



The Impact of Raising Alcohol Taxes on Government Tax Revenue: Insights from Five European Countries

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Abstract

Background and Objective Reducing the affordability of alcoholic beverages by increasing alcohol excise taxation can lead to a reduction in alcohol consumption but the impact on government alcohol excise tax revenue is poorly understood. This study aimed to (a) describe cross-country tax revenue variations and (b) investigate how changes in taxation were related to changes in government tax revenue, using data from Estonia, Germany, Latvia, Lithuania and Poland.

Methods For the population aged 15 years or older, we calculated the annual per capita alcohol excise tax revenue, total tax revenue, gross domestic product and alcohol consumption. In addition to descriptive analyses, joinpoint regressions were performed to identify whether changes in alcohol excise taxation were linked to changes in alcohol excise revenue since 1999.

Results In 2022, the per capita alcohol excise tax revenue was lowest in Germany (€44.2) and highest in Estonia (€218.4). In all countries, the alcohol excise tax revenue was mostly determined by spirit sales (57–72% of total alcohol tax revenue). During 2010–20, inflation-adjusted per capita alcohol excise tax revenues have declined in Germany (–22.9%), Poland (–19.1%) and Estonia (–4.2%) and increased in Latvia (+56.8%) and Lithuania (+49.3%). In periods of policy non-action, alcohol consumption and tax revenue showed similar trends, but tax level increases were accompanied by increased revenue and stagnant or decreased consumption.

Conclusions Increasing alcohol taxation was not linked to decreased but increased government revenue. Policymakers can increase revenue and reduce alcohol consumption and harm by increasing alcohol taxes.

Key Points for Decision Makers

In 2022, the per capita government tax revenue from alcohol sales was considerably higher in the Baltic countries (Latvia = €167; Lithuania = €188; Estonia = €218) than in Germany (€44) and Poland (€90).

Periods of increasing alcohol taxes were linked to increasing government tax revenue.

Increasing alcohol excise taxes has the potential to lower alcohol consumption and the resulting harm, as well as increase revenue for the government.

1 Background

Increasing excise taxation of alcoholic beverages is considered a “best practice” in alcohol control policy, according to a recent overview [1]. It is also recognised as one of the “best buys” by the World Health Organization (WHO) [2], as increasing taxation has proven to be an effective and cost-efficient method for reducing social and health harm associated with alcohol consumption [3, 4]. In addition to reducing attributable harm, there are also economic reasons for implementing excise taxation on alcohol. These reasons include generating revenue and paying for negative externalities associated with alcohol use [5, 6]. Consequently, all countries have implemented excise taxation on some or all types of alcoholic beverages.

Several economic factors, such as disposable income or inflation, are key to understanding changes in alcohol consumption. Controlling for these determinants, many studies have found that increases in alcohol taxation are associated with reductions in alcohol consumption, even

after accounting for the extent to which the tax increase is passed on to the consumer because the consumer only experiences the tax through the retail price. With a price elasticity of demand of -0.5 [7], doubling the retail prices of alcoholic beverages is linked to a 50% reduction in the quantity demanded [6]. While elasticities differ by beverage type and preferred beverage in a country, 0.5 was chosen as an average value consistent with prior reviews [7, 8].

However, the impact of tax changes on government tax revenue is not well understood. An Australian modelling study suggested that a more effective tax structure would not only reduce alcohol consumption but also increase revenue [9]. Yet, some stakeholders argue that tax increases do not only increase prices and reduce consumption but also could result in *decreased* tax revenue (for industry arguments, see [10, 11]) as well as increased unrecorded alcohol consumption [12]. Consequently, many governments shy away from this measure [13], also in part for fear of such measures being unpopular with voters. For instance, results of a pan-European survey showed a substantial rejection of alcohol control policies in general, and of taxation specifically [14].

The hesitance to raise alcohol excise taxes contrasts starkly with measures implemented to curb tobacco smoking: in the European Region, cigarettes have become less affordable in 19 countries and only more affordable in nine countries between 2012 and 2022 [15]. Here, the tax share in the retail price of the most widely sold brand ranged between 31 and 86% (WHO recommended tax share: 75%). In contrast, the share of excise taxes for alcohol is estimated at 6, 14 and 31% for retail prices of wine, beer and spirits, respectively [16].

In most countries in the European Union, alcohol excise taxation levels have remained stable in recent years. However, over the past decade, the Baltic nations of Estonia, Latvia and Lithuania have increased taxation rates on alcohol as a means to decrease the high levels of per capita alcohol consumption. These three countries share very similar cultural, economic and historical backgrounds, have high levels of alcohol consumption, and have implemented different strong alcohol control policies to reduce attributable social and health harm, including different levels of tax increases [17, 18]. In contrast to the Baltic countries, alcohol excise taxes seem to be under-utilised as a measure for fiscal or alcohol control policies in Poland and Germany. Despite high levels of consumption and health consequences, their alcohol control policies have either been dismantled (Poland: [19]) or remain unaddressed (Germany: [20]).

The varying alcohol policies across the five countries provide an ideal case study for examining the correlation between alcohol control implementation and changes in alcohol tax revenue. Essentially, this represents a natural experiment, with the Baltic countries (intervention group) having rigorous control policies in place and Germany and

Poland (control group) having implemented fewer alcohol control measures. The geographical, political and economic proximity of these five nations provide additional support for an evaluative framework. Moreover, the prevalence of alcohol use has been quite similar in the five countries (68–79% in 2016), as is the level of alcohol consumption (11.5–15.1 L per capita total alcohol consumption in 2015). Differences regarding alcohol consumption can be observed regarding the prevalence of heavy episodic drinking (higher in the Baltic countries [47–55% in 2016] relative to Poland and Germany [\sim 40% in 2016]) and regarding the share of spirits in total alcohol consumption (higher in the Baltic countries and Poland [36–41%] relative to Germany [19%] in 2016; all data compiled by the WHO [21]).

In this study, we examine the generated alcohol excise tax revenues in these high-income countries of the European Union. Specifically, we aim to (1) describe the variation of tax revenue between countries and (2) investigate how changes in taxation are related to changes in government tax revenue.

2 Methods

2.1 Data Sources

We sourced annual alcohol excise tax revenue data for Estonia [22], Germany [23], Lithuania [24], Latvia (unpublished data of the Ministry of Finance) and Poland (unpublished data of the Ministry of Finance). For Poland, the only country with a currency other than Euros (€), we converted the annual revenue data into € using the yearly conversion factor from 1 October of that year [25]. The country-specific nominal alcohol excise tax rates are presented in Tables 1–5 of the Electronic Supplementary Material (ESM). This summary shows that the alcohol excise tax rates are usually not adjusted for inflation.

As the taxation system for alcoholic products differs across countries, we classified the tax revenue into three categories (beer, spirits and wine). The classification of country-specific tax types is described in Table 1.

To compare alcohol with tobacco revenue, we also obtained taxation revenue data from tobacco sales for each country. To contextualise the volume of alcohol tax revenue across countries, we obtained annual data on the total tax revenue for each country from the same sources. For further contextualisation, we also obtained the per capita recorded (i.e. sales-based) alcohol consumption for all years up to 2020 (in litres of pure alcohol; last available data point; unpublished WHO estimates). Last, we obtained data on the gross domestic product (GDP) in € (current prices) from Eurostat (indicator “nama_10_gdp”; [26]), which facilitated a comparison between trends in revenues

Table 1 Definition and level of excise taxes for beer, wine and spirits in each country in 2022

Country	Beer	Spirits	Wine
Estonia	Beer taxed at €12.70 per 1% of alcohol per 100-L beverage	“Other alcohol” taxed at €1881 per 100 L of pure alcohol	Wine (> 6% ABV) and fermented beverages (> 6% ABV) taxed at €147.82 per 100-L beverage; wine (≤ 6% ABV) and fermented beverages (≤ 6% ABV) taxed at €63.41 per 100-L beverage; intermediary products taxed at €289.33 per 100 L of pure alcohol
Germany	Beer taxed at €0.787 per 1° Plato of 100-L beverage	Spirits taxed at €1303 per 100 L of pure alcohol; alcopops taxed at €5500 per 100 L of pure alcohol	Sparkling wine taxed at €51 (if ABV < 6%) or 136 (if ABV ≥ 6%) per 100-L beverage; intermediary products taxed at €102 (if ABV > 1.2 and ≤ 15%) or €153 (if ABV > 15 and ≤ 22%); no excise taxes on regular/still wine
Latvia	Beer taxed at €8.20 per 1% of alcohol per 100-L beverage	“Other alcohol” taxed at €1724 per 100 L of pure alcohol	Wine (< 18% ABV), fermented beverages (if ABV > 6 and ≤ 15.0%) and intermediate products (if ABV ≤ 15%) taxed at €111 per 100-L beverage; fermented beverages (if ABV ≤ 6%) taxed at €64 per 100-L beverage; intermediary products (if ABV > 15 and ≤ 22%) taxed at €185 per 100-L beverage
Lithuania	Beer taxed at €7.82 per 1% of alcohol per 100-L beverage	“Other alcohol” taxed at €2163 per 100 L of pure alcohol	Wine and other fermented beverages taxed at €78 (if ABV ≤ 8.5%) or €181 (if ABV > 8.5%); intermediary products taxed at €200 (if ABV ≤ 15%) or €285 (if ABV > 15%)
Poland	Beer taxed at 9.43 PLN per 1° Plato of 100-L beverage	Ethyl alcohol taxed at 6903 PLN per 100 L of pure alcohol	Wine and fermented beverages taxed at 191 PLN per 100-L beverage; intermediary products taxed at 385 PLN per 100-L beverage

For years other than 2022, see Tables 1–5 of the ESM
 ABV alcohol by volume

and macroeconomic development. To adjust for inflation, we used the annual harmonised index of consumer prices (HICP) from Eurostat (indicator “prc_hicp_aind”; [27]). To describe changes over time, we calculated per capita indices using the population aged 15 years or older based on the UN Population Prospects [28].

To examine how changes in alcohol excise taxes influence the total alcohol excise tax revenue, we compiled any law changes for each of the three beverage groups for the five countries. Comparing the tax levels before and after the respective law changes, we obtained estimates for the percentage change in alcohol excise tax for each country (see Tables 1–5 of the ESM). For Germany, the only tax increase occurred on 1 July, 2004 with the introduction of taxes for alcopops (sweetened beverages with alcohol content between 1.2 and 10%), which increased prices substantially for this beverage type [29].

2.2 Analyses

The main outcome variable is annual per capita alcohol excise tax revenue, which gives the amount of any alcohol excise tax per person aged 15 years and older in € in different countries. The main analyses were performed on the nominal tax revenue rather than inflation-adjusted data, as we believe that the nominal indicator is of higher interest to stakeholders (e.g. policymakers) and the public. In additional analyses, we also investigated inflation-adjusted trends by calculating real values that account for inflation using the consumer price index [real value = (nominal value in year x /HICP in year x) \times 100]. If not mentioned explicitly, all results refer to nominal rather than inflation-adjusted values.

Descriptive statistics including Pearson correlations were performed. To compare how variables of interest have changed over time, we chose 2010 as the reference year. Being the first year after the economic crisis (2007–9) in the examined countries as well as being centred in the study period in most countries, this reference year was considered an appropriate choice for obtaining comparable changes over time.

To identify whether alcohol excise tax changes were associated with changes in per capita alcohol excise tax revenue, we performed joinpoint regression analyses for each country. In time series data, these analyses serve to determine (a) the annualised rate of change and (b) distinguish between periods of varying slopes, i.e. determine change points (also called joinpoints). That method is particularly well suited to test whether hypothesised change points exist in the data (see e.g. changes in drug seizures during the coronavirus disease 2019 pandemic: [30]).

Using the Joinpoint Trend Analysis Software of the US-based National Institute of Health [31] within the R environment, we identified the best-fitting joinpoint model.

We assumed that model errors were autocorrelated (first order) and the models were run on logarithmised outcomes, allowing us to obtain estimates that can be interpreted as a percentage change per additional year. In the software, the simplest model (no joinpoint, one trend fits the whole period) is compared to more complex models with additional joinpoints. We allowed up to four joinpoints and selected the best model based on the weighted Bayesian Information Criterion.

In Poland (the only country without € in our analyses), we used the per capita alcohol excise tax revenue in zloty to minimise bias by currency conversion (weakening or increasing value over time). Except for the joinpoint analyses, all data were processed and analysed with R version 4.2.3 [32]. The code and data are shared publicly [33].

3 Results

3.1 Cross-Country Variation of Tax Revenue

In 2022, the per capita alcohol excise tax revenue was lowest in Germany (€44) and Poland (€90) and considerably higher in Latvia (€167), Lithuania (€188) and Estonia (€218). A similar but more pronounced pattern could be observed in the proportion of alcohol excise tax revenue from total tax revenue. While alcohol excise tax revenue only contributed 0.4% to the total tax revenue in Germany, this share was considerably higher in the other four countries (Estonia: 2.3%, Latvia: 2.1%, Lithuania: 2.9%, Poland: 2.7%; see also Table 6 of the ESM for data from other years). For further context, the contribution of tax revenue from tobacco sales to total tax revenue was 2.4, 1.6, 2.1, 2.3 and 4.7% in Estonia, Germany, Latvia, Lithuania and Poland, respectively.

As illustrated in Fig. 1, the per capita alcohol excise tax revenue in all countries is mostly determined by spirit sales, which contribute between 57% and 71% of total alcohol excise tax revenue. For comparison, data from 2020 indicate that spirit sales made up about 20% of total pure alcohol sales in Germany and about 39–45% in the other three countries.

3.2 Trends in Per Capita Alcohol Excise Tax Revenue

The trends in per capita alcohol excise tax revenue for each country are shown in Fig. 2. Several patterns can be observed between 2010 and 2022.

In all five countries, the per capita GDP went up (between +47 and 173%) and the total tax revenue increased nominally, although to different extents. Germany saw the lowest increase in GDP and total tax revenue while the largest increases were observed for Lithuania. Both macroeconomic variables correlated highly ($r > 0.98$

Fig. 1 Per capita alcohol excise tax revenue in 2022 (*upper half*) and per capita recorded alcohol consumption in 2020 (*lower half*) for Estonia, Germany, Latvia, Lithuania and Poland. The numbers in each bar indicate the relative contribution of each beverage type to per capita alcohol excise tax revenue/consumption

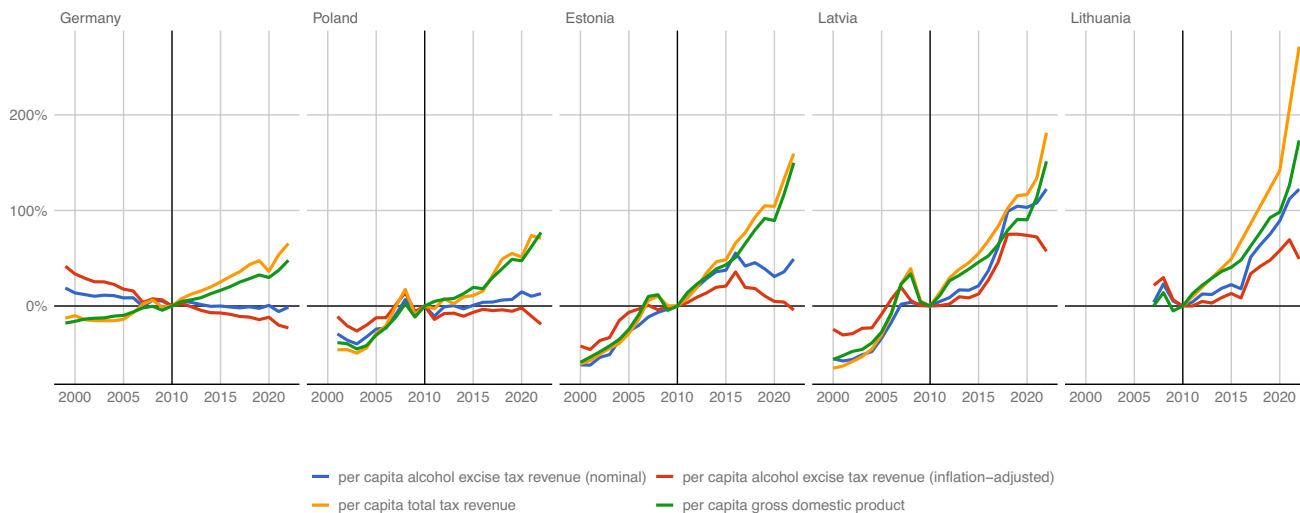
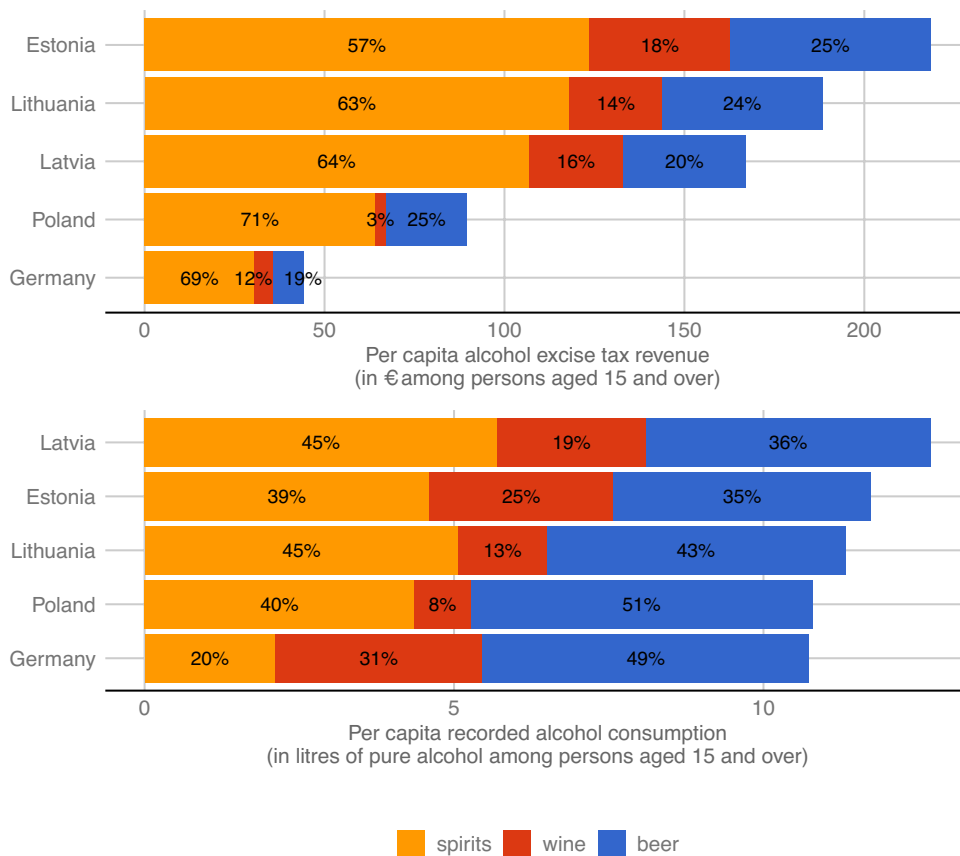


Fig. 2 Changes in per capita **a** alcohol excise tax revenue (nominal and inflation adjusted), **b** total tax revenue and **c** gross domestic product, relative to 2010 (vertical solid line)

in each of the five countries). Paralleling these trends, we observed increasing nominal per capita alcohol excise tax revenue in Estonia (+ 49%), Latvia (+ 122%) and Lithuania (+ 122%). A similar trend but at a lower magnitude was observed in Poland (+ 13%). In Germany (− 1.3%),

nominal per capita alcohol excise tax revenue has declined slightly.

When adjusting for inflation, we find that the real per capita alcohol excise tax revenue has declined in Germany (− 22.9%), Poland (− 19.1%) and Estonia (− 4.2%). Between

2010 and 2022, inflation-adjusted increases in per capita alcohol excise tax revenue could be observed only in Lithuania (+49.3%) and Latvia (+57.2%).

3.3 Impact of Alcohol Taxation Increase on Alcohol Excise Tax Revenue

To examine whether taxation increases are linked to changes in per capita alcohol excise tax revenue, we conducted jointpoint regressions. The findings are reported in Table 7 of the ESM and Figs. 3, 4, 5, 6 and 7. We present the findings for each country separately, starting with the three Baltic countries and followed by the two central European countries.

In Estonia, alcohol excise tax increases were implemented in 13 out of 23 years. The jointpoint analysis suggests breaking points in the time series of per capita alcohol excise tax revenue in 2002, 2005, 2016 and 2020 (Fig. 3). The nearly annual increases of alcohol excise taxes in the periods 2003–5 and 2005–16 were accompanied by rising tax revenue. Between 2016 and 2020, alcohol excise taxes were increased (2016–18) but also decreased (2019). In this period, per capita alcohol excise tax revenue stagnated. In the first years, trends of per capita recorded alcohol consumption and excise tax revenue were mostly parallel. After a series of (substantial) tax increases, a separation of these trends followed, with increasing tax revenue and decreasing consumption.

In Latvia, alcohol excise taxes were increased in 2006, 2009–11 and between 2015 and 2020. The jointpoint analysis suggests breaking points in the time series of per capita alcohol excise tax revenue in 2003, 2007, 2015 and 2018

(Fig. 4). There were two periods of increasing per capita alcohol excise tax revenue: the first reflected increasing consumption during 2003 and 2007 and the second reflected stagnating consumption and rising taxes during 2015 and 2018. As in Estonia, the mostly parallel trend of consumption and tax revenue diverged after a series of tax increases were implemented after 2014.

In Lithuania, alcohol excise taxes were increased in 10 years between 2007 and 2022. The jointpoint analysis suggests breaking points in the time series of per capita alcohol excise tax revenue in 2010 and 2015 (Fig. 5). The tax increases in 2008 and 2009 were not accompanied by increased tax revenue or decreasing consumption. Between 2014 and 2022, during which alcohol taxes were repeatedly increased (substantially), per capita alcohol excise tax revenue increased and recorded alcohol consumption decreased: between 2015 and 2022, per capita alcohol excise tax revenue nearly doubled from €103.7 to 188.4, while per capita recorded alcohol consumption fell from 13.0 to 11.3 L (between 2015 and 2020).

In Germany, alcohol excise taxes for alcopops were increased in 2004 and the jointpoint analysis suggests that the continuous decrease of per capita alcohol excise tax revenue was slowed down after 2007 (Fig. 6). Across the entire time series, per capita recorded alcohol consumption and excise revenue followed a parallel downward trend.

In Poland, alcohol excise taxes were decreased in 2002 but increased in 6 other years. The results of the jointpoint analysis suggested three breaking points (in 2006, 2009 and 2018) in the time series of per capita alcohol excise tax revenue (Fig. 7). While alcohol excise tax revenue

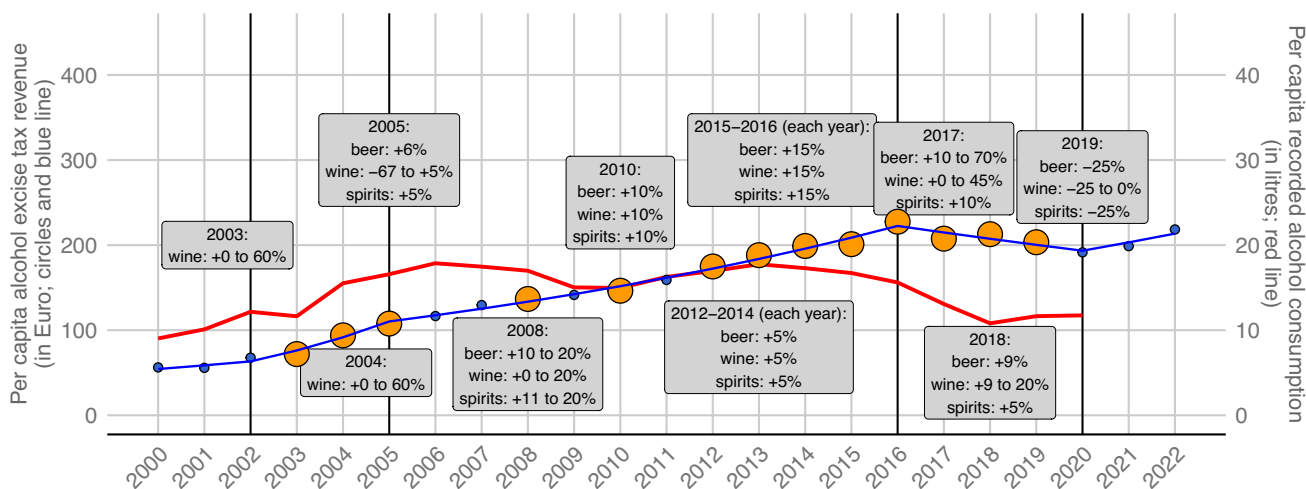


Fig. 3 Per capita alcohol excise tax revenue (left axis) and per capita recorded alcohol consumption (right axis) in Estonia. The circles represent the observed alcohol excise tax revenue data while the larger orange circles highlight years with changes in alcohol excise taxation that are further detailed in the grey boxes. The blue solid

line indicates the predicted trend from the jointpoint regression on tax revenue, with the vertical solid lines indicating the jointpoints. The red line indicates the trend in per capita recorded alcohol consumption based on sales data

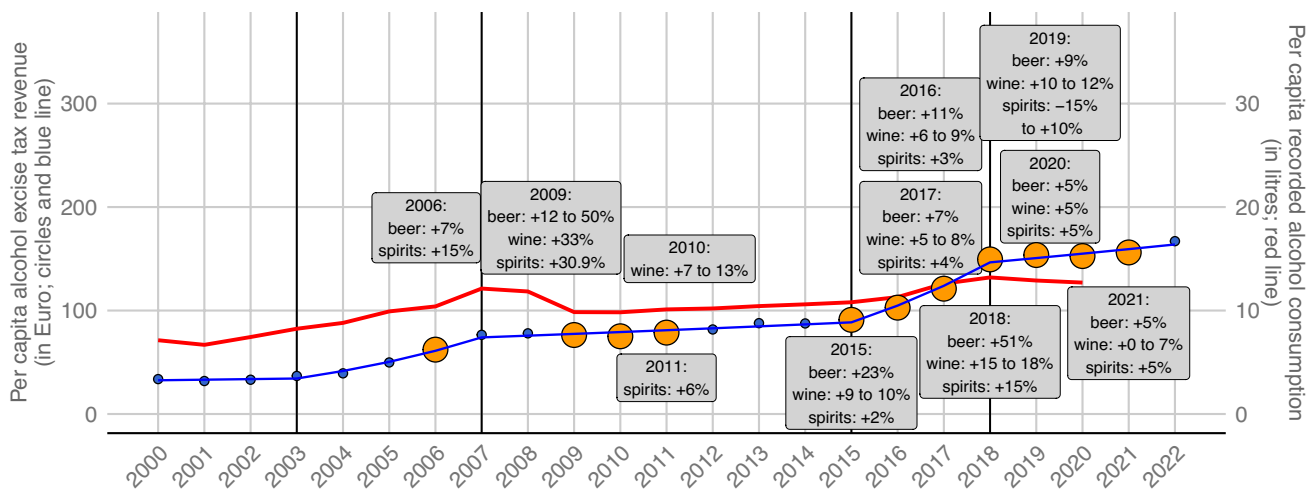


Fig. 4 Per capita alcohol excise tax revenue (*left axis*) and per capita recorded alcohol consumption (*right axis*) in Latvia. The *circles* represent the observed alcohol excise tax revenue data while the *larger orange circles* highlight years with changes in alcohol excise taxation that are further detailed in the *grey boxes*. The *blue solid*

line indicates the predicted trend from the jointpoint regression on tax revenue, with the *vertical solid lines* indicating the jointpoints. The *red line* indicates the trend in per capita recorded alcohol consumption based on sales data

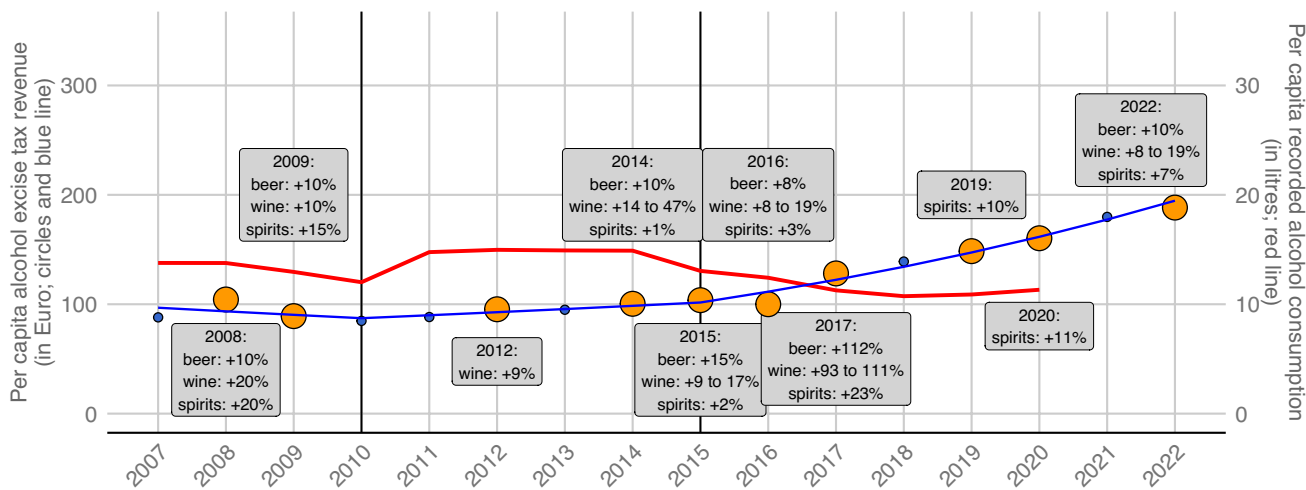


Fig. 5 Per capita alcohol excise tax revenue (*left axis*) and per capita recorded alcohol consumption (*right axis*) in Lithuania. The *circles* represent the observed alcohol excise tax revenue data while the *larger orange circles* highlight years with changes in alcohol excise taxation that are further detailed in the *grey boxes*. The *blue solid*

line indicates the predicted trend from the jointpoint regression on tax revenue, with the *vertical solid lines* indicating the jointpoints. The *red line* indicates the trend in per capita recorded alcohol consumption based on sales data

(and consumption) increased throughout the entire time series, there were two periods of accelerated tax revenue rise in Poland: the first period between 2006 and 2009 was characterised by increasing alcohol consumption and ended with a moderate alcohol excise tax increase. The second period started in 2018 and was accompanied by

two moderate alcohol excise tax increases in 2020 and 2022.

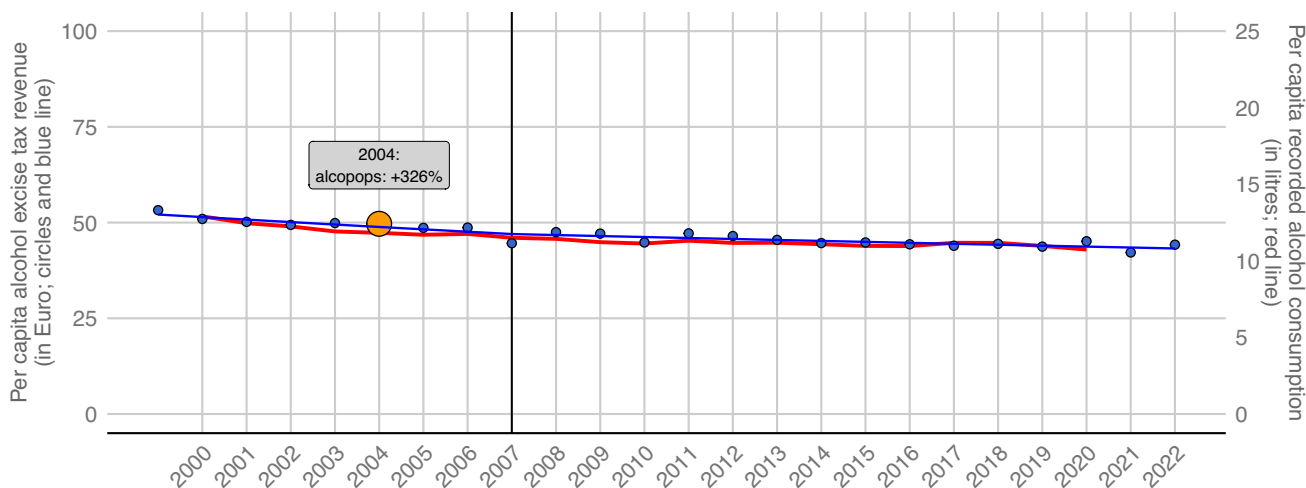


Fig. 6 Per capita alcohol excise tax revenue (*left axis*) and per capita recorded alcohol consumption (*right axis*) in Germany. The *circles* represent the observed alcohol excise tax revenue data while the *larger orange circles* highlight years with changes in alcohol excise taxation that are further detailed in the *grey boxes*. The *blue solid*

line indicates the predicted trend from the joinpoint regression on tax revenue, with the *vertical solid lines* indicating the joinpoints. The *red line* indicates the trend in per capita recorded alcohol consumption based on sales data

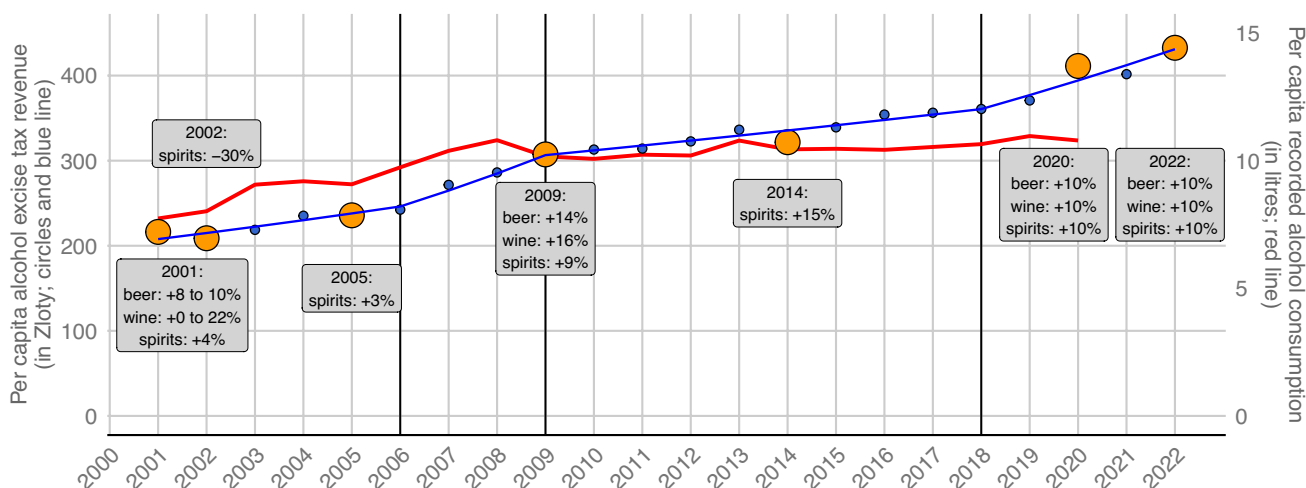


Fig. 7 Per capita alcohol excise tax revenue (*left axis* in Złoty) and per capita recorded alcohol consumption (*right axis*) in Poland. The *circles* represent the observed alcohol excise tax revenue data while the *larger orange circles* highlight years with changes in alcohol excise taxation that are further detailed in the *grey boxes*. The *blue*

solid line indicates the predicted trend from the joinpoint regression on tax revenue, with the *vertical solid lines* indicating the joinpoints. The *red line* indicates the trend in per capita recorded alcohol consumption based on sales data

4 Discussion

4.1 Main Findings

The analyses of current as well as historical data on alcohol excise taxation reveal several insights. First, more than half of alcohol excise revenue is derived from spirit sales, although it makes up markedly less than half of alcohol

consumption. The relatively higher tax rates for spirits are based on the significantly lower production costs per unit of alcohol of this beverage type. Second, the cross-country variations in alcohol excise tax revenue reflect the different levels of taxes, with higher revenue generated in countries with higher per capita taxation levels (see also [16]). Third, per capita alcohol excise tax revenue has decreased since 2010 in three out of five countries when adjusting for inflation and in no country has alcohol

excise tax revenue increased at the same magnitude as overall tax revenue, resulting in a decreasing contribution of alcohol sales to the overall state budget. Fourth, alcohol excise tax revenue and alcohol consumption appear to follow similar trajectories during times of non-action, i.e. stagnant alcohol excise tax rates (or declines when adjusting for inflation), but when alcohol excise taxes are raised, revenue increases while consumption stagnates or declines.

4.2 Limitations

We acknowledge several limitations to our data. First, analysing high-level aggregate data at the annual level employs a birds-eye perspective without disclosing changes in lower-level behaviour. While rising retail prices are generally expected to reduce sales, they may also incentivise obtaining and using alcohol from other sources (e.g. home-brew beer and cross-border imports). Generally, potential increases in the consumption of alcohol from other sources are not expected to offset decreases in consumption resulting from tax increases [12]; however, the exact outcome will depend on the country, i.e. on retail price levels, income levels, and the availability and costs of unrecorded alcohol products. These factors need to be considered when estimating the impact of alcohol tax increases on tax revenue and consumption. Second, we considered any changes in alcohol taxes in our analyses; however, it should be acknowledged that small changes are unlikely to result in behavioural changes. For example, if the net income rises by 5%, alcoholic beverages likely become more affordable, except if the retail price increases by at least 5% as well. As alcohol excise taxes usually make up less than 30% of the retail price [16], tax increases of 15% or more would be required to actually decrease affordability. For this reason, analyses of the impact of tax changes on health outcomes are usually restricted to those changes that reduce affordability (e.g. [17]). Aiming to identify possible attenuating effects of tax increases on revenue, we pursued a more lenient approach and considered any tax change. Third, in our analyses, we did not systematically include other alcohol-control measures, which have been clearly shown to impact alcohol consumption in the region, and which were in part implemented at the same time or in close temporal proximity [34].

4.3 Implications

Empirical research on the relationship between alcohol taxation and revenue is still sparse. This knowledge gap is surprising given the interest in revenue among policymakers. An Australian study found that changes in the beer taxation structure were not related to government revenue

or consumption [35]. Other than that, it has been speculated [36] or statistically modelled [9, 37] that increasing alcohol taxes results in increased revenue based on price elasticity estimates. However, given the industry's claims that raising alcohol tax revenue declines following tax increases, our study provides important direct empirical evidence to refute this claim.

The unbalanced tax structure across European countries has been previously described [38], demonstrating overall low rates of alcohol excise tax levels in most countries. A modelling study estimated that a sizeable number of alcohol-attributable deaths could be avoided if countries increased their current taxation level to increase prices and achieve higher percentages of taxation in the retail price [16]. In addition to cross-country differences, countries also consistently levy higher taxes for spirits than for other alcoholic beverages. In 14 out of 28 countries of the European Union, no excise taxes are levied for wine and in 21 countries, less than £0.10 (about €0.12) excise taxes per unit of beer with 5% alcohol content was levied in 2018 [38]. In contrast, only three countries levied less than £0.10 excise taxes per unit of spirits with 40% alcohol content. Accordingly, it is not surprising that beer makes up between 35 and 51% of consumption but contributes only between 19 and 25% of government revenue. Closing this gap is expected to reduce consumption and increase revenue.

Data from Germany suggest that the annual revenue from alcohol excise taxes, which amount to about €3 billion annually, constitutes only a fraction of direct health-care costs attributable to alcohol use, which amounted to about €9 billion in 2009, not considering the €30 billion indirect costs (e.g. sick leave or premature mortality; [39]). The non-action of the German government is reflected in stagnating revenue from alcohol sales since 2007 and a net loss of inflation-adjusted revenue of 23% between 2010 and 2022. In contrast, alcohol taxes were repeatedly increased in Lithuania and Latvia, resulting in considerable gains in the inflation-adjusted alcohol excise tax revenue in those two countries. For Estonia, the annual increase in alcohol taxes between 2012 and 2019 was contrasted by a considerable tax reduction in 2019. This act coincided with a discontinuation of a decreasing trend of per capita recorded alcohol consumption.

To understand the dynamics of increases and specifically decreases in alcohol excise taxes in Estonia and Latvia, it should be noted that the cross-border alcohol trade in Latvia and Estonia increased in 2016 and 2017, mostly driven by lower alcohol retail prices in Latvia. To reduce cross-border trade, the Estonian government reduced the alcohol excise tax by 25% in July 2019. The Latvian government responded in August 2019 by lowering the excise tax on spirits in Latvia by 15% [40, 41]. However, the cross-border trade dynamics between Estonia and Latvia were not necessarily altered

by these contesting tax changes but rather by the onset of travelling restrictions related to coronavirus disease 2019 pandemic containment measures.

In Poland, geographically located between Germany and the Baltic countries, the trends in alcohol excise tax revenue and consumption appear to be a mix between those two ends. As one of the few European countries, per capita recorded alcohol consumption has increased steadily in Poland since 2002, with increasing levels of alcohol harm observed in recent years [19]. Alcohol excise taxes have been moderately increased on a few occasions in the past 20 years. As in the Baltic countries and unlike in Germany, per capita revenue from alcohol sales is slowly diverging from per capita recorded alcohol consumption in Poland. As the tax increases in Poland have been rather moderate, there appears to be potential to reduce consumption and harm, as well as reverse increasing trends of alcohol-attributable harm in Poland by increasing alcohol excise taxes.

5 Conclusions

Our findings highlight the relevance of alcohol excise taxation for the government budget as well as for public health. We did not find any evidence supporting concerns that increasing alcohol taxes results in decreased revenue. On the contrary, increasing alcohol excise taxes can raise government revenue and mitigate alcohol-attributable harm by reducing consumption. Thus, policymakers seeking to increase their revenue from alcohol consumption should not incentivise increased consumption but consider increasing excise taxes, at minimum, to align with inflation. The largest untapped potential for those benefits may be found in countries with low alcohol excise taxes and a high affordability of alcoholic beverages, such as Germany, Spain or France [42].

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Declarations

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Conflict of interest Jakob Manthey has worked as a consultant for and received honoraria from public health agencies. Inese Gobiņa, Laura Isajeva, Jarosław Neneman, Rainer Reile, Mindaugas Štelemėkas and Jürgen Rehm have no conflicts of interest that are directly relevant to the content of this article.

Ethics approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

Availability of data and material The datasets generated during and/or analysed during the current study are made available through a public repository (doi: <https://doi.org/10.6084/m9.figshare.24080862>).

Code availability The code used to analyse the data is made available through a public repository (doi: <https://doi.org/10.6084/m9.figshare.24080862>).

Author contributions JM: conceptualisation, methodology, software, validation, formal analysis, investigation, resources, data curation, writing—original draft, writing—review and editing, visualisation, supervision, funding acquisition. IG: validation, investigation, resources, writing—review and editing. LI: validation, investigation, resources, writing—review and editing. JN: conceptualisation, methodology, validation, investigation, resources, writing—review and editing. RR: conceptualisation, methodology, validation, investigation, resources, writing—review and editing. MS: validation, investigation, resources, writing—review and editing, funding acquisition. JR: validation, supervision, funding acquisition. JM is the guarantor and accepts full responsibility for the work and/or the conduct of the study, had access to the data and controlled the decision to publish. All authors had full access to the full study data.

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