Better cigarette tax policies and higher tobacco excise tax revenues

Hye Myung Lee, Jeffrey Drope, Carlos Manuel Guerrero-López, Anne-Marie Perucic, Frank J Chaloupka

ABSTRACT

Background In November 2021, the Tobacconomics team published the second edition of the Cigarette Tax Scorecard which evaluates cigarette taxation in each country based on four components—cigarette price, affordability change, tax share and tax structure. This study examines the relationship between the overall cigarette tax score and tobacco excise tax revenue between 2014 and 2018.

Methods Using cigarette tax scores from the Tobacconomics Cigarette Tax Scorecard and tobacco excise tax revenue information from WHO, this analysis is based on ordinary least squares estimations to assess the association between the overall cigarette tax scores and tobacco excise tax revenues per capita controlling for countries’ tobacco control environment, sociodemographic characteristics and country and year fixed effects.

Results A 1-point higher overall cigarette tax score is associated with higher tobacco excise tax revenue per capita of $11.98 (in constant 2018 purchasing power parity international dollars). For low and middle-income countries and lower performing countries at baseline, a 1-point higher overall cigarette tax score is associated with higher tobacco excise tax revenue per capita of $11.32 and $6.92, respectively. If all countries had increased their scores to ‘5’, the tobacco excise tax revenue per capita would have increased by 22.51%.

Conclusions Higher overall cigarette tax scores are associated with higher tobacco excise tax revenue per capita. Countries aiming to reach higher cigarette tax scores would be able to reduce tobacco use and increase their tobacco tax revenue, which can be allocated to development priorities.

INTRODUCTION

Tobacco use is the leading cause of preventable premature death worldwide. Tobacco kills more than 8 million people annually, and more than 80% of tobacco users are in low and middle-income countries (LMICs). Among many tobacco control policies, tobacco taxation is the most effective and cost-effective measure to reduce tobacco use. Tobacco taxes can also serve as an important revenue source for governments to improve fiscal outcomes. While some countries have made improvements on tobacco taxation, tobacco taxes have not been effectively implemented in many other countries, most of which have not made substantial improvements in recent years.

In November 2021, the Tobacconomics team released the second edition of the Cigarette Tax Scorecard, following their first edition which was published in December 2020. The Scorecard evaluates the performance of cigarette tax policies based on four key components: (1) cigarette price, (2) change in affordability, (3) tax share in cigarette prices and (4) tax structure. The Scorecard results demonstrate that there were no significant increases in scores for many countries between 2014 and 2020.

There is an extensive literature on cigarette tax and tobacco use. These prior studies can be categorised based on the four key components of the Cigarette Tax Scorecard. Prior studies document higher cigarette prices, which can be obtained from higher taxes on cigarettes, lead to decreases in cigarette smoking, increases in cessation among current smokers and reduction in smoking initiation. On average, a 10% increase in price is associated with a decrease in cigarette consumption by 4% in high-income countries (HICs) and 5% in LMICs. Higher cigarette taxes are effective in reducing cigarette affordability, which is often measured as relative income price (ie, the percentage of per-capita income required to purchase 100 packs of cigarettes), and lower affordability of cigarettes leads to reductions in cigarette consumption.

Higher tax shares in cigarette prices generally lead to higher cigarette prices and, thereby, are associated with lower cigarette consumption. Uniform and specific tax structures are associated with lower taxation, which can be allocated to development priorities.
cigarette consumption compared with complicated tax structures which show larger price variations and lower average prices.\textsuperscript{15–17} A recent study shows that a 1-point higher overall cigarette tax score in the Tobaccoconomics Cigarette Tax Scorecard is associated with lower per-capita cigarette consumption by 9%.\textsuperscript{18}

In contrast to a vast number of studies assessing the relationship between cigarette tax and tobacco use, there is a paucity of research on the relationship between cigarette taxes and related revenues. The few existing studies find that increases in cigarette excise tax are associated with increases in tobacco tax revenue.\textsuperscript{19–22} Although cigarette tax evasion (including smuggling), tax avoidance and reduction in smoking may follow tobacco tax increases, tobacco tax revenue still typically increases.\textsuperscript{20,22} Case studies in WHO Technical Manual on Tobacco Tax Policy and Administration also show positive revenue impacts of excise tax increases using data from South Africa, the Philippines, Ukraine, Australia and Canada.\textsuperscript{11}

Tobacco taxation has been an important research topic for many economic and public health researchers. However, there is limited evidence assessing its effect on countries’ tobacco tax revenue, which is very often the focus of tax policymakers whose principal concerns are maintaining or growing tax revenues. Given this gap in the literature, this study examines the association between the overall cigarette tax score and tobacco excise tax revenue using the Tobaccoconomics Cigarette Tax Scorecard. We hypothesise that countries with higher cigarette tax scores experience higher tobacco excise tax revenues. We focus on tobacco excise tax revenues because the international best practice is to apply these types of taxes since they affect the price of tobacco products relative to other goods and services.\textsuperscript{13} This does not mean that other tax revenues such as those from value-added tax (VAT) will not be affected by reforms affecting demand and such complexities should be considered in simulation modelling, but the largest effect is most likely from the excise taxes. In this analysis, we regress country-level tobacco excise tax revenue per capita on the overall cigarette tax scores along with important controls including the tobacco control environment, demographic and socioeconomic information, country fixed effects and year fixed effects. Subgroup analyses are also conducted using country income group and baseline level of overall cigarette tax scores.

**METHODS**

**Data**

Tobaccoconomics cigarette tax scores

Overall cigarette tax scores are obtained from the second edition of the Tobaccoconomics Cigarette Tax Scorecard.\textsuperscript{5} The Scorecard evaluates the performance of cigarette tax policies in 160 countries based on four scoring components: cigarette price, changes in cigarette affordability, the tax share of cigarette price and tax structure. Each component is scored on a scale of 0–5, in which a score of 5 represents the best performance (see online supplemental table A1). The overall cigarette tax score is a composite measure that is calculated as the average of all four component scores.

Tobacco excise tax revenue per capita

Tobacco excise tax revenue data are collected by WHO from national governments. Annual tobacco tax revenue is collected at the country level by tax category, including excise tax, VAT (and other sales tax) and import duties. Currencies are adjusted to constant 2018 purchasing power parity (PPP) international dollars using currency information in the World Development Indicators (WDI) from the World Bank (WB) database. Information on the countries’ population size is obtained from the WDI in the WB database. Per-capita measures are generated by dividing the tobacco excise tax revenue by the number of population aged 15+.

**Tobacco control environments**

Information on the tobacco control environment of each country is obtained from the biennial WHO Report on the Global Tobacco Epidemic. The report presents MPower scores for each year and country based on their performances in six tobacco control domains: monitoring tobacco use and prevention policies (M), protecting people from tobacco smoke (P), offering help to quit using tobacco (O), warning people about the dangers of tobacco use (W), enforcing bans on tobacco advertising, promotion and sponsorship (E) and raising taxes on tobacco products (R).\textsuperscript{3} Each domain measure takes a score from 1 to 5, where a score of 1 indicates no recent data or no data to represent the national population. A score between 2 and 5 indicates the level of policy implementation where a score of 5 represents the highest performance. In our analyses, we use the scores, since monitoring (M) more likely measures tobacco control policies in broader performance rather than a particular intervention, and we use cigarette tax scores to measure the performance in tobacco taxation (R).\textsuperscript{18} The POWe score is a summation of the four measures and, thus, can range from 4 to 20.

**Demographic and socioeconomic information**

Data on country-level demographic and socioeconomic information, which includes gross domestic product (GDP) per capita, total tax revenue (%) of GDP, % population aged 15–64 and % population aged 65+, are obtained from the WDI in the WB database.\textsuperscript{21} GDP per capita is reported in constant 2018 PPP international dollars. In our subgroup analyses by income group, we use WB classification for each year. Baseline levels of cigarette tax scores are categorised into three groups (low, middle and high) using the country’s earliest score among 2014, 2016 and 2018.

**Empirical approach**

**Main analysis**

The main analysis is based on ordinary least squares estimations to test the association between countries’ overall cigarette tax scores and tobacco excise tax revenue per capita. We include GDP per capita, total tax revenue (%) of GDP, tobacco control environment (POWe), % population aged 15–64 and % population aged 65+ to control for demographic and socioeconomic characteristics of countries. Country and year fixed effects are also included to address the country-specific time-invariant factors and to account for time-specific socioeconomic shocks which could potentially affect tobacco excise tax revenues. SEs are clustered at the country level. The specification of the regression model is presented in the online supplemental appendix. For robustness checks, we also conducted the analysis using different specifications (eg, a log-linear model) and different dependent variables (eg, tobacco excise tax revenue (%) of GDP, tobacco excise tax revenue (%) of total tax revenue). All statistical analyses were conducted using Stata V.16.1.

**Simulations**

Based on the regression estimates from the main analyses, we run simulations on the increase in tobacco excise tax revenues in the base and ideal scenarios. In the base scenario, we predict
the tobacco excise tax revenue in 2014 and 2018 using the actual overall cigarette tax scores and the estimated coefficients. With these predicted tobacco excise tax revenues, we calculate the percentage increases from 2014 to 2018. We take a similar approach in the ideal scenario, but we predict the tobacco excise tax revenue as if all countries scored ‘5’ in 2018. Actual tax scores are used for 2014. Percentage increases are calculated based on these predicted tobacco excise tax revenues.

**RESULTS**

Summary statistics of the sample are presented in **Table 1**. The average tobacco tax revenue per capita is $212.98 (in constant 2018 PPP international dollars) and the average overall cigarette tax score is 2.62. On average, the total overall tax revenue is 17% of the country’s GDP and 66% of the population is aged 15–64. The analysis includes 176 observations for 70 countries.

**Figure 1** shows the relationship between the overall cigarette tax scores and tobacco excise tax revenue per capita using all countries. In all 3 years, tobacco excise tax revenue per capita increases as the overall cigarette tax score increases. While the slopes of the fitted line are similar between 2014 and 2016, the slope becomes flatter in 2018.

The regression estimates are presented in **Table 2**. Column 1, which includes all countries in the sample, shows a positive association between the overall cigarette tax scores and tobacco excise tax revenue per capita. A 1-point higher overall cigarette tax score is associated with higher tobacco excise tax revenue per capita of $11.98 (in constant 2018 PPP international dollars). For the HICs, there was no significant association found. For the LMICs, a 1-point higher overall cigarette tax score was associated with higher tobacco excise tax revenue per capita of $11.32 (in constant 2018 PPP international dollars).

**Table 3** shows the association between the overall cigarette tax scores and tobacco excise tax revenue per capita by the baseline overall cigarette tax score level of each country. Countries with low scores at baseline period were found to have a positive relationship between the overall cigarette tax score and tobacco excise tax revenue per capita. A 1-point higher overall cigarette tax score was associated with higher tobacco excise tax revenue per capita of $6.92 (in constant 2018 PPP international dollars). Although not statistically significant, the estimates of countries with middle and high scores at baseline period suggest that the overall cigarette tax score of these countries is positively associated with tobacco excise tax revenue per capita.

**Table 1** Summary statistics

<table>
<thead>
<tr>
<th></th>
<th>All countries</th>
<th>HICs</th>
<th>LMICs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco tax revenue per capita*</td>
<td>212.98</td>
<td>278.97</td>
<td>145.47</td>
</tr>
<tr>
<td>Overall cigarette tax score</td>
<td>2.62</td>
<td>3.25</td>
<td>1.98</td>
</tr>
<tr>
<td>Price score</td>
<td>2.67</td>
<td>3.58</td>
<td>1.72</td>
</tr>
<tr>
<td>Change in affordability score</td>
<td>1.52</td>
<td>1.79</td>
<td>1.24</td>
</tr>
<tr>
<td>Tax share score</td>
<td>3.10</td>
<td>3.78</td>
<td>2.40</td>
</tr>
<tr>
<td>Tax structure score</td>
<td>3.22</td>
<td>3.85</td>
<td>2.56</td>
</tr>
<tr>
<td>GDP per capita (in $10 000)*</td>
<td>2.95</td>
<td>4.51</td>
<td>1.36</td>
</tr>
<tr>
<td>Total tax revenue (%) of GDP</td>
<td>17.47</td>
<td>20.05</td>
<td>14.84</td>
</tr>
<tr>
<td>POGE score</td>
<td>15.67</td>
<td>16.11</td>
<td>15.21</td>
</tr>
<tr>
<td>% population aged 15–64</td>
<td>65.65</td>
<td>66.30</td>
<td>64.98</td>
</tr>
<tr>
<td>% population aged 65+</td>
<td>13.05</td>
<td>17.14</td>
<td>8.86</td>
</tr>
<tr>
<td>Observations</td>
<td>176</td>
<td>89</td>
<td>87</td>
</tr>
<tr>
<td>Countries</td>
<td>70</td>
<td>36</td>
<td>38</td>
</tr>
</tbody>
</table>

POGE indicates four tobacco control domains: P, protecting people from tobacco smoke; O, offering help to quit using tobacco; W, warning people about the dangers of tobacco use; E, enforcing bans on tobacco advertising, promotion and sponsorship.

*Currency adjusted in constant 2018 purchasing power parity (PPP) international dollars.

GDP, gross domestic product; HICs, high-income countries; LMICs, low and middle-income countries.
Simulations were conducted using the regression estimates in Table 2. In Table 4, the simulated estimates show the predicted change of tobacco excise tax revenue per capita under the base scenario and an ideal scenario that all countries score 5 in 2018. Based on the estimates of all countries, there was an increase in tobacco excise tax revenue per capita by 8.67%. However, if the countries had increased their scores to 3, the change would have been 22.51%. Similarly, using the estimates for LMICs only, if the LMICs have implemented the optimal tobacco tax policies, the per-capita tax revenue change would have been 25.08%.

**DISCUSSION**

This study examines the association between the scores from the *Tobacconomics Cigarette Tax Scorecard* and tobacco excise tax revenue per capita. We find that a 1-point higher overall cigarette tax score is associated with higher tobacco excise tax revenue per capita of $11.98 (in constant 2018 PPP international dollars). While the association was not significant for the HICs, the LMICs were found to have a positive association in which a 1-point higher overall cigarette tax score was associated with higher tobacco excise tax revenue per capita of $11.32 (in constant 2018 PPP international dollars). Also, countries with low baseline scores were found to have a positive association where a 1-point higher overall cigarette tax score was associated with higher tobacco excise tax revenue per capita of $6.92 (in constant 2018 PPP international dollars). Simulation results suggest that if countries had increased their overall cigarette tax scores to a score of 5, they would experience average increases in tobacco excise tax revenue per capita by 22.51%. Similarly, if the LMICs had increased their overall scores to their highest level, their tobacco excise tax revenue per capita could have increased by 25.08%.

Our results indicate that LMICs would experience larger increases in tobacco excise tax revenue in response to higher cigarette tax scores than HICs. Although the average tobacco excise tax revenue per capita is less in LMICs ($145 in constant 2018 PPP international dollars) than HICs ($279 in constant 2018 PPP international dollars), LMICs are more likely to rely on these tax revenues for only LMICs, higher taxes still benefit the public health of both HICs and LMICs. This suggests that although higher tax scores were associated with higher tax revenues for LMICs, higher taxes still benefit the public health of both HICs and LMICs by reducing cigarette consumption. Also, marginal effects are larger for the lower scoring countries at baseline in their association between overall tax scores and tax revenue. This suggests there are more opportunities for these countries to make improvements in cigarette taxation and increase their government tax revenue compared with countries that are already implementing a high and well-designed excise tax on cigarettes.

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**Table 2** The association between overall cigarette tax scores and tobacco excise tax revenue per capita

<table>
<thead>
<tr>
<th>Variables</th>
<th>1 All countries</th>
<th>2 HICs</th>
<th>3 LMICs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall cigarette tax score</td>
<td>11.96***</td>
<td>15.03</td>
<td>11.32**</td>
</tr>
<tr>
<td>(4.59)</td>
<td>(11.91)</td>
<td>(5.05)</td>
<td></td>
</tr>
<tr>
<td>GDP per capita</td>
<td>−53.24***</td>
<td>−58.46***</td>
<td>74.57</td>
</tr>
<tr>
<td>(7.58)</td>
<td>(9.31)</td>
<td>(58.95)</td>
<td></td>
</tr>
<tr>
<td>Total tax revenue (%) of GDP</td>
<td>2.20</td>
<td>0.44</td>
<td>4.46</td>
</tr>
<tr>
<td>(1.83)</td>
<td>(2.98)</td>
<td>(3.07)</td>
<td></td>
</tr>
<tr>
<td>POWE score</td>
<td>6.79**</td>
<td>5.19</td>
<td>5.79**</td>
</tr>
<tr>
<td>(2.76)</td>
<td>(5.81)</td>
<td>(2.80)</td>
<td></td>
</tr>
<tr>
<td>Population (%) aged 15–64</td>
<td>−8.65*</td>
<td>−27.11*</td>
<td>−3.91</td>
</tr>
<tr>
<td>(5.00)</td>
<td>(14.80)</td>
<td>(4.62)</td>
<td></td>
</tr>
<tr>
<td>Population (%) aged 65+</td>
<td>10.49</td>
<td>5.97</td>
<td>1.48</td>
</tr>
<tr>
<td>(8.73)</td>
<td>(16.72)</td>
<td>(10.47)</td>
<td></td>
</tr>
<tr>
<td>Year 2016</td>
<td>9.23*</td>
<td>2.86</td>
<td>10.54*</td>
</tr>
<tr>
<td>(4.86)</td>
<td>(10.12)</td>
<td>(5.59)</td>
<td></td>
</tr>
<tr>
<td>Year 2018</td>
<td>3.38</td>
<td>−14.99</td>
<td>6.16</td>
</tr>
<tr>
<td>(8.88)</td>
<td>(14.97)</td>
<td>(10.79)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>176</td>
<td>89</td>
<td>87</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.985</td>
<td>0.958</td>
<td>0.992</td>
</tr>
<tr>
<td>Mean (tobacco excise tax revenue per capita)</td>
<td>212.98</td>
<td>278.97</td>
<td>145.47</td>
</tr>
</tbody>
</table>

POWE indicates four tobacco control domains: P, protecting people from tobacco smoke; O, offering help to quit using tobacco; W, warning people about the dangers of tobacco use; E, enforcing bans on tobacco advertising, promotion and sponsorship.

Regressions include country fixed effects. SEs clustered at country level are presented in parentheses.

*P<0.1; **p<0.05; ***p<0.01.

GDP, gross domestic product; HICs, high-income countries; LMICs, low and middle-income countries.

**Table 3** The association between overall cigarette tax scores and tobacco excise tax revenue per capita by baseline score

<table>
<thead>
<tr>
<th>Variables</th>
<th>1 Low-score countries</th>
<th>2 Middle-score countries</th>
<th>3 High-score countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall cigarette tax score</td>
<td>6.92***</td>
<td>19.58</td>
<td>17.42</td>
</tr>
<tr>
<td>(3.22)</td>
<td>(12.80)</td>
<td>(15.58)</td>
<td></td>
</tr>
<tr>
<td>GDP per capita</td>
<td>132.65*</td>
<td>−60.83***</td>
<td>17.10</td>
</tr>
<tr>
<td>(67.42)</td>
<td>(7.10)</td>
<td>(93.28)</td>
<td></td>
</tr>
<tr>
<td>Total tax revenue (%) of GDP</td>
<td>0.63</td>
<td>0.59</td>
<td>5.49</td>
</tr>
<tr>
<td>(2.32)</td>
<td>(2.84)</td>
<td>(4.06)</td>
<td></td>
</tr>
<tr>
<td>POWE score</td>
<td>3.58</td>
<td>13.14*</td>
<td>−1.08</td>
</tr>
<tr>
<td>(2.13)</td>
<td>(7.43)</td>
<td>(6.16)</td>
<td></td>
</tr>
<tr>
<td>Population (%) aged 15–64</td>
<td>−4.94</td>
<td>−3.63</td>
<td>−25.14</td>
</tr>
<tr>
<td>(3.47)</td>
<td>(11.82)</td>
<td>(23.63)</td>
<td></td>
</tr>
<tr>
<td>Population (%) aged 65+</td>
<td>−10.06</td>
<td>15.00</td>
<td>9.72</td>
</tr>
<tr>
<td>(12.40)</td>
<td>(14.74)</td>
<td>(24.69)</td>
<td></td>
</tr>
<tr>
<td>Year 2016</td>
<td>7.73</td>
<td>10.22</td>
<td>3.88</td>
</tr>
<tr>
<td>(6.31)</td>
<td>(8.28)</td>
<td>(16.23)</td>
<td></td>
</tr>
<tr>
<td>Year 2018</td>
<td>9.16</td>
<td>−0.33</td>
<td>−29.28</td>
</tr>
<tr>
<td>(10.14)</td>
<td>(14.74)</td>
<td>(29.79)</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>55</td>
<td>68</td>
<td>53</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.983</td>
<td>0.977</td>
<td>0.956</td>
</tr>
<tr>
<td>Mean (tobacco excise tax revenue per capita)</td>
<td>75.61</td>
<td>231.77</td>
<td>331.43</td>
</tr>
</tbody>
</table>

POWE indicates four tobacco control domains: P, protecting people from tobacco smoke; O, offering help to quit using tobacco; W, warning people about the dangers of tobacco use; E, enforcing bans on tobacco advertising, promotion and sponsorship.

Regressions include country and year fixed effects. SEs clustered at country level are presented in parentheses.

*P<0.1; **p<0.05; ***p<0.01.

GDP, gross domestic product.
This is the first study to examine tobacco taxation in relation to tobacco tax revenue at the global level with a large sample of HICs and LMICs. Our findings show that higher overall cigarette tax scores are associated with higher tobacco excise tax revenue per capita, especially for the LMICs and the lower performing tobacco taxation countries at baseline. These findings are consistent with prior literature that higher and better designed taxes increase tobacco tax revenue for the government, especially for LMICs. While health taxes, including tobacco taxes, are underused globally, this study suggests that introducing or reforming tobacco taxes can generate more public tax revenues. Governments can improve fiscal balances by increasing tobacco tax revenues and by reducing tobacco-related healthcare expenditures, especially in these times when many countries are facing serious challenges in their health and fiscal systems.

This study has limitations. First, our analysis only considers the legal sales of cigarettes. The amount and changes in illicit sales of cigarettes are not addressed as they are not captured by the legal taxation scheme. While simpler tax systems and higher cigarette tax scores can enhance transparency and reduce opportunities for tax evasion activities such as smuggling, we were not able to test this due to data availability. Still, given that domestic tax evasion is a pervasive challenge in some LMICs, theoretically, LMICs would have experienced greater changes in illicit transactions of cigarettes and tobacco tax revenues in response to higher taxes. However, we find a stronger and more significant association between cigarette tax scores and tobacco tax revenue in LMICs. This may suggest that the increase in illicit cigarettes is minimal and may not undermine the increases in tax revenues.

Second, similarly, our study focuses on cigarettes and does not include other tobacco products in the analysis. When cigarette tax and price increase, smokers may switch down to cheaper or lower taxed tobacco products, which might include roll-your-own (RYO) and smokeless tobacco. This type of substitution would happen particularly in countries where other tobacco products are prevalent and where there are wide gaps in price across tobacco products. A study using data from 25 European Union member states finds that effective taxation of cigarettes and RYOs leads to reduction in price gaps between cigarettes and RYOs. Higher and effective taxes on both cigarettes and other tobacco products are essential to limit substitution.

Third, our findings can be sensitive to the sample size and the selection of countries in our sample. Our sample includes 176 observations for 70 countries in total. The size of our analytical sample could affect the statistical power of the analysis, along with the CIs in our simulation results. However, when using different specifications and different dependent variables (see online supplemental table A2), the direction and significance of the estimates are similar to our main results. Also, our sample over-represents HICs, consisting of an equal composition of HICs (51%) and LMICs (49%), while there are 70% of LMICs at the global level. In fact, there are less data available on tobacco taxation, including tobacco tax revenue, in LMICs and hence our sample tends to be skewed towards HICs suggesting potential bias. The availability of other data, including POWe scores and total tax revenue, may also affect our results. Greater support for data collection is needed in more countries, especially LMICs, and future studies should further expand this research with a larger sample.

Fourth, this analysis considers cigarette excise tax revenue as tobacco excise tax revenue. In WHO data, countries report their tobacco tax revenue as either ‘all tobacco’ or ‘cigarettes only’. While there are countries reporting their tax revenues for ‘all tobacco’, some countries reported their excise tax revenues as for ‘cigarettes only’. For these countries, their cigarette excise tax revenues were used as tobacco excise tax revenue. Nevertheless, cigarettes are still the most commonly used tobacco product in all countries worldwide, and overwhelmingly so in almost all. Thus, cigarette excise tax revenue remains to be the largest portion of tobacco excise tax revenue.

Fifth, the overall cigarette tax score is an average of the four key component scores, and a specific component score can be more associated with tobacco excise tax revenue. Online supplemental table A3 shows regression estimates using all four components together and each component separately. Using all four component scores together, only the tax share score is associated with tobacco excise tax revenue. When each key component is regressed on tobacco excise tax revenue individually, the affordability change score and tax share score are statistically significant. Model fit statistics including adjusted R-squared, the overall F-test and root mean square errors suggest that the overall score measure shows better performance compared with tax share score alone.

Sixth, the dependent variable for this study is tobacco excise tax revenue per capita which is subject to changes in the tobacco tax, smoking prevalence and intensity and population size. Tobacco tax is included in the estimation as the overall cigarette tax score for each country and year. Smoking prevalence and smoking intensity are not included in the estimation model since the measure can be a mediator between cigarette tax scores and tobacco excise tax revenue per capita. When we included cigarette smoking prevalence and per-capita cigarette consumption in the analysis, the direction and significance of the estimates were similar. While using a per-capita measure can be subject to changes in population size, this measure enables cross-country comparisons by presenting the scope of tax revenue collection relative to the country population. Analyses using different dependent variables such as ‘Tobacco excise tax revenue (%) of GDP’ and ‘Tobacco excise tax revenue (%) of total tax revenue’ show similar results in terms of the direction and significance of the coefficients (see online supplemental table A2).

Table 4 Simulation estimates

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Simulated estimates</th>
<th>Base scenario</th>
<th>Ideal scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Actual scores in 2014</td>
<td>Actual scores in 2018</td>
<td>% change</td>
</tr>
<tr>
<td>Per-capita tobacco excise tax revenue— all countries</td>
<td>205.92 (188.62–223.22)</td>
<td>223.77 (214.79–232.75)</td>
<td>8.67</td>
</tr>
<tr>
<td>Per-capita tobacco excise tax revenue— LMICs</td>
<td>142.61 (126.61–158.60)</td>
<td>145.17 (139.47–150.87)</td>
<td>1.80</td>
</tr>
</tbody>
</table>

CIs are presented in parentheses.

LMICs, low and middle-income countries.
CONCLUSIONS

Using the Tobaccoconomics Cigarette Tax Scorecard, this study finds that higher overall cigarette tax scores are associated with higher tobacco excise tax revenue per capita. Countries should aim to reach the highest level in all four components in the Cigarette Tax Scorecard by increasing excise taxes to generate high absolute cigarette prices, reducing cigarette affordability, increasing cigarette tax shares and applying better designed tax structures. In this way, these countries would be able to reduce tobacco use and increase their tobacco tax revenue which can be allocated to programmes to help low-income smokers to quit and higher development priorities, including health and education.

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