No smoking gun: tobacco taxation and smuggling in Sierra Leone

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ABSTRACT

Objective To evaluate the common industry claim that higher tobacco taxation leads to higher levels of smuggling, particularly in a limited state capacity setting.
Design This paper evaluates the effects of a tobacco tax increase in Sierra Leone on smuggling by using gap analyses. Its models are based on multiple rounds of the Demographic and Health Survey and customs data as well as newly collected data on cigarette prices.
Results The paper shows that despite a substantial increase in cigarette taxation, and despite the absence of other formal tobacco control policies, smuggling has not increased in Sierra Leone. Its primary model shows a decrease in cigarette smuggling by 16.74% following the tax increase, alongside a decrease in cigarette consumption more widely and an increase in tax revenue.
Conclusions By presenting a low income and lower enforcement capacity case study, this paper provides novel and critical evidence to the debate on the tax-smuggling link. Furthermore, it points to new questions on how states in these contexts can limit cigarette smuggling.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The claim that higher tobacco taxation leads to higher levels of smuggling, undermining tobacco control objectives, is a central part of tobacco industry discourse.
⇒ This claim however has been subject to increasing empirical criticism in recent years, frequently highlighting that tobacco control policies can de-link taxation and smuggling.

WHAT THIS STUDY ADDS

⇒ Due to methodological challenges in studying the relationship between smuggling and tax, there is a relative scarcity of good case studies.
⇒ Critically, the empirical evidence base on this topic is limited in countries with lower state capacity, particularly in low-income countries and Africa.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE AND/OR POLICY

⇒ This study expands the evidence base on the relationship between taxation and smuggling by providing an ideally positioned case study, new data and a result that further contributes to the rejection of the long-standing tobacco industry hypothesis that higher taxes lead to increased smuggling.
⇒ Furthermore, this study suggests that higher tobacco taxation can also be an effective tool to decrease tobacco consumption and increase revenue in a lower state capacity context.

INTRODUCTION

The early 21st century has seen a marked increase in tobacco control discussions on the African continent. While traditionally smoking has been less prevalent in Africa than in Europe or North America, smoking levels in Africa have increased substantially in recent years as they dropped in the global North.[1] This has created a critical policy window for African governments to reduce public health damages in coming decades.[2] Among tobacco control strategies, taxation is usually presented as the single most effective policy tool to decrease smoking and fund public health responses. Tobacco taxation is also frequently pointed to as a particularly effective strategy for low-income and middle-income countries as it is comparatively cheap to implement.[3] Article 6 of the WHO Framework Convention on Tobacco Control (FCTC) explicitly recommends introducing price and tax measures, and WHO has suggested a benchmark for the total share of taxes of at least 75% of retail prices. As of 2019, only three African countries met that benchmark.[4]

Recent work has linked discrepancies between tobacco tax recommendations and their actual rates to lobbying by the tobacco industry.[5] One central argument from the tobacco industry has been that higher taxes will lead to more smuggling, consequently lowering revenue, increasing crime and worsening health outcomes.[5–8] The veracity of this claim, especially in the context of low-income and middle-income countries, is a central debate in tobacco control scholarship. Research in recent years has strongly contested the assumption that higher taxation will necessarily lead to higher levels of smuggling.[9–13] In particular, several studies have emphasised that the relationship between smuggling and taxation is mediated through various aspects of state enforcement capacity such as tax administration standards, track and trace systems, border control measures and effective revenue services.[11 14–17] Here, it is notable that there has been comparatively less work on the relationship between tobacco taxation and smuggling in countries with comparatively limited state capacity.[9 11–13 18–20]

This paper seeks to contribute to this discussion by providing new evidence about Sierra Leone, a low-income and limited state capacity context. In 2018, it introduced a new excise tax on cigarettes of 30% of retail price, while also increasing import duties on all tobacco products. Our study asks whether the increase in tobacco taxation in Sierra

Leone has led to an increase in tobacco smuggling. It employs gap analysis and data from multiple iterations of the Demographic and Health Survey (DHS), customs data as well as newly collected data on cigarette prices to estimate the effects of the tax increase. It finds strong evidence that smuggling has not increased, and in fact likely decreased. It also finds that the tax increase has been associated with decreased levels in smoking and increased public revenues.

Sierra Leone provides a particularly fitting case study to examine the effects of tax increases on smuggling. If the relationship between tobacco taxation and smuggling was to be strong and positive, as frequently claimed by the tobacco industry, we would expect Sierra Leone to be a prime example for this dynamic.

Tobacco consumption in Sierra Leone is highly skewed towards cigarettes[21] and has had substantial effects on health and public finances in the country—according to estimations in a United Nations Development Programme report, tobacco consumption is responsible for over 3300 deaths annually and imposes annual costs on the country equivalent to 1.5% of its GDP.[22] Notably, it has no domestic tobacco production—all domestically consumed cigarettes are imported.

While Sierra Leone ratified the FCTC in 2009, there has been little new tobacco control legislation since. To date, it has not introduced bans on advertisement, information campaign, plain packaging or warning label regulations. Notably, it has introduced no tax stamps or track and trace system that could limit smuggling. However, through 2017 to 2018, Sierra Leone enacted a substantial tobacco tax reform, introducing a 30% ad valorem excise tax on the wholesale price of cigarettes, and raising import duty on all tobacco products twice from 10% to 35% of cost, insurance and freight import value (Finance Amendment Act 2018, Supplement to the Sierra Leone Extraordinary Gazette Vol. CXLIX, No. 64 dated 19 July 2018; The Finance Act, 2018, Supplement to the Sierra Leone Gazette Vol. CXLIX, No. 31 dated 1 March 2018; The Finance Act, 2017, Supplement to the Sierra Leone Gazette Vol. CXLVIII, No. 30 dated 8 June 2017). While substantially higher than the previous level, these rates still fall below those mandated by the 2017 Economic Community of Western African States directive.[23]

Sierra Leone shares large borders with Guinea and Liberia. There are indications that illicit trade is prevalent in the region. Evidence of cigarettes smuggling in Sierra Leone exists going back to the 1980s, highlighting involvement of the tobacco industry[24] as well as the existence of smuggling routes from neighbouring Guinea.[25] Anecdotal evidence suggests the existence of various brands and packets on the Sierra Leonean market that were not produced for sale in the country. There are strong indications that state capacity in Sierra Leone to combat smuggling is limited. The Global Initiative against Transnational Organised Crime index category on state resilience to organised crime activities lists Sierra Leone in 12th place out of 15 West African countries, noting high levels of corruption and underfunded institutions.[26] No tax stamps or track and trace policies have been implemented before or during the timeframe studied in this paper.

The combination of a tax increase isolated from other tobacco control policies, the presence of smuggling networks and limited state enforcement capacity all make Sierra Leone a particularly fitting case study to test the relationship between smuggling and taxation. If the positive relationship between cigarette taxation and smuggling were to hold more generally, these are strong reasons to believe that it should be visible in Sierra Leone. If the substantive tax increase in Sierra Leone did not lead to a substantive increase in smuggling, this leaves much to be explained for a price-based approach to modelling smuggling.

METHOD

This paper uses gap analyses to estimate changes in cigarette smuggling. Gap analysis quantifies illegal markets size as the difference between estimated total consumption and legal production or import. Used systematically and extensively by the UK,[27] gap analysis has seen application in a variety of global contexts.[28 29] Our analysis is particularly indebted to its detailed applications in South Africa in recent years.[9 11 30]

Gap analysis is based on a simple model defining total cigarettes consumption (Q) as the sum of legally (QL) and illegally (QI) consumed cigarettes:

$$Q = QL + QI$$

As QI cannot be directly observed, it is estimated as the gap between Q and QL.[30] Q is normally given by the product of smoking intensity and smoking prevalence—with estimates produced through surveys—and QL is obtained through data provided by government agencies, such as customs services or revenue authorities. The methodological challenges of gap analyses often lie in obtaining the relevant data and in the assumptions that might be required, as discussed in the following paragraphs of this section.

As our interest is primarily in the effect of the change in tobacco taxation on the levels of smuggling, our focus is directed to the change in QI over time, rather than the overall level of QI at any one point. This somewhat facilitates our tasks, as the assumptions that we make on factors such as consumption under-reporting or smoking by the elderly are only required to be time-invariant to correctly estimate the direction of the change.

The key variables required for our gap analysis are the smoking prevalence and intensity within Sierra Leone's population (to estimate total consumption), as well as the total value and unitary price of imported cigarettes (to estimate legal consumption as Sierra Leone as no domestic production is present).

We obtain smoking prevalence and smoking intensity from the DHS 2013 and 2019, which contains the percentage of smokers in the population and the number of cigarettes smoked in the previous 24 hours. Two main challenges emerged here.

First, 2019 respondents were asked how frequently they smoked ('daily' or 'less than daily'), and data about smoking intensity was only collected for daily smokers. This complicates a direct comparison of the two rounds, as there is no information about frequency of smoking behaviour for 2013, only on the number of cigarettes smoked in the previous 24 hours for all those who smoke. Our main model tackles this by assuming that non-daily smokers smoke one cigarette every other day. As outlined in online supplemental appendix 1, we also run alternative models under a different assumption to check the robustness of our analysis.

A second challenge is the fact the DHS survey only covers females between the age of 15 and 49 years and males between the age of 15 and 59 years. While these represent the majority of the population, 'senior citizens' likely also consume tobacco. Therefore, we apply the gendered distributions of smoking incidence and intensity obtained from the two DHS waves to all Sierra Leonean aged above 15 years. The procedure to obtain updated smoking population figures, as well as the check that these are not driving our results, are presented in online supplemental appendix 1.

Furthermore, the DHS might underestimate total consumption due to under-reporting. Recent studies typically account for this

by inflating reported consumption by a fixed amount.[11] While this is less relevant for our analysis if we assume that under-reporting is time invariant, we inflate consumption in our 'main model' by 20%, a value within the bounds of those typical in the literature.[2 11] We include different inflation levels as controls in online supplemental appendix 1.

The total value of imported cigarettes was obtained from custom data made available by the National Revenue Authority (NRA) of Sierra Leone. While this was transaction-level data, missing information about quantities made the recovery of unitary price from this source impossible. Fortunately, the NRA implemented a country-wide survey on tobacco prices prior to the 2017 tax increase, which was also made available. In theory, by deflating the average wholesalers' price to 2013 values with the tobacco-specific component of inflation, we could recover the relevant unitary price. However, the 2017 survey did not specify whether the reported price was pretax, and cigarettes were subject to an import duty of 20%, as well as import value-added tax of 15% and an environmental charge of 2.7%. Based on the values reported, we assume that prices in the survey include these taxes. However, results for the alternative assumptions that reported prices were pretax are reported in online supplemental appendix 1.

The issue does not apply for 2019 prices, as these are obtained from a new wave of the price survey, implemented in 2021 (price levels for 2019 was also obtained by deflating the prices reported in the 2021 survey using the tobacco-specific component of inflation) by the authors in conjunction with the NRA, where pretax prices were explicitly asked. Both waves of the survey also included information for importers, so that we could use importer only averages. However, the coverage is very limited—only three and nine importers were covered in 2017 and 2019, respectively. Hence, we prefer to use prices for the whole sample, but we report results for importer only prices in online supplemental appendix 1.

RESULTS

Common positions that argue against the imposition of higher tobacco taxation on the basis of smuggling argue more broadly that tobacco tax increases will lead to an increase in smuggling, and, in the stronger version of that argument, that revenue gains that the tobacco tax increase could generate will be offset by increases in smuggling.

Our gap analysis finds strong evidence to reject both arguments for Sierra Leone, although under slightly differing assumptions. As the section above has discussed, our main model is built on a number of assumptions on the behaviour of non-daily smokers, the smoking habits of 'senior citizens', the level of misreporting and our price data. Based on what we consider our baseline model—which assume non-daily smokers consume a cigarette every other day, include 'senior citizens' and inflate reported consumption by 20%—our model rejects both statements. In fact, it shows that the 'gap' between total cigarette consumption and its legal import, a likely proxy for the level of smuggling, has decreased substantially, from 42.67% in 2013 to 25.92% in 2019. This represents a decrease in the market share of illicit cigarettes of 16.74% of the total market. At the same time, the price for cigarettes has increased substantially and tax revenues from cigarettes has more than doubled in real terms (while tax revenue collected through Goods and Service Tax has fallen due to lower imports, this has been made up by the higher rates of import duty and excise tax) Notably, and in line with the expected effects of an increase in tobacco taxation, the

Table 1 Summary statistics for number of smokers and cigarette-tax revenue, gap sizes in baseline model, 2013–2019

	2013	2019
Number of smokers (male)	519 684	429 053
Number of smokers (female)	89 945	78 505
Total tax revenue from cigarettes in million in Sierra Leone	16 537	39 342*
Cigarette 'Gap' in per cent of the whole market	42.67	25.92

Source, authors calculation based on Sierra Leone Demographic and Health Survey 2013 and 2019 and NRA data.
*Deflated to 2013 terms for comparability. The procedure for obtaining both 2013 and 2019 tax revenue is reported in online supplemental appendix 1.

number of smokers has decreased substantially across genders despite an increase in the total population. Consequently, illegal and legal imports decreased between 2018 and 2019. Table 1 summarises these results. In the estimation of this model, the tobacco tax increase has achieved all its key goals and has not led to an increase in smuggling.

In order to test the robustness of our conclusions we have estimated a total of 40 models, in which we have varied all the assumptions outlined in the previous section. We provide a full discussion of these models in online supplemental appendix 1, and summarise these results in table 2. Across these 40 models, 36 find that the gap—and proxy for the level of smuggling—has decreased between 2013 and 2019. Only four models find that the gap has increased—and in all cases, the increase is small in comparison to the substantial tax increase, with a maximum of 3.51%. As discussed in online supplemental appendix 1, we do not consider these four models to be among the most plausible presented here, as they all require strong assumptions about high levels of smoking among non-daily smokers and about the reporting of prices. Notably, this wider set of models demonstrates that no single assumption outlined in the section above is driving the results of the above model—we need to vary at least two assumptions for the model to generate a gap increase.

Consequently, while this wider set of models is not able to reject the possibility that smuggling has increased, it shows relatively little support for it, as even when selecting all assumptions in order to produce a higher 'gap', at most a comparatively marginal increase in smuggling is obtained. This wider set of models also serves as a comprehensive rejection of the idea that revenue gains from the tax increase could be significantly offset by increases in smuggling.

Naturally, there are limitations to these results. First, our analysis observes correlations of consumption and imports between two periods of time—this does not make a causal argument. However, we believe it provides ample evidence to doubt the broad causal argument inherent in many tobacco tax discussions. Second, the gap that we observe is not in itself an observation of the level of smuggling, but merely a proxy for it. For example domestic, production, legal or illegal, could distort

Table 2 Summary statistics for model results across different assumptions

	Number of models	Average	Minimum	Maximum
Gap increase	4	2.5%	1.82%	3.51%
Gap decrease	36	−11.18%	−0.41%	−25.62%

Source, authors calculation based on Sierra Leone Demographic and Health Survey 2013 and 2019 and NRA data.

this relationship. However, there are no reports of either in the country, so we have no reason to believe this might be a significant factor. Third, we cannot exclude that the gap exhibited a non-linear trend over the period—decreasing significantly between 2013 and 2018 and increasing again between 2018 and 2019. If this is the case, what we consider a decrease in the gap would instead represent an increase over an already materialised (and unobserved) decrease. However, this seems unlikely given that, after decreasing between 2013 and 2015 due to the Ebola epidemic, the volume of imported cigarettes grew on average of 9.8% per year between 2016 and 2018, exhibiting a positive year-on-year growth in each year, before then decrease by 31.9% between 2018 and 2019, following the tax increase and in line with the fall in consumption observed in the most recent DHS survey. For the gap to first decrease and then increase in response to the raise in tax rate, we would require cigarette consumption to have steadily decreased from 2013 onwards at an approximately constant rate, while also not responding to the change of tax rate. Given the absence of any tobacco control policy prior to the tax increase of late 2017, and the sharp decline in import volume following the second raise in 2018, this seems unlikely.

The magnitude of the import drop between 2018 and 2019 might seem large, but we do not find it surprising for three reasons. First, it reflects the substantial decrease in the overall number of smokers documented above. Second, the corresponding decrease in import value is substantially lower—13.9%. The higher decrease in import volume is connected with the strong inflationary pressure that the country faced in 2019,[31] caused by a currency devaluation, and to the recently increased tax rate. Both of these factors contributed to increasing cigarette prices, and therefore the difference between the drop in value and in volume. Third, cigarette importers had ample time to stockpile ahead of the tax increase, which was first announced in November 2016[32] but fully implemented only in July 2018. Stockpiling for future sales over this period would represent a rational economic strategy. Indeed, import volume increased by 8.1% between 2016 and 2017 and by 11.9% between 2017 and 2018, despite a decrease in consumption which was likely already ongoing. Seen in these contexts, the drop in volume is then not cause for concern.

CONCLUSION AND IMPLICATIONS

Our results strongly suggest that all main goals of the tobacco tax increase have been achieved in Sierra Leone: prices have increased, tax revenue has increased and smoking has decreased. At the same time, we find strong evidence to suggest that, contrary to common arguments, smuggling has decreased. From this emerges a clear policy assessment: the revenue authority of Sierra Leone has made the right decision in increasing tobacco taxation and can consider increasing it further to the WHO recommended level without fear of its effect being eclipsed through smuggling. Given the porosity of the country's border and the lack of additional tobacco control measures, the same conclusion is then very likely to apply to many revenue authorities in low-income countries.

At the same time, our results also point to a puzzle. Recent arguments that have sought to de-link tobacco taxation and smuggling have often emphasised the effect of state enforcement capacity and of other tobacco control interventions.[33] However, as we have noted, state capacity in Sierra Leone is comparatively limited, especially in the context of combatting organised crime. Sierra Leone does not have a tax stamp or track and trace system, and no new tobacco control policies have been introduced in

the past few years. To us, this does not detract from the importance of building enforcement capacity and introducing tobacco control policies in limited-capacity contexts. Instead, it suggests that tobacco taxation can make substantial gains even in contexts where other control measures are not fully established yet.

Our hypothesis is that the explanation for this result can be found in the structure and functioning of the cigarette smuggling market in Sierra Leone. An analysis of mirror statistics, customs data and conversations with relevant actors suggest to us that cigarette smuggling in Sierra Leone should not be imagined primarily as bootlegging and small-scale operations across uncontrolled land borders. Instead, there are some indications that a substantial part of the country's cigarette smuggling could occur through formal points of entry, and consequently likely via formal sector actors. These observations suggest that in this case the relevant form of 'state enforcement capacity' then lie in the state's ability to control large borders or supply chains, and is dependent on its interaction with a small number of large-scale actors, potentially tied to the formal sector. This relates to an emerging literature on informal regulation of smuggling[34] and could explain the decrease in smuggling and how even a 'limited state capacity' context like Sierra Leone could achieve this.

These results suggest that there is significant scope for new research and new discussions on the relationship between tobacco control and smuggling, especially in limited-capacity contexts. This includes the role of formal sector actors, informal regulation, different forms of state capacity and the role of points of entries. An older discussion, meanwhile, 'does tobacco taxation necessarily cause smuggling', should finally be put to rest.

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Appendix I: Models Construction, Specifications and Results.

A total of 40 different models were estimated for this study, in order to verify that our results are robust to variations in the assumptions needed for implementing the methodology. These assumptions are:

1. Inclusion of tax component in the reported price. This is especially relevant for the first wave of the survey, as the questionnaire did not specify if the required price was net of taxes. The 2017 wave of Tobacco price survey – which we use to recover 2013 prices – was implemented before the tobacco tax increase reform came into force, so that cigarettes were subjected to the same taxation as 2013. These included an import duty, equal to 10% of the CIF value, an import VAT charge of 15% of CIF value and an environmental tax equal to 2.7% of CIF value. The 2017 tax reform abrogated the environmental tax, increased the import duty tariff to 20% of and introduced an excise tax equal to 30% of the wholesale price, and the 2018 tax reform further raised the import duty level to 35%. As previously stated, the questionnaire of the 2017 wave of the tobacco price survey did not make a clear distinction between pre-tax and post-tax prices, so that we cannot be sure if the prices reported include the various charges that existed at the time. This is an issue, as in order to recover the true quantity of imported cigarettes we need to have pre-tax unitary prices - post-tax unitary prices are always higher than pre-tax ones, and this would lead us to recover a quantity of imported cigarettes lower than the actual one. As we cannot be sure, we calculate the gap for 2013 both assuming that the reported prices are pre-tax and assuming the they are post-tax, with latter always leading to higher imported volumes and, everything else equals, lower gaps. This is not an issue in the 2021 wave of the survey, as it was explicitly asked to respondents to report prices net of taxes if they were importers.

2. Construction of average cigarette price. Both rounds of the price survey include information about brand demand, as well as including several cigarettes importers. From this information, we construct three different price measures. One is a simple average of all cigarette prices

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from wholesaler, one is a weighted average of wholesalers' prices, where high-demand branded are weighted at 50%, medium-demand brands at 30% and low demand brands at 20%. Finally, we also construct a simple average price using only information from importers. Simple average prices are higher than weighted average ones, with importer-only averages being the lowest. As above, the higher the price, the lower the quantity of imported cigarettes, the higher the gap – everything else equal.

3. Treatment of non-daily smokers. While the DHS 2013 did not contain information about smoking frequency, the 2019 round does, and information about smoking intensity is only widely available for daily smokers. This poses issues of comparability, so that non-daily smokers are always included in the estimates, although in two different ways. In the "floor" scenario, non-daily smokers only smoke one cigarette every other day, while in the "ceiling" scenario they consume half as many cigarettes as a daily smoker. That is, we apply the same distribution of daily cigarette consumption of daily smokers to non-daily ones, but with smoking levels reduced to a half. In the "floor" scenario, the number of cigarettes consumed is lower, so that, everything else equal, the gaps are also lower.

4. Inclusion of senior citizens. The Demographic and Health Survey (DHS) only covers male respondents aged between 15 to 59 and female respondents aged 15 to 49, as it mostly targets information about reproductive health. However, there are no reason to assume that senior citizens do not smoke, so that they should reasonably be included in the estimates. In order to do so, we obtained the distribution of the overall population by gender and age cohort from the Housing and Census Population 2015 and from the Sierra Leone Integrated Housing Survey 2018, both implemented by Statistics Sierra Leone. Both reports included population growth rates, which we assumed to be homogenous across age cohorts. With this assumption, we extrapolated the dimension of the missing population brackets, using the 2015 census to augment the DHS 2013 and the 2018 survey to augment the DHS 2019. After obtaining the gendered distribution of smoking intensities from the two DHS, we applied it to the newly obtained populations. That is, we assume that both smoking incidence and the distribution of smoking intensity for the male cohort of those aged 60-80+ and the female cohort of those

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aged 50-80+ are the same of those of the male cohort aged 15-59 and the female cohort aged 15-49 respectively. As a consequence, everything else equal, excluding senior citizens lead to lower cigarette consumption, hence to lower gaps.

5. Under-reporting of cigarettes consumed. It is widely thought that self-reported levels of cigarette consumption are under-estimated by respondents, due to both recall bias and undesirability of the habit. We consequently proceed to inflate the reported level of consumption by 5% in certain scenarios and 20% in others. Inflating reported consumption increases the number of cigarettes smoked, hence increasing the size of the gap.

Given the above assumptions, we construct 4 sets of scenarios:

a) Exclusion of senior citizens, no inflation of reported consumption.

b) Inclusion of senior citizens, no inflation of reported consumption.

c) Exclusion of senior citizens, inflation of reported consumption by 5%

d) Inclusion of senior citizens, inflation of reported consumption by 20%.

In each of the above sets of scenarios, we then calculate the difference between the gap in 2013 and the gap in 2019 using all constructed average prices - simple average, weighted average, importers-only simple average - either including or excluding the tax component for each average price other than importer averages, which are assumed net of taxes. Furthermore, for each price combination, we calculate the difference in gaps over time for both the "floor" level of consumption of non-daily smokers (one cigarette very other day) and to the ceiling level (half the number of cigarettes consumed by daily smokers). Consequently, for each of the 4 scenarios the combination of assumptions gives rise to 10 diverse differences in gaps, namely:

i. Simple average – pre-tax price – "floor" consumption

ii. Simple average – pre-tax price – "ceiling" consumption

iii. Simple average – post-tax price – "floor" consumption

iv. Simple average – post-tax price – "ceiling" consumption

v. Weighted average – pre-tax price – "floor" consumption

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vi. Weighted average – pre-tax price – "ceiling" consumption

vii. Weighted average – post-tax price – "floor" consumption

viii. Weighted average – post-tax price – "ceiling" consumption

ix. Imported average – pre-tax price – "floor" consumption

x. Imported average – pre-tax price – "ceiling" consumption

Summary figures for the key variables are reported in Table.A1 below. We consider our baseline model the one calculated using weighted average prices, post tax with "floor" consumption by non-daily smokers, including senior citizens and with inflated consumption at 20% (scenario d-vii), as this seems the most reasonable set of assumptions. Let us walk the readers through the calculation.

Table.A1 Summary statistics of key variables under different scenarios.

	2013	2019
Number of smokers, no senior	551,529	444,356
Number of smokers, senior included	609,629	507,558
Cigarettes smoked, no senior, no inflation (floor 2019)	1,919,641,832	1,058,560,298
Cigarettes smoked, no senior, no inflation (ceiling 2019)		1,127,618,370
Cigarettes smoked, no senior, 20% inflation (floor 2019)		1,270,272,358
Cigarettes smoked, no senior, 20% inflation (ceiling 2019)	2,303,570,198	1,353,142,044
Cigarettes smoked, senior, no inflation (floor 2019)	2,112,296,231	1,197,457,323
Cigarettes smoked, senior, no inflation (ceiling 2019)		1,277,670,149
Cigarettes smoked, senior, 20% inflation (floor 2019)	2,534,755,478	1,436,948,787
Cigarettes smoked, senior, 20% inflation (ceiling 2019)		1,533,204,179
Simple average price, import price	51.090	139.734
Simple average price, cleared custom price	39.543	93.468
Weighted average price, import price	50.570	139.731
Weighted average price, cleared custom price	39.141	93.466
Importer average price, import price	42.307	130.508
Importer average price, cleared custom price	32.745	87.296

Source: Authors elaboration on DHS 2013 and 2019 and tobacco prices surveys.

In 2013, the import data obtained from NRA gives us an overall CIF value of imported cigarettes of 56.63 billion Leones (Le). From the 2017 wave of tobacco price survey, the average unitary price of a cigarette at wholesale, weighted for the demand of different brands, is Le111.93, which, deflated using the tobacco component of the Consumer Price Index (CPI), is equal to Le50.57. Assuming that the respondents gave us prices which include the tax component, once we account for a 10% CIF

import duty, a cascading GST of 15% and an environmental tax of 2.7% CIF, we have a unitary pre-tax import price of Le39.14 per cigarette. Applying this to overall import value, we obtain a volume of import equal to 1.45 billion cigarettes, which is the size of the legal market (QL in the model presented in the main body of the article). From the 2013 wave of the DHS, augmented to include 'senior citizen', we have a smoking population 609,629, which consumed during the year 2.1 billion cigarettes. After accounting for potential under reporting by smokers and inflating the cigarettes consumed by 20%, we have an overall consumption equal to 2.52 billion cigarettes, which is the size of the actual market (Q in the model). By subtracting QL from Q we obtain QI (1.08 billion cigarettes), which is equal to 42.67% of the actual market (QI/Q).

The process to obtain QL for 2019 is specular, simply starting from the 2021 round of the tobacco price survey, while there is one key difference in obtaining Q – a further assumption is required for the treatment of non-daily smokers. After accounting for the inclusion of 'senior citizens', in 2019 there are 507,558 smokers, of whom 427,042 smoke daily and 80,516 only occasionally. In the 'floor' scenario, we assume that non-daily smokers consume one cigarette every other day, hence consuming 14.65 million cigarettes during the year, which, added to the 1.18 billion cigarettes consumed by daily smokers, give us an actual consumption of 1.2 billion cigarettes. As for 2013, we proceed to inflate consumption by 20%, which yields 1.43 billion cigarettes, the Q for 2019. Given a QL of 1.06 billion, QI is equal to 372.51 million cigarettes, or 25.92% of the actual market (QI/Q). The obtained difference in gap size between 2019 (25.92%) and 2013 (42.67%) is -16.74%, hence equivalent to a sizeable reduction in smuggling.

Out of 40 obtained scenarios, the only one leading to a positive gap difference between the two periods (i.e., an increase in smuggling) are scenarios a-x (+1.91%), scenario b-x (+3.51%), scenario c-x (+1.82%) and scenario d-x (+2.92%). Let us also show the calculation for scenario b-x, the one yielding the highest increase in smuggling. As before, we start from a CIF value of imported cigarettes equal to Le56.63 billion in 2013. However, rather than the weighted average unitary price amongst wholesalers as in the previous example, this time we use the average unitary price amongst direct importers. From the 2017 survey, this is equal to Le93.64, which deflated to 2013 prices

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becomes Le42.31. Differently from before, this time we assume that this price is already net of taxes, and hence we proceed directly to obtain an import volume (QL) of 1.33 billion cigarettes. As before, we augment the DHS 2013 data by including 'senior citizens', but, differently from the previous scenario, we do not assume under reporting of consumption amongst smokers, so that cigarettes consumed (Q) remains equal to 2.1 billion. As a consequence, the size of the illegal market is now 774.49 million cigarettes (QI), or 36.83% of the actual market (QI/Q).

As before, the process to obtain QL for 2019 is specular, while to obtain Q we need a further assumption on the behaviour of non-daily smokers. Differently from the previous scenario though, this time we use the 'ceiling' rather than the 'floor' assumption for their consumption. That is, we assume that non-daily smokers smoke with half the intensity of daily smokers – the same amount per day, but only every other day. As a consequence, this time their annual consumption is equal to 94.87 million cigarettes, which, added to the same 1.18 billion cigarettes consumed by daily smokers as per the previous scenario, yields 1.28 billion cigarettes. As in this case we do not assume any underreporting, this is already the Q for the year. Given a QL of 762.32 million cigarettes – different from the one of the previous scenario as we now use average importer prices, assumed to be net of taxes, also for 2019 – the resulting gap is 515.35 million cigarettes (QI), or 40.34% of the market (QI/Q). This time, the difference between the gap size in 2019 (40.34%) and that in 2013 (36.83%) is equal to 3.51%, corresponding to a slight increase in smuggling amongst the two periods.

Looking again at what scenarios yield increase in smuggling (a/b/c/d-x), it is possible to notice that the only combination of assumptions leading to an increase in smuggling is the use of the importer-only average price with a high cigarette consumption of non-daily smokers. Varying either of these two assumptions – that is, using importer-only average prices but with "floor" consumption (a/b/c/d-ix), or using "ceiling" consumption with any price other than importers-only averages (a/b/c/d-ii/iv/vi/viii) – leads instead to a decrease in gap. Even in the 4 scenarios in which smuggling increase, the increases in revenue from higher taxation more than makes up for the loss due to higher smuggling. Hence, we can decisively reject the argument that the increase in revenue from higher

tobacco taxes will be offset by increases in smuggling, and while we cannot as strongly reject that increases in smuggling will take place, we find very little support for it.

The procedure to calculate the tax revenue reported in Table 1 is subjected to two assumptions - perfect enforcement (i.e., all the taxes due are collected) and no mark-up from wholesalers (i.e., the excise value is calculated on the import price and ignores the profit of wholesalers). While both of these assumptions are clearly unrealistic, they allow us to identify the effect of the tax reform in an ideal situation. The figures reported have been obtained from the CIF value of imported cigarettes communicated by the NRA as follows. In 2013, the total CIF value for imported cigarettes was Le56.63 billion. The import duty rate was 10% of CIF value, hence equal to Le5.66 billion, the cascading (i.e., applied to the sum of the CIF value and the import duty) GST rate is 15%, hence equal to Le9.35 billion, and the Environmental tax rate is 2.7% of the CIF value, hence equal to Le1.53 billion, for a total of Le16.54 billion. In 2019, the total CIF value of imported cigarettes was Le99.49 billion. The import duty rate was 35% of CIF value, hence equal to Le34.82 billion, the cascading GST rate is still at 15%, hence yielding Le20.15 billion, and the Environmental Tax has been repealed. However, there is now an ad-valorem excise of 30% of wholesale price, which we assume equal to the CIF value, hence yielding Le29.85 billion, for a total of Le84.81 billion. For comparability, we deflate this figure to 2013 value through the normal CPI, which yields a total revenue of Le39.34 billion.

Appendix II: Price Survey

There currently is no publicly available data on cigarettes' prices in Sierra Leone. The price data used in this article comes from 2 waves of a tobacco price survey implemented by the Sierra Leone National Revenue Authority (NRA), the first in 2017 - with support from the World Bank - and the second in 2021 – with support from the International Centre for Tax and Development. The samples for the surveys were obtained from the taxpayers' registry of the NRA, while additional informal cigarette retailers were also included during the enumeration to obtain a better picture of actual prices.

In addition to price information, the surveys collected a variety of other information, including market demand for different brands, impact of inflation on cigarettes' prices, average price mark-up applied by different business, as well as different questions about each respondent's perception about market structure and impact of taxes on cigarette price and demand.

The first round of the survey targeted 123 respondents, of which 13 (10.6%) were wholesalers and 3 (2.4%) were direct importers. The majority of the respondents (46.3%) were located in Freetown, the capital city, followed by respondents in Bo (18.7%), Kenema (18.7%) and Makeni (16.3%), respectively the second, fourth and third cities in the country for population. Overall, the survey included 443 data points on cigarettes' prices, of which 56 (12.6%) were from wholesalers and 7 (1.6%) were from importers. The second round of the survey targeted 183 respondents, of which 38 (20.8%) were wholesalers and 9 were importers (4.9%). As for the first wave, the majority of respondents were located in Freetown (54.1%), followed by Kenema (18.6%), Makeni (15.3%) and Bo (12%). The survey included 695 data points on cigarettes' prices, of which 129 (18.6%) were from wholesalers and 23 (3.3%) were from importers.

Apart from a slightly more extensive set of quantitative questions, the main difference between the two surveys lies in the wording of the question on the price of cigarettes. The first wave of the survey simply asked respondents to provide prices at which products were "sold to the public", without specifying if these should have been net of taxes or including them. The second round of the survey asked instead both the price at which products were acquired and the price at which products were sold, explicitly stating that if the respondent imported directly the price net of import duties and VAT was required. In this way, it was possible to acquire a clearer picture of price markups along the value chain, as well as acquiring the most representative prices to calculate the quantity of cigarettes imported.

We are currently working with our partners to make the data from this survey publicly available. In the meantime, for any enquiries please contact the authors.