32.5%
Tobacco, unmanufactured tobacco refuse	1.8%	44.8%	7.1%	2.6%	13.9%	33.7%	0.1%	45.7%	0.8%	43.9%	0.3%	36.8%
Cigars, cheroots, cigarillos and cigarettes of tobacco or of tobacco substitutes	11.5%	0.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Cigarettes, containing tobacco	11.5%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
Others	1.3%	59.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Manufactured tobacco and manufactured tobacco substitutes n.e.c.; homogenised or reconstituted tobacco; tobacco extracts and essences	0.0%	75.1%	0.0%	12.1%	0.0%	13.8%	12.8%	3.0%	58.2%	16.4%	64.0%	0.0%

Source: UN COMTRADE.
 Plain text indicates specific goods.
 Bold text indicates sub-groups.
 Bold and underlined text indicates product groups.

Table 2 Paraguayan trade balance—artificial filament tow (kilograms)

	2000		2005		2010		2015		2016		2017	
	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports
Paraguay=>World												
Artificial filament tow	<u>0</u>	<u>1 133 163</u>	<u>0</u>	<u>5 298 114</u>	<u>9958</u>	<u>6 319 557</u>	<u>17 465</u>	<u>6 319 557</u>	<u>1798</u>	<u>6 723 923</u>	<u>2517</u>	<u>7 192 075</u>
Fibres; artificial filament tow	0	1 133 163	0	5 298 114	9958	6 319 557	17 465	6 319 557	1798	6 723 923	0	0
Fibres; artificial filament tow of cellulose acetate	0	0	0	0	0	0	0	0	0	0	0	0
Fibres; artificial filament tow other than cellulose acetate	0	0	0	0	0	0	0	0	0	0	0	96
Paraguay=>Brazil												
Artificial filament tow	<u>0</u>	<u>10 697</u>	<u>0</u>	<u>1 098 469</u>	<u>9958</u>	<u>1 831 980</u>	<u>0</u>	<u>1 831 980</u>	<u>0</u>	<u>2 061 910</u>	<u>2517</u>	<u>1 844 870</u>
Fibres; artificial filament tow	0	10 697	0	1 098 469	9958	1 831 980	0	1 831 980	0	2 061 910	0	0
Fibres; artificial filament tow of cellulose acetate	0	0	0	0	0	0	0	0	0	0	0	2517
Fibres; artificial filament tow other than cellulose acetate	0	0	0	0	0	0	0	0	0	0	0	0
Brazilian share (%)												
Artificial filament tow	–	0.9%	–	20.7%	100.0%	29.0%	0.0%	29.0%	0.0%	30.7%	100.0%	25.7%
Fibres; artificial filament tow	–	0.9%	–	20.7%	100.0%	29.0%	0.0%	29.0%	0.0%	30.7%	–	–
Fibres; artificial filament tow of cellulose acetate	–	–	–	–	–	–	–	–	–	–	100.0%	25.7%
Fibres; artificial filament tow other than cellulose acetate	–	–	–	–	–	–	–	–	–	–	–	0.0%

Source: UN COMTRADE.

Plain text indicates specific goods.

Bold text indicates sub-groups.

Bold and underline text indicates product groups.

Table 3 Paraguayan trade balance—cigarette paper (kilograms)

	2000		2005		2010		2015		2016		2017	
	Exports (to)	Imports (from)	Exports (to)	Imports (from)	Exports (to)	Imports (from)	Exports (to)	Imports (from)	Exports (to)	Imports (from)	Exports (to)	Imports (from)
Paraguay=>World												
Cigarette paper	5327	1 966 410	297 463	3 880 975	14 709	5 391 487	13 048	5 388 922	9881	4 789 747	15 855	6 095 391
Paper, cigarette in the form of booklets or tubes	0	0	0	0	0	1173	0	2271	0	2221	0	5706
Paper, cigarette in rolls of a width not exceeding 5 cm	5327	1 331 418	295 168	3 017 783	13 969	3 759 861	12 050	3 650 737	3531	3 265 027	15 855	4 238 471
Paper, cigarette (other than in rolls of a width not exceeding 5 cm or in booklets or tubes)	0	634 992	2295	863 192	740	1 630 453	998	1 735 914	6350	1 522 499	0	1 851 214
Paraguay=<Brazil												
Cigarette paper	0	749 098	295 168	94 995	13 912	1 301 050	12 050	1 321 639	3360	1 478 351	15 074	2 394 416
Paper, cigarette in the form of booklets or tubes	0	0	0	0	0	0	0	0	0	0	0	0
Paper, cigarette in rolls of a width not exceeding 5 cm	0	511 113	295 168	94 995	13 912	910 319	12 050	962 468	3360	1 127 330	15 074	1 807 630
Paper, cigarette (other than in rolls of a width not exceeding 5 cm or in booklets or tubes)	0	237 985	0	0	0	390 731	0	359 171	0	351 021	0	586 786
Brazilian share on Paraguayan trade (%)												
Cigarette paper	0.0%	38.1%	99.2%	2.4%	94.6%	24.1%	92.4%	24.5%	34.0%	30.9%	95.1%	39.3%
Paper, cigarette in the form of booklets or tubes	-	-	-	-	-	0.0%	-	0.0%	-	0.0%	-	0.0%
Paper, cigarette in rolls of a width not exceeding 5 cm	0.0%	38.4%	100.0%	3.1%	99.6%	24.2%	100.0%	26.4%	95.2%	34.5%	95.1%	42.6%
Paper, cigarette (other than in rolls of a width not exceeding 5 cm or in booklets or tubes)	-	37.5%	0.0%	0.0%	0.0%	24.0%	0.0%	20.7%	0.0%	23.1%	-	31.7%

Source: UN COMTRADE.

Plain text indicates specific goods.

Bold text indicates sub-groups.

Bold and underline text indicates product groups.

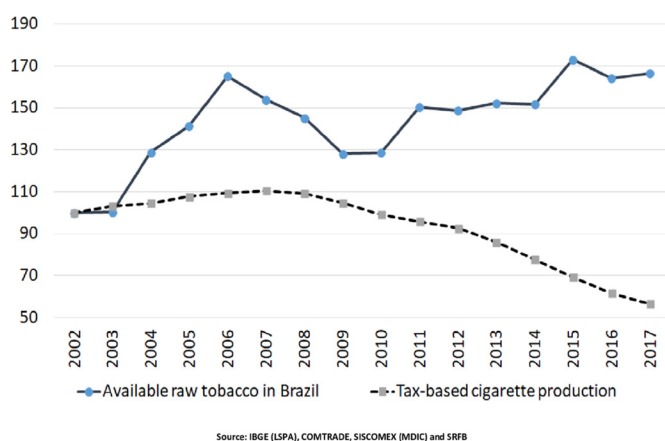
Table 4 Brazilian ranking within Paraguayan imports (2000–2017)

	2000	2005	2010	2015	2016	2017
Tobacco and tobacco products	1st	7th	1st	1st	1st	2nd
Cigarette filter	4th	2nd	2nd	2nd	2nd	2nd
Cigarette paper	2nd	8th	2nd	2nd	2nd	1st

Source: UN COMTRADE.

tobacco within the country (ie, production plus net imports) does not reconcile with the declining trend observed in legal cigarette production. Recurrent inventory build-up would be a solution to this puzzle, yet amounts would have to be huge (and increasing) and producer's behaviour far from rational. The most likely way to reconcile these trends is through illicit tobacco trading—and not only of final products.

Researchers usually focus solely on illicit cigarette trading, but something else could be (also) happening: it is likely that the total input available in Brazil is not the actual input available for our legal domestic cigarette production.



Source: IBGE (LSPA), COMTRADE, SISCOMEX (MDIC) and SRFB

Figure 3 Input versus output trends in Brazil (av 3Y, 2012=100).

What this paper adds

- ▶ International trade data show that Brazil is a relevant legal supplier of intermediate goods for the Paraguayan tobacco complex and has an irrelevant position as legal buyer of Paraguayan tobacco-related goods (either inputs or final goods).
- ▶ Paraguayan net imports of production inputs seem to be abnormally high for their legal needs, suggesting a potential oversupply of cigarettes in that country—likely diverted to illicit trade.
- ▶ Over the last decade, there is a growing discrepancy between domestically available unmanufactured tobacco and tax-based cigarette production in Brazil, an evidence of illicit tobacco trading in Brazil—not necessarily of final products.
- ▶ A proper analysis of the illicit cigarette market in Brazil necessarily involves a deeper discussion of the Paraguayan production chain and its interaction with the Brazilian market.
- ▶ A deeper analysis of the Brazil/Paraguay tobacco supply chain would be welcomed given the likely operation of these two countries as a single 'production/consumption hub' of both legal and illegal tobacco products.

In the one hand, the international trade analysis strongly supports Brazil's role as supplier to Paraguay, with interconnected tobacco production chains between the two countries. As Brazil is not known as a net exporter of illicit cigarettes (quite the opposite), trade diversion could be happening in raw materials—that is, available inputs in Brazil could be smaller than legal figures suggest. On the other hand, anecdotal evidence also suggests that illicit production has been growing in Brazil—especially fakes of best-selling brands, ironically including the (illegally imported) Paraguayan brands (O Estado de São Paulo (5 November 2015): 'PF e Receita descobrem sonegação de R\$ 2,3bi no mercado de cigarros'. Available at <https://politica.estadao.com.br/blogs/fausto-macedo/pf-e-receita-descobrem-sonegacao-de-r-23-bi-no-mercado-de-cigarros/>). On that sense, raw tobacco diversion could be happening within our country, in a cigarette-production chain that runs in-border and almost entirely in the shadows.

The stylised facts presented of this paper suggest a deeper analysis of the Brazil/Paraguay tobacco supply chain. Something challenging, but also welcomed given the likely operation of these two countries as a single 'production/consumption hub' of both legal and illegal products (either inputs or final tobacco products).

On that sense, public policies should foster controls not only on cigarettes but also on raw inputs, both on their production sites and on cross-border trade. Policy implications would be the following:

1. *Foster controls and independent potential supply estimates in Brazil:* crosscheck IBGE surveys in order to confirm raw tobacco production figures and create ways to evaluate potential production by other inputs than tobacco leaves.
2. *Focus on the cellulose acetate tow supply in Brazil:* create track and tracing mechanisms on acetate tow, expanding SRFB SCORPIOS system to cigarette inputs. Acetate tow is particularly interesting because just a handful of companies dominate its global supply.
3. *Impose a 'track and tracing tax' on each link of the cigarette production chain:* a small tax rate levied in every step of the production chain would help tracing flows from raw input producers to final tobacco products.
4. *Increase border surveillance:* besides focusing on inbound illicit cigarette flows, Federal Police operations should also focus on outbound illicit raw inputs flows.
5. *Enhance the understanding of the Paraguay/Brazil cigarette production chain:* trace the actors involved, scope bilateral flows of inputs and outputs and confirm potential changes on Brazilian illicit production structure with the emergence of actors specialised in 'fakes' of best-selling brands that run their production chains almost entirely 'in the shadows'.

Acknowledgements The authors would like to thank for the comments of Frank Chaloupka, German Iglesias, Roberto Iglesias, Cecilia Alemany, Oscar Cetrangolo, Pedro Velasco and Fernando Lorenzo, as well to all the participants of the seminars held in Montevideo (Uruguay) and Guayaquil (Ecuador). The authors are grateful

for the amazing research assistance by Juliana Damasceno de Souza. The remaining errors are of our entire responsibility.

Funding This paper is funded by the University of Illinois at Chicago's Institute for Health Research and Policy through its partnership with Bloomberg Philanthropies.

Competing interests None declared.

Patient consent for publication Not required.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository.

ORCID iD

Livio Santos de Leite Ribeiro <http://orcid.org/0000-0002-3413-5697>

REFERENCES

- Joossens L, Raw M. From cigarette smuggling to illicit tobacco trade. *Tob Control* 2012;21:230–4.
- Aliança de Controle do Tabagismo (ACT). Mercado ilegal de cigarros no Brasil: Aproximações através da estimativa do saldo de tabaco [Internet]., 2012. Available: 747_mercado_ilegal_estimativasaldodetabaco_factsheet.pdf [Accessed 05 Sept 2018].
- Biz AN. O comércio ilícito de cigarros no Brasil: uma análise. [Internet], 2010. Available: http://www.econ.puc-rio.br/uploads/adm/trabalhos/files/Aline_Navega_Biz.pdf [Accessed 02 Aug 2019].
- Iglesias RM, Szklo AS, Souza MCde, *et al.* Estimating the size of illicit tobacco consumption in Brazil: findings from the global adult tobacco survey. *Tob Control* 2017;26:53–9.
- Szklo A, Iglesias RM, Carvalho de Souza M, *et al.* Trends in illicit cigarette use in Brazil estimated from legal sales, 2012–2016. *Am J Public Health* 2018;108:265–9.
- Instituto de Desenvolvimento Econômico e Social de Fronteiras (IDESF). O custo do Contrabando [Internet], 2015. Available: <http://www.idesf.org.br/wp-content/uploads/2015/03/O-custo-do-contrabando-1.pdf> [Accessed 02 Sept 2019].
- Family Smoking Prevention and Tobacco Control Act. Public Law 111–31 [Senate and House of Representatives of the USA]., 2009. Available: <https://www.govinfo.gov/content/pkg/PLAW-111publ31/pdf/PLAW-111publ31.pdf> [Accessed 19 Sept 2018].
- Iglesias RM. A economia do controle do tabaco nos países do Mercosul e associados: Brasil. [Internet], 2006. Available: <http://sms.sp.bvs.br/lidbi/docsonline/get.php?id=3236> [Accessed 02 Aug 2019].
- Iglesias RM, Gomis B, Carrillo Botero N, *et al.* From transit hub to major supplier of illicit cigarettes to Argentina and Brazil: the changing role of domestic production and transnational tobacco companies in Paraguay between 1960 and 2003. *Global Health* 2018;14.
- Gomis B, Lee K, Carrillo Botero N, *et al.* “We think globally”: the rise of Paraguay’s Tabacalera del Este as a threat to global tobacco control. *Global Health* 2018;14.
- Ramos A. Illegal trade in tobacco in MERCOSUR countries. *Trends Organ Crim* 2009;12:267.
- Carneiro Filho CP. Tríplice fronteira Brasil-Argentina-Paraguai: transfronteirização através do crime. *Relações Internacionais no Mundo Atual* 2012;84–101.
- Joossens L, Chaloupka FJ, Merriman D. Issues in the smuggling of tobacco products. In: Jha P, Chaloupka FJ, eds. *Tobacco control policies in developing countries*. Oxford: Oxford University Press, 2000: 393–406.
- World Health Organization (WHO). *Raising taxes on tobacco. WHO report on the global tobacco epidemic*. WHO, Tobacco Free Initiative (TFI), 2015. ISBN: ISBN: 978 92 4 150912 1.
- Merriman D. Understand, Measure, and Combat Tobacco Smuggling [Internet]. Washington DC, 2002. Available: <http://documents.worldbank.org/curated/pt/418961468163740317/pdf/805800NWP070Sm0Box0379807B00PUBLIC0.pdf> [Accessed cited 2018 September 05].
- WITS WB. Imports, Exports and Mirror Data with UN COMTRADE. [Online], 2010. Available: https://wits.worldbank.org/wits/wits/witshelp/Content/Data_Retrieval/Intro/B2.Imports_Exports_and_Mirror.htm [Accessed 27 Sept 2019].
- National Research Council and Institute of Medicine Reuter P, Majmundar M, eds. *Understanding the U.S. illicit tobacco market: characteristics, policy context, and lessons from international experiences. Committee on the illicit tobacco market: collection and analysis of the International experience*. Washington, D.C.: The National Academies Press, 2015.
- Neumann V. Towing the Line: Controlling Key Inputs to Disrupt Illegal Tobacco. [Internet], 2014. Available: <http://www.macdonaldlaurier.ca/files/pdf/Appendix%20F%20-%20Neumann%20Presentation.pdf> [Accessed 28 Aug 2018].
- Ng M, Freeman MK, Fleming TD, *et al.* Smoking prevalence and cigarette consumption in 187 countries, 1980–2012. *JAMA* 2014;311:183–92.