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Cigarette excise tax structure and cigarette prices in nine sub-Saharan African countries: evidence from the Global Adult Tobacco Survey

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ABSTRACT

Background Economic theory predicts that the excise tax structure influences the distribution of cigarette prices. Evidence shows that uniform specific excise tax structures exhibit the least price variability relative to other tax structures. The distribution of cigarette prices under different excise tax structures has never been examined for a group of African countries.

Objectives To examine the distribution of cigarette prices under different tax structures in nine African countries and to critically evaluate the effectiveness of African regional tax directives in promoting public health.

Methods Data from the Global Adult Tobacco Survey, conducted in eight African countries during 2012–2018, and data from the 2017 Gambia Tobacco Survey were used to construct survey-derived cigarette prices. The coefficients of variation and skewness of the price distribution were compared in the context of each country's cigarette excise tax structure.

Results The least price variability is found in countries with a uniform specific tax, or a mixed system with a minimum specific floor. Cigarette price variability is largest in countries with uniform ad valorem tax structures. Three of the four countries with ad valorem tax structures are in regional blocs, where the tax directives specify that they should implement an ad valorem structure.

Conclusions Regional tax directives that require the adoption of uniform specific excise taxes, or high minimum specific floors, could be an efficient way to get multiple African countries to adopt a tax structure that reduces substitution possibilities in response to excise tax increases.

INTRODUCTION

Although significant increases in excise taxes have been shown to be the most effective policy for reducing cigarette smoking,^{1,2} the impact of a tax increase on consumption can be greatly reduced if it is easy for smokers to switch to cheaper brands when taxes and prices increase.³ The ability to substitute to cheaper brands can be measured by the distribution of cigarette prices within a country.^{4–8} If cigarette price variation is small, smokers are more likely to quit or to reduce consumption, instead of switching to a cheaper brand in response to a taxed price increase.⁶

Congruent with the predictions of economic theory, a small but growing body of empirical literature^{4–8} shows that cigarette excise tax structures that deviate from a simple uniform specific structure are associated with a greater price gap

WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Most African countries levy purely ad valorem taxes, or mixed excise taxes with no minimum specific floor; many implement these systems under the guidance of regional tax directives.
- ⇒ A growing body of empirical literature shows that tax structures that deviate from a simple uniform specific structure are associated with a greater price gap between higher-priced and lower-priced products.
- ⇒ Absent from this growing body of evidence is any analysis of the distribution of cigarette prices under different excise tax structures in African countries.

WHAT THIS STUDY ADDS

- ⇒ We provide the first comparison of the distribution of cigarette prices, under different tax structures, for a group of African countries.
- ⇒ The smallest price variability exists in countries with a uniform specific tax, or with a mixed system with a minimum specific floor that effectively works like a uniform specific tax.
- ⇒ Price variability is greatest in African countries that have adopted an ad valorem tax structure.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

- ⇒ Our study provides Africa-specific evidence for governments on the continent to improve their tobacco excise tax structures.
- ⇒ Our results point to weaknesses in past and existing tobacco tax directives on the African continent, which actively favour the use of ad valorem excise tax structures.
- ⇒ Tax directives that require the adoption of uniform specific excise taxes, or minimum specific floors, could be an efficient way to get multiple African countries to improve their excise tax structures.

between higher-priced and lower-priced products, and thus with more opportunities for smokers to avoid taxes by switching to cheaper products as taxes increase. Uniform specific excise taxes reduce price variability, while ad valorem excises and tiered tobacco tax structures result in greater variability in prices.^{4–8} The policy implication of these findings is that increases in cigarette taxes in countries with simpler tax structures will be more effective in reducing cigarette smoking and its health and economic consequences than comparable tax



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increases in countries where tax structures are more complicated. To this end, the WHO Framework Convention on Tobacco Control (FCTC) Article 6 guidelines, adopted in 2014, recommend that countries adopt a uniform specific excise tax, or a mixed excise tax structure with a minimum specific floor.⁹

Despite the growing evidence that documents the association between complicated tax structures and greater price variability,^{4–8} this association has not been examined in Africa. In this paper, we provide a descriptive comparison of the distribution of cigarette prices, under different tax structures, for a group of African countries. To conduct the analysis, we use the cross-sectional, individual-level price data from each of the eight sub-Saharan African countries where the Global Adult Tobacco Survey (GATS) has been completed and comparable individual-level price data from the 2017 Gambia Tobacco Survey. Data from the Gambia are added to our GATS sample because none of the GATS countries had a uniform excise tax structure at the time that the GATS was conducted. The Gambia is the only sub-Saharan African country that has both a uniform specific tax structure and a GATS-comparable data set on cigarette prices. The GATS countries used in this analysis are Botswana (2017), Cameroon (2013), Ethiopia (2016), Kenya (2014), Nigeria (2012), Senegal (2015), Tanzania (2018) and Uganda (2013). At present, these eight countries are the only sub-Saharan African countries that have conducted a GATS. Some of the most important demographic and economic characteristics of the countries in our sample are presented in online supplemental table 1.

Five of the eight countries in our sample are members of regional blocs that have adopted tax directives or practices which specify principles for what constitutes appropriate excise taxation among member states. Botswana is a member of the Southern African Customs Union (SACU). SACU requires its members to mirror the tobacco excise tax policy of South Africa.¹⁰ Cameroon is a member of the Economic and Monetary Community of Central Africa (CEMAC), which requires that member states apply a minimum ad valorem excise tax of 30% the value of tobacco products.¹¹ The Gambia, Nigeria and Senegal are members of the Economic Community of West African States (ECOWAS).¹² Since 2017, ECOWAS mandates that member states apply a minimum ad valorem tax of 50% of the import value for imported cigarettes/the ex-factory value for domestically produced cigarettes and a minimum specific of US\$0.40 per pack of 20 cigarettes.¹² In addition to being a member of ECOWAS, Senegal is also a member of the West African Economic and Monetary Union (WAEMU), which has a tax directive that does not fully align with ECOWAS's tax directive. Like ECOWAS, WAEMU requires its members to apply a minimum ad valorem tax of 50% of the import value for imported cigarettes/the ex-factory value for domestically produced cigarettes; however, unlike ECOWAS, WAEMU imposes an upper limit for the maximum ad valorem tax rate at 150% and does not require countries to implement a specific tax. Taken together, the tax directives or agreements to which the countries in the sample are subject cover more than half of the countries in sub-Saharan Africa and 44% of the region's population.¹³

In comparing cigarette price distributions under different tax structures for the countries in our sample, we not only add to the growing literature on the distribution of cigarette prices under different tax structures, but also provide select Africa-specific evidence for governments on the continent to improve their tobacco excise tax structures. This is particularly relevant since 6 of the 28 countries in the world that levy tiered taxes are located

in sub-Saharan Africa, and most countries in the region levy purely ad valorem taxes, or mixed excise taxes (a combination of specific and ad valorem excise taxes) with no minimum specific floor—in fact many implement these systems under the guidance of regional tax directives.¹⁴

DATA AND METHODS

To construct our measure of prices, we use individual-level data on self-reported cigarette prices, taken from the GATS conducted in eight sub-Saharan African countries between 2012 and 2018 and data from the Gambia Tobacco Survey conducted in the Gambia in 2017. No GATS studies were conducted in Africa before 2012.

The GATS is a nationally representative, standardised household survey of non-institutionalised adults aged 15 and older using a standardised protocol to monitor tobacco use and related tobacco control indicators globally. It includes various modules that gather individual-level information on topics such as the respondents' background characteristics, tobacco use and cessation, exposure to secondhand smoke, expenditure on cigarettes and quantities purchased, media, as well as attitudes towards and perceptions about tobacco use.¹⁵ GATS samples are randomly selected through stratified multistage cluster sampling methods to ensure adequate coverage of the entire target population. Survey sample weights were created with non-response and poststratification adjustments to provide nationally representative estimates for adults aged ≥ 15 years.¹⁵ The total sample sizes for completed individual interviews vary across countries: Botswana (4643), Cameroon (5271), Ethiopia (10 150), Kenya (4408), Nigeria (9765), Senegal (4347), Tanzania (9765) and Uganda (8508).

The 2017 Gambia Tobacco Survey, our source of data on cigarette prices for the Gambia, is a nationally representative survey of tobacco use among people aged 18 years and older. The total sample size for completed individual interviews is 1211. Like the GATS, the 2017 Gambia Tobacco Survey has various modules, one of which provides data identical to that of the GATS on cigarette purchases and prices paid.¹⁶

We calculate cigarette prices in each country from the following questions in the GATS: 'The last time you bought cigarettes for yourself, how many cigarettes did you buy?', from which we obtain the unit of purchase (individual cigarettes, packs or cartons) and the number of cigarettes in each unit. From the question 'How much did you pay for this purchase?' we obtain the overall purchase amount in local currency. For each smoker, we then calculate the price per stick by dividing the reported purchase cost by the number of cigarettes in the purchase. We then multiplied the single-stick price by 20 to estimate the price per 20 sticks. We ran an identical process for the Gambia based on identical questions given in the 2017 Gambia Tobacco Survey data.

To compare prices and their distributions across countries, we convert the derived prices in local currencies into constant 2019 international dollars using the purchasing power parity (PPP) conversion factors and the consumer price index of the country. PPP conversion factors and the consumer price index for each country are obtained from the World Bank Development Indicators database.¹³ To account for extreme outliers in our constructed price variable, we drop any observation that is greater than 30 international dollars since these prices are unrealistically high and are likely to reflect data capture or reporting errors (table 1). Subsequently, we drop any observation greater than 3 SD from the mean price in each country (table 1).

Table 1 Number of outliers dropped

Country	Observations before removing the outliers (n)	Step 1: observations >30 international PPP dollars (n)	Step 2: observations >3× SD from the mean (n)
Botswana (2017)	464	27	10
Cameroon (2013)	367	1	3
Ethiopia (2016)	498	12	5
The Gambia (2017)	792	6	5
Kenya (2014)	408	0	2
Nigeria (2012)	374	4	9
Senegal (2015)	184	0	2
Tanzania (2018)	288	2	0
Uganda (2013)	390	1	7

PPP, purchasing power parity.

Data on the tax structures in place at the time of each survey are obtained from the WHO Country Reports that inform the biannual *WHO Report on the Global Epidemic* and the WHO FCTC Convention Secretariat implementation reports, which form the basis of the Global Progress Report released every second year since 2008. These tax structures were further verified using information from journal articles and reports. As summarised in table 2, the following excise systems are applied in our sample of countries:

Table 2 Tax structures in year of survey

Country	Tax structure in year of survey	Tax rate levied	Trade bloc tax directive requirements in place at the time of GATS
Botswana (2017)	Uniform mixed excise tax ²⁷	11 pula per pack of 20 cigarettes and 30% of the manufacturing cost (for domestic production) or 30% of the CIF value (for imported production). ²⁹	SACU: uniform specific excise tax, which is adjusted annually by at least the inflation rate.
Cameroon (2013)	Uniform ad valorem excise ³⁴	25% of the sales value of cigarettes. ²⁵	CEMAC: ad valorem excise tax in the range of 0%–25% of the sales value of cigarettes.
Ethiopia (2016)	Uniform ad valorem excise ¹⁹	75% of the manufacturing cost (for domestic production) or 75% of the CIF value (for imported production). ²³	None.
The Gambia (2017)	Uniform specific ¹⁷	12 dalasi per pack of 20 sticks. ¹⁷	ECOWAS: ad valorem excise tax with a minimum rate of 15% and a maximum rate of 100% on the CIF price for imported cigarettes, or the ex-factory price for domestically produced cigarettes.
Kenya (2014)	Uniform ad valorem system with minimum specific floor ²⁶	24 shillings per pack of 20 cigarettes or 35% of the retail selling price, whichever is higher. ²⁶	None.
Nigeria (2012)	Uniform ad valorem ²²	20% of the CIF value for imported products or 20% of the ex-works price for domestically produced cigarettes. ²²	ECOWAS: ad valorem excise tax with a minimum rate of 15% and a maximum rate of 100% on the CIF price for imported cigarettes, or the ex-factory price for domestically produced cigarettes.
Senegal (2015)	Uniform ad valorem tax ²¹	45% on the CIF value for imported products or 45% of the ex-factory price for domestically produced cigarettes.	ECOWAS: ad valorem excise tax with a minimum rate of 15% and a maximum rate of 100% on the CIF price for imported cigarettes, or the ex-factory price for domestically produced cigarettes. WAEMU: ad valorem excise tax at a minimum rate of 15% and a maximum rate of 45% on the CIF, or the ex-factory price.
Tanzania (2018)	Tiered specific excise tax ³¹	Filtered cigarettes: 588 shillings (Tsh) per 20 cigarettes. Unfiltered cigarettes: 249 Tsh per 20 cigarettes. 'Other' category: 1065 Tsh per 20 cigarettes.	None.
Uganda (2013)	Tiered specific tax system ²⁰	Soft cap cigarettes: 640 shillings (Ush) per 20 cigarettes. Soft cap 2: 700 Ush per 20 cigarettes. Hinge-lids: 1380 Ush per 20 cigarettes. ²⁰	None.

Local currencies are used for specific excise rates listed in this table.

CEMAC, Economic and Monetary Community of Central Africa; CIF, cost, insurance and freight; ECOWAS, Economic Community of West African States; GATS, Global Adult Tobacco Survey; SACU, Southern African Customs Union; Tsh, Tanzanian shilling; Ush, Ugandan shilling; WAEMU, West African Economic and Monetary Union.

Uniform specific excise tax

Of the countries in our sample, the Gambia was the only country that applied a uniform specific excise tax, at a rate of 12 Gambian dalasi (or 0.82 international dollars) per pack of 20 sticks.¹⁷ This is in spite of the fact that the Gambia is a member of ECOWAS, which at the time, under Directive C/DIR.2.06.09, required member states to implement an ad valorem excise tax with a minimum rate of 15% and a maximum rate of 100% on the cost, insurance and freight (CIF) price for imported cigarettes, or the ex-factory price for domestically produced cigarettes.¹⁰

Uniform ad valorem excise tax

At the time of their respective GATS surveys, Cameroon,¹⁸ Ethiopia,¹⁹ Nigeria²⁰ and Senegal²¹ levied uniform ad valorem excise taxes. As a member of ECOWAS, Nigeria implemented its excise tax policy in accordance with the aforementioned ECOWAS directive. The ad valorem tax was levied at 20% of the CIF value for imported products, or 20% of the ex-factory price for domestically produced cigarettes.²² Senegal is a member of two overlapping regional blocs, ECOWAS and WAEMU, which have different tax directives.¹² At the time of Senegal's GATS survey, WAEMU Tax Directive 03/2009/CM/UEMOA required members to levy ad valorem excise taxes on cigarettes at a minimum rate of 15% and a maximum rate of 45% on the CIF, or ex-factory price. Senegal implemented an ad valorem excise tax of 45%.²¹

Ethiopia is a member of the Common Market for Eastern and Southern Africa, but this regional trade bloc has no directives

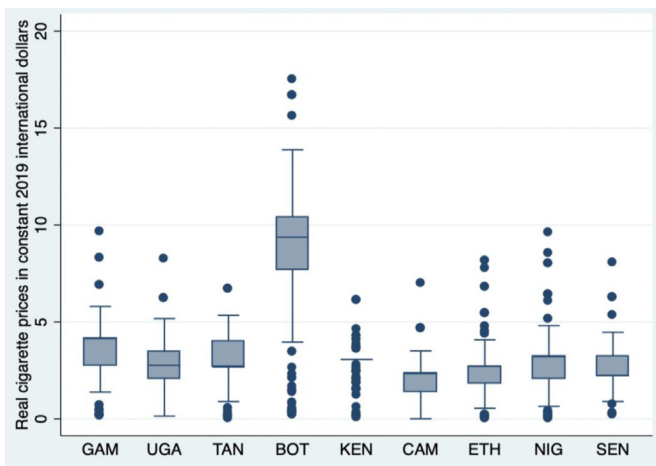


Figure 1 Boxplot of cigarette price distributions by country. BOT, Botswana; CAM, Cameroon; ETH, Ethiopia; GAM, The Gambia; KEN, Kenya; NIG, Nigeria; SEN, Senegal; TAN, Tanzania; UGA, Uganda.

on tobacco. In Ethiopia, the excise tax was levied at 75% of the declared cost of production.²³ Cameroon is a member of CEMAC. At the time of Cameroon's GATS survey, CEMAC members were subject to Directive 1/99/CEMAC-028-CM-03, which stipulated that the excise duty rates are freely determined by each member state in the range of 0%–25% of the sales value of cigarettes.²⁴ Cameroon set its ad valorem rate at 25%.²⁵

Uniform combination of specific and ad valorem taxes

While both Kenya and Botswana have mixed excise tax structures, the way the structure is implemented differs in each country. Kenya applies an ad valorem excise tax with a minimum specific floor,²⁶ while Botswana applies a mixed system that combines an ad valorem and a specific component.²⁷ The distinction between the mixed excise taxes adopted in Kenya and Botswana is shown in online supplemental figure 1. In the case of a uniform ad valorem structure with a minimum specific floor, the ad valorem rate only applies if it is higher than the minimum specific tax. In this way, the minimum tax functions as a specific duty. At the time of Kenya's GATS survey, the excise tax was set at a minimum specific floor of 1200 Kenyan shillings per 1000 cigarettes (ie, 24 shillings per pack) or 35% of the retail selling price, whichever is higher.²⁶

Botswana is a member of SACU.¹⁰ It is therefore required to mirror the excise tax policy of South Africa. South Africa levies a uniform specific excise tax, which is adjusted annually by at least the inflation rate.²⁸ The revenues generated by the excise taxes applied in each SACU country are collected in the SACU Common Revenue Pool and are distributed to the various countries by means of a revenue sharing formula.¹⁰ Since 2014, in addition to the SACU specific excise tax, Botswana has applied an ad valorem additional levy of 30% on the cost of production (for domestically produced cigarettes) or the CIF price (for imported cigarettes).²⁹ It is the only SACU country to implement such an additional levy.²⁷

Tiered specific tax system

Uganda and Tanzania have tiered excise tax systems. Both of these countries are members of the East African Community, which does not impose any directives on tobacco excise taxes. In Uganda, a three-tiered tax system was applied which distinguished between cigarettes packaged in soft cap packs (soft cap

1 and soft cap 2) and cigarettes packaged in hinge-lid packs.²⁰ The excise tax on soft cap 1 cigarettes was 640 Ugandan shillings (0.66 international dollars) per 20 cigarettes, on soft cap 2 700 Ugandan shillings (0.72 international dollars) and on hinge-lids 1380 shillings (1.43 international dollars).²⁰ In Tanzania, a three-tier specific excise tax structure distinguishes between cigarettes with filters, cigarettes without filters and an 'other' cigarette category. For filtered cigarettes, the excise tax is 588 Tanzanian shillings (0.79 international dollars) per 20 cigarettes; for cigarettes with no filter, the tax is 249 shillings (0.33 international dollars) per 20 cigarettes; and for the 'other' category, it is 1065 shillings (1.42 international dollars).³⁰

In the following section we describe the distribution of cigarette prices by country and compare these price distributions on the basis of the excise tax structure in each country. Reported prices are weighted by cigarette consumption. Consumption weights are calculated as the ratio of each individual's consumption to the total consumption in the sample.

We examine the price variation of cigarettes by comparing the coefficients of variation (CoV) across countries. The CoV is calculated by dividing the SD of the prices used in the sample by the mean price of the sample. The higher the CoV, the greater the level of dispersion around the mean. We test for whether differences in CoV by excise tax structure are statistically significant using t-tests. Although not directly a measure of variability, we also analyse the skewness coefficient of the reported prices. Skewness is a measure of the lack of symmetry of a distribution. If the distribution is symmetric, the coefficient of skewness is 0. If the distribution has a positive skewness coefficient, most observations are for lower prices and there are relatively few higher prices in the distribution. If the skewness coefficient is negative, most prices are relatively higher and there are relatively few lower prices in the distribution.

RESULTS

Figure 1 presents the price variability using a boxplot. Each country's boxplot displays the five-number summary of the set of prices in that country. The five-number summary is the minimum, first quartile, median, third quartile and maximum. Figure 2 shows the distribution of prices ranked from the lowest to the highest for the nine countries in our sample. From figure 1 one can see that the IQR for many countries is relatively small; in the case of Kenya the IQR is 0. The variation of prices is presented differently in figure 2, but tells an identical story as figure 1. While these graphical representations of the data are helpful in forming an intuitive understanding of the distribution of prices for the nine countries in our sample, they do not allow for a rigorous comparison of the price distributions across countries.

Table 3 shows the prices paid in the context of each country's tobacco tax structure. The CoV is highest in the four countries that have adopted uniform ad valorem taxes, with coefficients ranging between 0.48 in Nigeria and 0.53 in Senegal (table 3). There is a relatively limited variation in prices in the Gambia (CoV=0.32) and Kenya (CoV=0.29). This was expected for the Gambia since it is the only country in our sample with a uniform specific tax on cigarettes. The minimum specific floor in the Kenyan system keeps the price distribution relatively tight, even though the tax system is classified as a mixed system. In 2014, cigarette prices were clustered at 100 shillings per pack, which is equal to 3.06 international dollars in 2019. The distribution of prices in Botswana (CoV=0.40), which has a uniform mixed

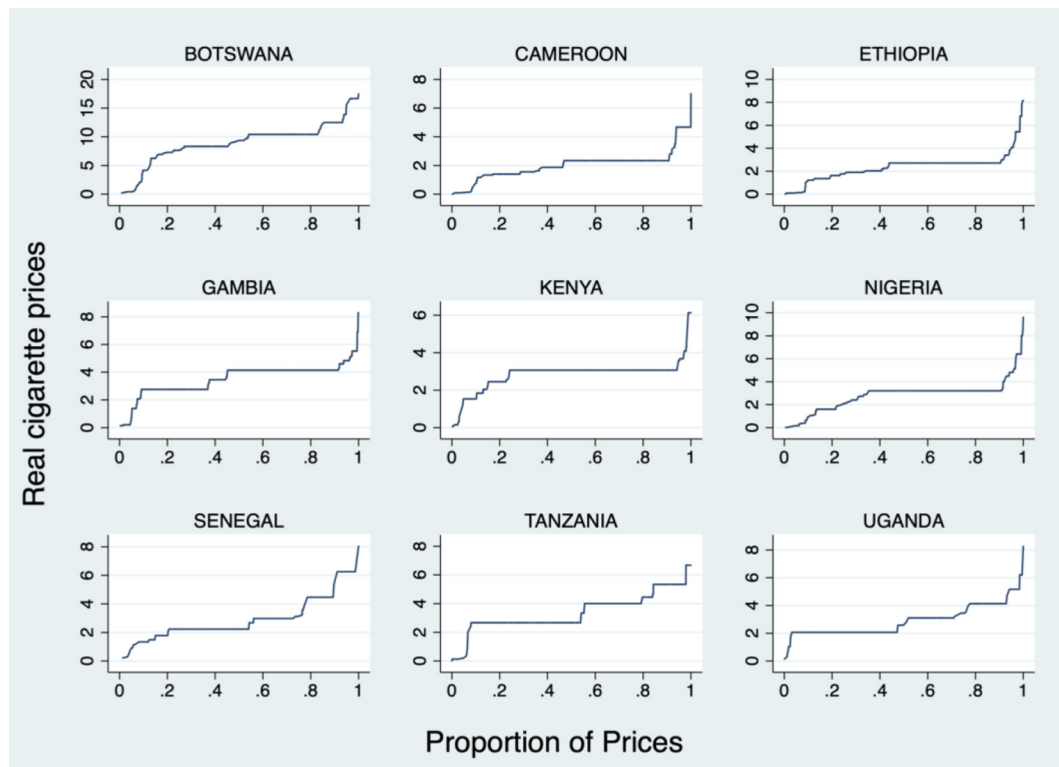


Figure 2 Distribution of prices in constant 2019 international dollars by country.

excise tax structure, is similar to that of Tanzania and Uganda, both of which have tiered excise tax structures (table 3).

An analysis of the CoV shows that this is highest in countries that levy a uniform ad valorem tax structure (table 3). A high coefficient indicates greater dispersion of price distribution. The CoV in countries that have a pure ad valorem excise tax structure is larger than in countries that have a specific tax component in the tax structure. However, because of the few countries in the sample, the differences are not statistically significant.

The skewness statistics presented in table 3 show that in countries with uniform ad valorem taxes, cigarette prices are positively skewed, which means that prices tend to be clustered at lower levels, while there are relatively fewer high prices in the distribution. This is also true for Uganda, where a tiered specific excise tax structure is applied. Prices are negatively skewed in Botswana, Kenya, Tanzania and the Gambia, which means that, in these countries, cigarette prices are clustered at higher-than-average levels,

with a small number of low prices. Of these countries, the Gambia has the largest skewness statistics, indicating that its cigarette prices are most skewed towards high prices in the distribution.

DISCUSSION

Consistent with a growing body of empirical literature,^{4 6–8} we find, for a sample of nine African countries, that the smallest price variability exists in countries with a uniform specific tax, or with a mixed system with a minimum specific floor that effectively works like a uniform specific tax.

Our results show that price variability is greatest in those countries in our sample that have adopted an ad valorem tax structure. Countries that currently have an ad valorem tax structure could add a minimum specific floor to their system, or convert to a uniform specific excise tax structure entirely, to reduce the variability of prices.

Table 3 Cigarette prices in real 2019 international PPP dollars: descriptive statistics

Tax structure	Specific		Mixed		Ad valorem				
	Uniform	Tiered	Uniform		Uniform				
Country	The Gambia	Uganda	Tanzania	Botswana (specific plus ad valorem)	Kenya (minimum specific floor)	Cameroon	Ethiopia	Nigeria	Senegal
n	712	322	221	302	326	275	405	288	165
Mean	3.50	2.92	3.38	8.94	2.84	2.01	2.32	2.80	2.93
Median	4.14	2.76	2.67	9.37	3.06	2.34	2.72	3.21	2.23
SD	1.14	1.27	1.34	3.58	0.82	0.99	1.16	1.34	1.57
Coefficient of variation	0.32	0.39	0.40	0.40	0.29	0.49	0.49	0.48	0.53
Skewness	-0.84	1.05	-0.12	-0.54	-0.22	0.69	1.14	0.48	1.08

Sample sizes do not add up to the sample sizes derived in table 1 because in this table consumption weighted price data are reported. Not all respondents who reported cigarette prices (as shown in table 1) reported on their cigarette consumption.
PPP, purchasing power parity.

We find that the two countries that have tiered specific excise taxes experience less price variability than the four countries with ad valorem systems, although they exhibit more price variability than the three countries that apply either uniform specific excise tax structures or ad valorem structures with a minimum specific floor. These results align with findings in the international literature that indicate that, from a public health perspective, tiered tax structures are not recommended.^{1 2} A mixed excise tax structure (uniform specific plus an ad valorem component), as adopted in Botswana, exhibits the same level of price variability around the mean as countries adopting a two-tiered specific excise tax structure and thus, from a public health point of view, is not an ideal tax structure. Our results suggest that, if the aim is to reduce price variation, a better strategy may have been for Botswana to introduce its tobacco levy in the form of a specific, rather than an ad valorem tax.

From a policy perspective, our findings suggest that there were substantial weaknesses in the excise tax directives that were in place in ECOWAS when the GATS were conducted (ie, 2012–2018). This was partially rectified in December 2017 when members of the 15-member regional bloc adopted a new tax directive that required members to increase the minimum ad valorem rate from 15% to 50% and add a specific tax of US\$0.40 (equivalent) per pack to their excise tax structure.¹² Our findings suggest that while this is an improvement over the purely ad valorem structure required under the previous ECOWAS directive, it still does not align with best practice. It seems likely that cigarettes would be subject to less price variability if ECOWAS states adopted a uniform specific excise tax, or a uniform ad valorem tax with a sufficiently high minimum specific floor. These specific taxes should be regularly increased to account for, at a minimum, inflation and income growth developments.

In addition, some regional economic communities on the continent have tax directives that explicitly favour ad valorem excise taxes. This is the case for WAEMU and CEMAC.³¹ WAEMU further imposes a maximum on the level of the tax rate that may apply. Such maxima should be removed. The current CEMAC tax directive, which was passed in 2019, only requires that member states apply a minimum ad valorem excise tax of 30% on tobacco products.³² The CEMAC directive makes provision for specific excise taxes, but to date only one CEMAC country (Equatorial Guinea) has included a minimum specific floor in its excise tax structure.³¹

This study has limitations. First, the prices reported in the GATS and the Gambian Tobacco Survey reflect the prices of brands consumed by smokers included in the survey and thus do not capture the full range of prices for all cigarettes available in each country. The chosen measure of prices may also capture illicit cigarettes, which could inflate the variability of the reported prices. Second, because we use self-reported prices, the prices used in our sample may be subject to reporting errors. The direction of the reporting errors is unknown. Third, we are limited to single cross-sections of data. We are therefore unable to quantify the relationship between tax structure and the distribution of cigarette prices and do not claim any causal relationships. Relatedly, we do consider any factors other than excise tax structure (eg, excise tax rates and Gross Domestic Product per capita) that could be associated with cigarette price variability for the countries in our sample. Fourth, the GATS did not take place in all countries in the same years. There is therefore a risk of bias being created by the different periods of time. Fifth, the Gambia Tobacco Survey covers those aged 18 and older, but the GATS covers those aged 15 years and older. There might therefore be a bias due to lack of younger smokers in the Gambia's

sample since younger smokers are more likely to be price-sensitive than older smokers and hence smoke cheaper brands. Finally, this paper does not examine the relationship between cigarette and non-cigarette tobacco prices and tax structures. It is possible that, in some countries, there could be substitution between cigarettes and other tobacco products if the tax on these products increases.

CONCLUSION

The nine sub-Saharan African countries included in our analysis implemented a range of different excise tax structures. Our analysis shows the greatest price variability and therefore the most scope for brand substitution in response to a price-led tax increase exists in countries which, at the time of their GATS surveys, had ad valorem excise tax systems. These results point to weaknesses in past and existing tobacco tax directives in these nine sub-Saharan African countries, which actively favour the use of ad valorem excise tax structures.

Tax directives that require the adoption of uniform specific excise taxes, or minimum specific floors, could be an efficient way to get multiple countries to adopt an FCTC-compliant excise tax structure.³³ The evidence presented here can be used by tobacco control advocates in these nine sub-Saharan African countries to incorporate the FCTC recommendations in future regional tax directives.

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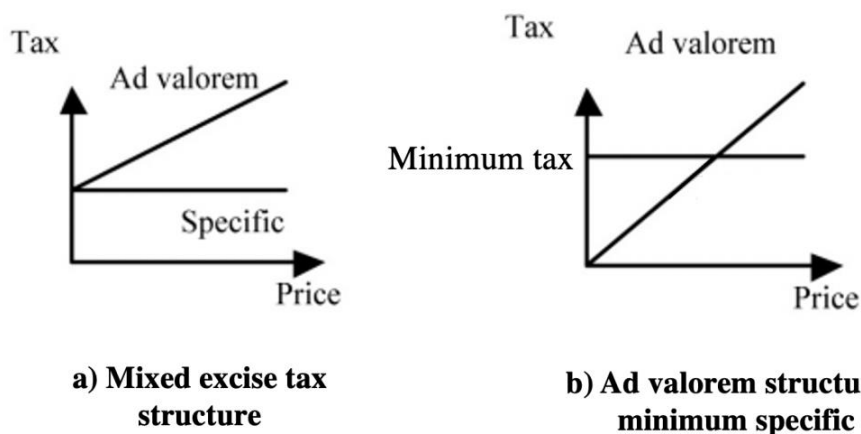
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Supplemental Table 1. Key demographic and economic characteristics of the countries in our sample in 2019

Country (survey year)	Per capita income (GDP per capita in real 2019 PPP dollars) ^[13]	Population aged 15 years or older (millions) ^[13]	Adult daily smoking prevalence ^[32]
Botswana	17 217	1.5	13%
Cameroon	3900	14.9	5%
Ethiopia	2308	66.9	3%
The Gambia	2314	1.3	9%
Kenya	4645	3.0	7%
Nigeria	5352	113.2	3%
Senegal	3503	9.3	5%
Tanzania	2773	3.6	6%
Uganda	2275	23.7	5%

Supplemental Figure 1. Mixed excise tax structure (panel a) compared to an ad valorem structure with a minimum specific floor (panel b)



Source: [1]

Notes to supplemental Figure 1:

A mixed specific system (Panel A) has both a uniform specific excise rate and an *ad valorem* rate applied to tobacco product(s). The impact of the tax on prices will depend on which element (*ad valorem* or specific) prevails [1]. Countries with an *ad valorem* excise system may set up a minimum specific floor excise tax (Panel B) so that when the *ad valorem* rate produces

a tax value lower than the minimum specific floor excise value, then the minimum specific floor excise rate becomes their tax liability. In Panel B, the minimum tax functions as a specific duty and ensures a relatively higher price level for low-and medium-priced products [1].