Addiction

FOR DEBATE

Alcohol taxation policy in Thailand: implications for other low- to middle-income countries

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ABSTRACT

Aim Prevention of drinking initiation is a significant challenge in low- and middle-income countries that have a high prevalence of abstainers, including life-time abstainers. This paper aims to encourage a debate on an alternative alcohol taxation approach used currently in Thailand, which aims specifically to prevent drinking initiation in addition to reduce alcohol-attributable harms. **Methods** Theoretical evaluation, simulation and empirical analysis. **Result** The taxation method of Thailand, 'Two-Chosen-One' (2C1) combines specific taxation (as a function of the alcohol content) and *ad valorem* taxation (as a function of the price), resulting in an effective tax rate that puts a higher tax both on beverages which are preferred by heavy drinkers and on beverages which are preferred by potential alcohol consumption neophytes, compared to either taxation system alone. As a result of these unique properties of the 2C1 taxation system, our simulations indicate that 2C1 taxation leads to a lower overall consumption than *ad valorem* or specific taxation alone. In addition, it puts a relatively high tax on beverages attractive to young people, the majority of whom are currently abstaining. Currently, the abstention rates in Thailand are higher than expected based on its economic wealth, which could be taken as an indication that the taxation strategy is successful. **Conclusion** 'Two-chosen-one' (2C1) taxation has the potential to simultaneously reduce alcohol consumption and prevent drinking initiation among youth; however, additional empirical evidence is needed to assess its effectiveness in terms of the public health impact in low- and middle-income countries.

Keywords Alcohol, drinking initiation, low and middle income countries, prevention, pricing, taxation, Thailand.
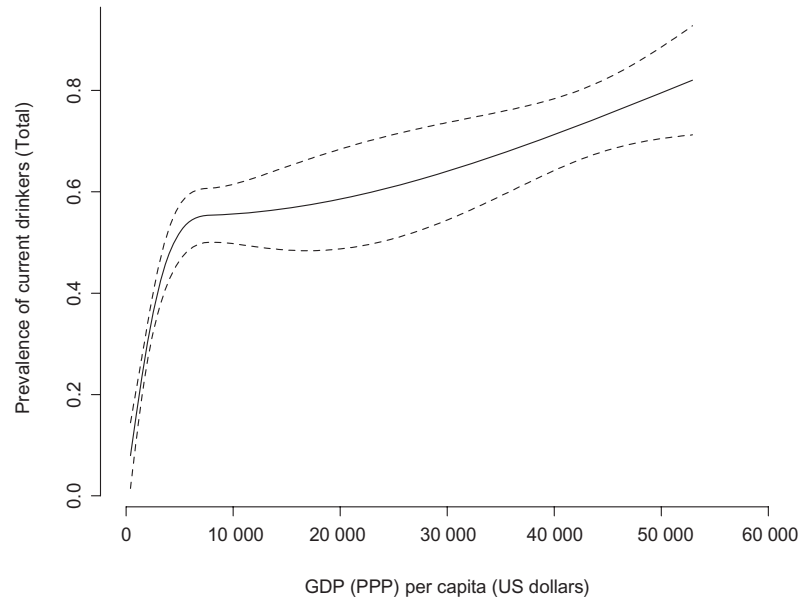
CONCISE STATEMENT

Alcohol taxation and other alcohol control policies in high-income countries aim mainly to reduce alcohol-attributable harms by reducing harmful alcohol consumption in current drinkers [1]. The goal of preventing people from drinking at all is rarely formulated, whereas delay of initiation is a major focus of prevention (e.g. [2,3]). Low- and middle-income countries not only aspire to reduce consumption and associated harm in drinkers, but are equally in need of alcohol taxation policies directed towards preventing initiation of drinking and maintaining high rates of abstention, including life-time abstention. The alcohol taxation system in Thailand tries to combine both aims, and is discussed in detail in this report.

ALCOHOL CONSUMPTION AND ATTRIBUTABLE HARMS IN LOW- AND MIDDLE-INCOME COUNTRIES—IMPLICATIONS FOR ALCOHOL CONTROL POLICIES

There are marked between-country differences in alcohol consumption and alcohol-attributable harms, and these differences are related to the economic wealth of nations [4–6]. Overall, the association between wealth as measured in gross domestic product—purchasing power parity (GDP–PPP) and alcohol consumption is very strong up to a GDP–PPP of about $10 000 to $15 000 and then this association levels off [5,7]. This is due mainly to a much higher proportion of abstainers, mainly life-time abstainers, in middle- and especially in

Figure 1 Association between prevalence of current drinkers (total) and gross domestic product (GDP–PPP) *per capita.* Our calculations are based on ongoing comparative risk assessment data (see also Global Information System on Alcohol and Health: http://apps.who.int/ghodata/?theme=GISAH)

low-income countries (LIC) [8]. Figure 1 describes the relationship between GDP–PPP and the prevalence of current drinkers in the adult population (based on 2005 rates of current drinkers from the ongoing comparative risk assessment).

As a result, the lowest-income countries tend to consume the least amount of alcohol on an adult per-capita basis [6]. In middle-income countries (MIC) adult per-capita consumption is higher than in LIC; however, consumption is still much lower than in high-income countries (HIC). While less alcohol is consumed in low- and middle-income countries (LMIC), the relative harm associated with each litre consumed per capita is much greater [9] due to alcohol being consumed in more harmful patterns [10], and there is a higher risk of mortality and morbidity from causes where alcohol plays a role (such as injuries) [11]. In addition, alcohol interacts with other risk factors such as poverty, crowding and malnutrition [5].

As a consequence of the above situation with the overwhelming majority of people drinking in HIC [8,12], the goal of preventing people from drinking at all (i.e. keeping a high proportion of life-time abstainers) is rarely formulated; most of the focus seems to be on delaying age of initiation and reducing harms associated with earlier initiation [2,3,13].
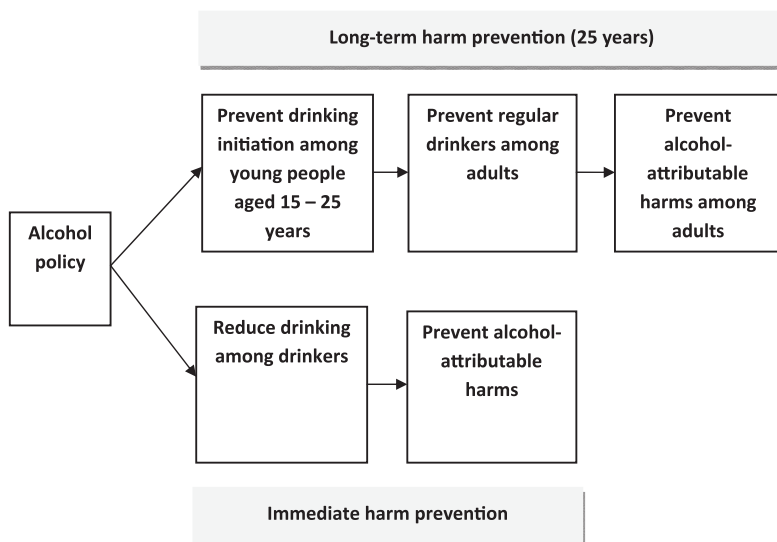
ALCOHOL CONSUMPTION AND ATTRIBUTABLE HARMS IN THAILAND

Thailand is considered an MIC with a GDP–PPP per capita of US$8643 in 2010 [14]. It had a low prevalence of current drinkers at approximately 30% (measured as having at least one drink in the past year) in 2007 [15],

and a high prevalence of abstainers, especially among youth, with 75% of male and 86% of female secondary school students having abstained from alcohol in the past year [16]. Given Thailand's GDP–PPP and the relationship between GDP–PPP and total adult per-capita consumption (see above), we would expect the prevalence of current drinkers in Thailand to be around 50%.

From 2001 to 2007 Thailand had relatively stable or slightly decreasing prevalence rates of current or past year drinkers for both males and females and in all age groups: 55.9–52.3% for males, 9.8–9.1% for females, 21.6–22.2% for the age group 15–24 years, 40.4–36.3% for the age group 25–40 years, 38.1–34.5% for the age group 40–60 years and 20.0–16.4% for the age group 60 years and over [15]. In addition, Thailand's total per-capita consumption has remained relatively stable from 1990 to 2008, while GDP–PPP increased from $2900 to $8200 international dollars [7]. This trend is unexpected, given the previously observed association between GDP–PPP and total adult per-capita consumption [7]. As has been shown elsewhere, in LMIC adult per-capita consumption is correlated highly with level of abstention [8].

Despite a low prevalence of current drinkers, Thailand's alcohol-attributable harms are substantial. In the past 5 years there were more than 18 traffic accident deaths per 100 000 people per year [17]; among these deaths, 40–60% were attributable to drink-driving [18]. There has been a fourfold increase in the likelihood of domestic violence when alcohol is involved [19], and 40% of youth crimes are related to alcohol [20].

Once Thai adolescents begin to drink, they tend to become regular drinkers (measured as drinking in the past month). Two-thirds of male and almost one-half of

Figure 2 Diagram of the immediate and long-term alcohol-attributable harms addressed by alcohol policy in Thailand

female students who have had at least one alcoholic drink have also consumed alcohol in the last 30 days [16]. For Thailand and countries with a similar situation of overall low consumption and a high rate of abstention, alcohol policy should thus aim to reduce alcohol consumption among drinkers and to prevent drinking initiation to maintain a high proportion of abstainers, mainly lifetime abstainers. Combining these aims may reduce immediate, mid-term and long-term alcohol-attributable harms (see Fig. 2).

In most HIC, in contrast, it is accepted that the overwhelming majority of the general population will become drinkers, and alcohol policy tries primarily to reduce alcohol-attributable harms by reducing harm among drinkers or by postponing initiation of drinking [21].

BEVERAGES PREFERRED BY YOUTH IN THAILAND

Thai youth tend to consume low alcohol content beverages, specifically beer [15], alcohol mixed with fruit juice and ready-to-drink (RTD) beverages [22], and rarely consume white spirits, and other beverages with medium or high alcohol content [15]. Moreover, youth abstainers are most likely to first consume low alcohol content beverages [23]. A taxation method that would heavily tax beverages preferred by youth would potentially limit drinking initiation among youth.

ALCOHOL EXCISE TAXATION SYSTEMS

Excise taxation, a selective tax on a particular good, can be used by governments to increase prices on certain goods and/or services that produce externalities, i.e. costs to the public [24]. Specifically, alcohol excise taxation

increases the price of alcohol to consumers who respond by decreasing their consumption, leading to a decrease in the resulting externalities attributable to alcohol consumption [24,25]. In comparison to other methods, taxation is one of the most effective interventions in terms of feasibility, implementation cost and cost-effectiveness [26,27].

There are two popular methods of excise taxation for alcoholic beverages: specific and *ad valorem* [24,28]. Specific taxation is based on the volume of pure alcohol in a beverage, while *ad valorem* taxation is a function of the price of a beverage. Specific taxation has proved to be appropriate for HIC with a high prevalence of current drinkers [29,30], as it favours low alcohol content beverages with lower overall intake of alcohol per occasion. However, it may encourage drinking initiation among youth in countries with a high prevalence of abstainers, as initiation is often via low alcohol content beverages [31]. However, for LMIC, it is imperative to prevent drinking initiation among youth as well as to reduce drinking levels among drinkers.

THAILAND'S ALCOHOL TAXATION SYSTEM

Thailand has six separate taxes which are charged on alcoholic beverages. The first tax is customs duty applied to imported beverages only. All other taxes are applied to imported and domestically produced beverages: excise tax, which is termed 'Two-Chosen-One' taxation (2C1), and municipality, health promotion and Thai television tax, which are equal to 10, 2 and 1.5% of the excise tax, respectively. Upon purchase, a value added tax, calculated as 7% of the retail price, is charged.

The customs taxation system is structured as a 2C1 taxation system with beverage-specific rates based on

price for *ad valorem* taxation, and a fixed sum per litre of pure alcohol for specific taxation. The higher of these two taxation methods is applied (see details below). The excise tax rate under 2C1 taxation in Thailand applies different tax rates to different alcoholic beverages as follows. The excise tax rates for beer and wine are 60% (inclusive rate) of ex-factory price (or producer price) for *ad valorem* taxation and 100 THB (Thai baht: $30 THB is about US$1) per litre of pure alcohol for specific taxation. For white spirits, mixed spirits and whisky, the *ad valorem* tax rate is 50% (inclusive rate) of ex-factory price for these distilled spirits, while the specific tax since 2009 has been calculated as 120, 300 and 400 THB per litre of pure alcohol, respectively.

TWO-CHOSEN-ONE TAXATION (2C1)

The 2C1 taxation method, outlined in the Alcohol Act 1950, calculates the excise tax of each alcoholic beverage using both primary taxation methods—specific and *ad valorem*; the excise tax on the beverage is then determined to be the higher of the two calculations. For example, the specific tax of a distilled spirit is 105 THB and the *ad valorem* tax is 58 THB; application of the 2C1 taxation system results in an excise tax of 105 THB. The specific tax of a beer is 3.15 THB and the *ad valorem* tax is 42.93 THB; application of the 2C1 taxation system results in an excise tax of 42.93 THB. Complete calculations for these examples are provided in Box 1.

Under 2C1 taxation, the excise tax on less expensive alcoholic beverages is equal to the calculated specific tax, while the excise tax on more expensive alcoholic beverages is the calculated *ad valorem* tax. The costs of producing low alcohol content, high image beverages result in these types of beverages generally being more expensive than low image but high alcohol content beverages [30,32]. In Thailand, low alcohol content beverages, such as alcohol mixed with fruit juice, RTD beverages, beers, wines and high image spirits are more expensive compared to domestic low image spirits. Figure 3 outlines the 2C1 tax rates and retail prices of 10 alcoholic beverages, arranged by alcoholic beverage type and by alcohol content. The sweet, low alcohol content beverages and beers on the left, and the high image, high alcohol content spirits on the right are expensive relative to their alcohol content and, thus, the 2C1 taxation system dictates that the applicable excise taxes are calculated as *ad valorem* taxes which are greater than their calculated specific taxes (see Table 1), whereas the applicable excise taxes on inexpensive spirits are calculated under the 2C1 taxation system as specific taxes. As a result, unlike specific taxation, which promotes low alcohol content beverages, 2C1 taxation favours medium strength alcoholic beverages. Consequently, under 2C1 taxation, the government can deter consumption of high alcohol content beverage consumption by adjusting the specific tax rate and also prevent drinking initiation by taxing highly advertised, high image alcoholic beverages and

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Box 1 Excise tax calculation examples for the 'Two-Chosen-One' (2C1) tax method
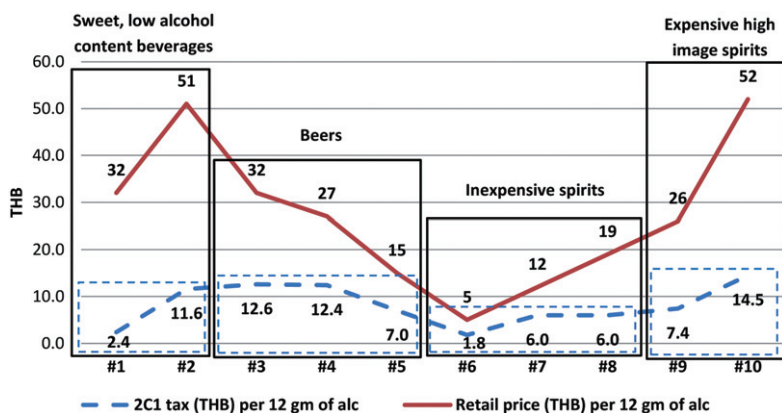
Example 1: A distilled spirit (whisky #7 in Table 1) with an alcohol concentration of 40%, a volume of 700 cc and an ex-factory price of 116 Thai baht (THB) per bottle. The specific tax rate for distilled spirit is 400 THB* per litre of pure alcohol while the *ad valorem* tax rate is 50% of its ex-factory price
- Using the specific tax method, the tax revenue is $= 0.40 \times 0.700 \times 400 = 112$ THB per bottle (equivalent to 6.08 THB per 12 g of alcohol)
- Using the *ad valorem* tax method, the tax revenue is $= 50\% \times 116 = 58$ THB per bottle (equivalent to 3.15 THB per 12 g of alcohol)
- Using the 2C1 tax method, the excise tax is 105 THB per bottle (or 6.08 THB per 12 g of alcohol) because it is the higher of the calculated amounts

Example 2: A beer (beer #4 in Table 1) with an alcohol concentration of 5%, a volume of 630 cc and an ex-factory price of 42.93 THB per bottle. The specific tax rate for beer is 100 THB per litre of pure alcohol, whereas the *ad valorem* tax rate is 60% of its ex-factory price
- Using the specific tax method, the tax revenue is $= 0.05 \times 0.630 \times 100 = 3.15$ THB per bottle (equivalent to 1.52 THB per 12 g of alcohol)
- Using the *ad valorem* tax method, the tax revenue is $= 60\% \times 42.93 = 25.76$ THB per bottle (equivalent to 12.42 THB per 12 g of alcohol)
- Using the 2C1 tax method, this beer excise tax would be 25.76 THB per bottle (or 12.42 THB per 12 g of alcohol) because it is the higher of the calculated amounts

*1 US$ = 30 THB on 10 January 2011

Figure 3 Graph of the 'Two-Chosen-One' (2C1) tax and retail prices per 12 g of alcohol of 10 alcoholic beverages, arranged by alcohol category and content (data in year 2010). Source: the values of the 2C1 tax per 12 g of alcohol of 10 alcoholic beverages are adopted from Table 1, while the values of retail prices per 12 g of alcohol of these beverages are calculated by the authors using data from alcohol producers for 2010; THB: Thai baht

Table 1 Ten examples of the excise tax calculation using the 'Two-Chosen-One' (2C1) taxation system.

Beverage	Strength	Volume	Ex-factory price (THB/12 g of alcohol)	Specific tax (THB/12 g of alcohol)	Ad valorem tax (THB/12 g of alcohol)	Excise tax (THB/12 g of alcohol)	The tax method applied
1. Wine cooler	5.0%	300 cc	9.44	1.52	2.36	2.36	AV
2. RTD (fruit flavour)	5.6%	275 cc	23.22	6.08	11.61	11.61	AV
3. Beer (imported)	5.0%	640 cc	20.93	1.52	12.56	12.56	AV
4. Beer (domestic)	5.0%	630 cc	20.7	1.52	12.42	12.42	AV
5. Beer (domestic)	6.4%	640 cc	11.72	1.52	7.03	7.03	AV
6. White spirit	40.0%	625 cc	2.93	1.82	1.47	1.82	Sp
7. Whisky (inexpensive—domestic)	40.0%	700 cc	6.29	6.08	3.15	6.08	Sp
8. Whisky (inexpensive—imported)	40.0%	700 cc	11.18	6.08	5.59	6.08	Sp
9. Brandy (expensive—domestic)	38.0%	700 cc	15.43	6.08	7.41	7.41	AV
10. Whisky (expensive—imported)	43.0%	750 cc	29.02	6.08	14.51	14.51	AV

Source: data of alcohol ex-factory prices, alcohol strengths, specific (Sp) excise tax rates and *ad valorem* excise tax rates were from the Excise Department; calculated into Sp, *ad valorem* (AV) and actual 'Two-Chosen-One' (2C1) tax rates per 12 g of alcohol by the authors. Note: wine cooler (beverage number 1) is in the wine category while ready-to-drink (RTD) (beverage number 2) is in the spirits category. Hence, they pay different tax rates. Note: the low tax rates of wine cooler (number 1) and white spirit (number 6) are not the result of 2C1 taxation. Instead, they are the result of a government differential tax rate determination among different alcoholic beverages; THB: Thai baht.

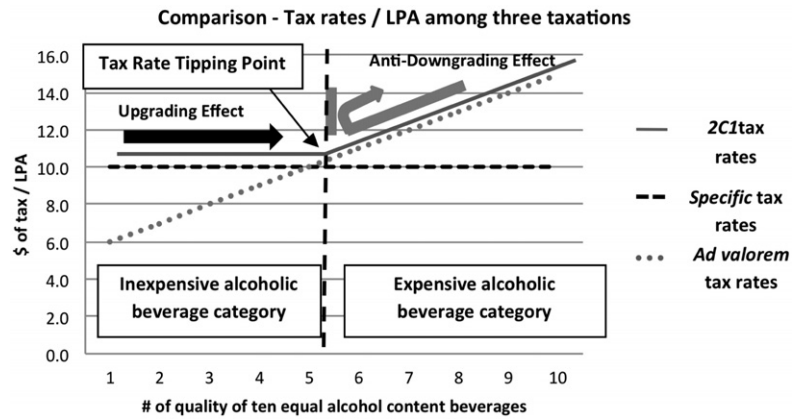low alcohol content beverages, which reduces the affordability of these beverages.

2C1 TAXATION'S THREE MECHANISMS

Ad valorem tax on alcoholic beverages is calculated based on price. In response to *ad valorem* taxation, alcohol producers tend to downgrade the perceived quality of their product (such as by removing non-alcoholic mixtures used in beverages, changing packaging and reducing advertising) in order to lower the costs associated with their product and the resulting tax; this response is referred to commonly as a 'downgrading effect' [28,33–35]. As a result, *ad valorem* tax promotes less expensive, but higher alcohol content beverages, and may increase overall alcohol consumption [28,33–35].

Specific tax is calculated based on alcohol content of the beverage. Because this method taxes alcohol content

irrespective of price or perceived quality, alcohol producers tend to decrease alcohol content in order to minimize the tax burden on alcohol products, referred to commonly as an 'upgrading effect' [28,33–35]. As a result, specific taxation promotes relatively high-priced, low alcohol content beverages of higher perceived quality [28,33–35]. Specific taxation has been shown to be effective for countries with a high prevalence of current drinkers, as it can reduce per-capita alcohol consumption and deter harmful alcohol consumption levels [29]. It may have a negative effect in promoting the low alcohol content beverages which lead to drinking initiation.

Even though 2C1 taxation applies both basic taxation methods, it possesses unique attributes. 2C1 taxation causes an 'upgrading effect' for inexpensive beverages (as with specific taxation); however, unlike *ad valorem* taxation, it does not have a pronounced 'downgrading effect'

Figure 4 Graphic representation of hypothetical alcoholic beverages' specific and *ad valorem* taxes using 'Two-Chosen-One' (2C1) taxation; LPA: litres of pure alcohol

for expensive alcoholic beverages, even though 2C1 taxes such beverages under the *ad valorem* taxation method. Because of the combination of specific and *ad valorem* taxation methods, 2C1 taxation has two unique features: a 'tax rate tipping point' and an 'anti-downgrading effect'. Outlined in Table 1 are four spirits which have the same specific tax rates of 6.08 THB per standard drink (defined in this paper as 12 g of pure alcohol [36]), but which have different ex-factory prices and, thus, different *ad valorem* tax rates of 3.11, 5.59, 7.41 and 14.51 THB per standard drink, respectively. The excise tax rates under 2C1 taxation for these beverages are 6.08, 6.08, 7.41 and 14.51 THB per drink, respectively. None of these spirits has an excise tax lower than 6.08 THB per drink. If alcohol producers decrease the price of their products such that the *ad valorem* tax is no longer higher than the specific tax, then the specific tax rate will apply. This is referred to as the 'tax rate tipping point', namely the price where the tax rate to be applied changes from the *ad valorem* tax to the specific tax if the price of the product goes down, and changes from specific to *ad valorem* if the price of the product goes up. As a result, due to the 'tax rate tipping point' alcohol producers have no tax-based incentive to downgrade their products below this point which, in turn, deters producers from decreasing the price of expensive alcoholic beverages and discourages consumption of expensive beverages. This mechanism can be referred to as an 'anti-downgrading effect'. In conclusion, 2C1 taxation has three mechanisms (i) the 'tax rate tipping point', which leads to (ii) an 'upgrading effect' for inexpensive alcoholic beverages and (iii) an 'anti-downgrading effect' for expensive alcoholic beverages.

Figure 4 illustrates the attributes of 2C1 taxation using an example of 10 hypothetical beverages with equal alcohol content, arranged in price from low to high. The 'tax rate tipping point' divides alcoholic beverages into two categories: inexpensive and expensive. Inexpensive beverages are taxed under the specific taxation

method, whereas expensive beverages are taxed under the *ad valorem* taxation method.

SPECIFIC EFFECTS OF 2C1 TAXATION

2C1 taxation generates a higher average tax rate resulting in lower total alcohol consumption, compared to the specific system or the *ad valorem* system individually. This can be proved using mathematical derivations (Box 2). 2C1 taxation can be seen as a specific 'plus' taxation system, as all beverages are taxed at least at a specific taxation rate, with expensive beverages being taxed at an *ad valorem* taxation rate. Higher tax rates act to lower alcohol consumption [29,30,37]; thus, 2C1 taxation lowers alcohol consumption more than if either the specific or the *ad valorem* taxation systems were applied (Box 3).

Table 2a,b demonstrates hypothetical taxation and substitution effects on alcohol consumption among three taxation methods: specific, *ad valorem* and 2C1. In these examples, all beverages have the same specific and *ad valorem* tax rates. Table 2a outlines an example of four beverages with equal alcohol content, but with different prices. Table 2b outlines an example of four beverages with equal quality (indicated by years of brew), but with different alcohol contents. For these examples, we assumed that consumers spend a fixed amount of money on alcohol. For each example, we considered two scenarios: (i) no substitution; and (ii) 10% cross-category substitution.

We observed that (i) price per unit of alcohol (regardless of taxation method) is higher in beverages with higher perceived quality (see line 6 of Table 2a) and in beverages with lower alcohol content (see line 6 of Table 2b); (ii) the range of post-tax prices of alcoholic beverages is narrower under specific taxation (see line 10 of Table 2a,b), which results in relatively greater consumption of more expensive and lower alcohol content

Box 2 Comparisons of specific and *ad valorem* taxation methods to 'Two-Chosen-One' (2C1) in terms of average tax rates

	Variable/equation			Explanation
	T_{2C1}	=		The average tax rate of the 2C1 method
	T_S	=		The average tax rate of the specific tax method
	T_V	=		The average tax rate of the *ad valorem* tax method
	t_S	=		The specific tax rate of an alcoholic beverage
	t_V	=		The *ad valorem* tax rate of an alcoholic beverage
	A	=		The alcohol content of an alcoholic beverage
	P	=		The price of an alcoholic beverage

In the 2C1

1. T_{2C1} = $T_s = t_s(A)$, if $T_s > T_v$ — This would happen in the inexpensive beverage category
   $T_v = t_v(P)$, if $T_v > T_s$ — This would happen in the expensive beverage category
2. In case, T_s > T_v, In cheap beverage
3. T_s = $T_v + T_{sov\text{-in cheap bev}}$ — $T_{sov\text{-in cheap bev}}$ is the extra tax that the specific taxation generates over the *ad valorem* taxation
4. In case, T_v > T_s, In expensive beverage
5. T_v = $T_s + T_{vos\text{-in expensive bev}}$ — $T_{vos\text{-in expensive bev}}$ is the extra tax that the *ad valorem* taxation generates over the specific taxation

Compare 2C1 to the specific tax method

6. X = $X_C + X_E$ — Suppose there are X units of alcohol in the whole alcohol market consisting of X_C units of inexpensive beverage category and X_E units of expensive beverage category
7. $T_{2C1}(X)$ = $T_s X_C + T_v X_E$ — The total tax revenue generation of the 2C1 is equal to the combination of the tax revenue generation in the inexpensive and expensive beverage categories. The revenue from the cheap beverage category is equal to the specific tax rate multiplied by X_C units of pure alcohol in the inexpensive beverage category, whereas the revenue from the expensive beverage category is equal to the *ad valorem* tax rate times X_E units of pure alcohol in the expensive beverage category
8. = $T_s X_C + (T_s + T_{vos})X_E$ — From 5: $T_v = T_s + T_{vos\text{-in expensive bev}}$
9. = $T_s X_C + T_s X_E + T_{vos} X_E$
10. = $(T_s X_C + T_s X_E) + T_{vos} X_E$
11. = $T_s(X_C + X_E) + T_{vos} X_E$
12. = $T_s(X) + T_{vos} X_E$ — Since $X = X_C + X_E$
13. = $(T_s + \Delta)(X)$ — Since $T_{vos} X_E > 0$; Δ = any positive number
14. T_{2C1} = $(T_s + \Delta)$ — The 2C1 taxation can be called the specific plus
15. T_{2C1} > T_s — Tax rate using 2C1 is higher than the tax rate using specific taxation

Compare *2C1* to the *ad valorem* tax method

16. $T_{2C1}(X)$ = $T_s X_C + T_v X_E$
17. = $(T_v + T_{sov})X_C + T_v X_E$ — From 3
18. = $T_v X_C + T_{sov} X_C + T_v X_E$
19. = $(T_v X_C + T_v X_E) + T_{sov} X_C$
20. = $T_v(X_C + X_E) + T_{sov} X_C$
21. = $T_v(X) + T_{sov} X_C$ — Since $X = X_C + X_E$
22. = $(T_v + \Delta)(X)$ — Since $T_{vos} X_E > 0$; Δ = any positive number
23. T_{2C1} = $(T_v + \Delta)$ — The 2C1 taxation can be called the *ad valorem* plus
24. T_{2C1} > T_v — Tax rate using 2C1 is higher than the tax rate using *ad valorem* taxation

Conclusion: 2C1 provides the highest tax rate, given the same tax revenue, compared to the specific and the *ad valorem* methods of taxation

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Box 3 Comparison of overall alcohol consumption for specific, *ad valorem* and 'Two-Chosen-One' (2C1) taxation methods

				Explanation
25.	R_{2C1}	=	R_s	Compare alcohol consumption between two tax systems given the same tax revenue
26.	$T_{2C1}X_{2C1}$	=	T_sX_s	
27.	Since, T_{2C1}	>	T_s	From 15
28.	Then, X_{2C1}	<	X_s	Meaning the 2C1 taxation encourages lower alcohol consumption than does specific taxation
29.	R_{2C1}	=	R_v	Compare alcohol consumption between two tax systems given the same tax revenue
30.	$T_{2C1}X_{2C1}$	=	T_vX_v	
31.	Since, T_{2C1}	>	T_v	From 24
32.	Then, X_{2C1}	<	X_v	Meaning 2C1 taxation results in overall lower consumption than specific taxation
33.				Conclusion: 2C1 encourages lower alcohol consumption compared to both the specific and the *ad valorum* taxation methods, given neutral revenue

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beverages (see lines 15 and 18 of Table 2a,b) compared to *ad valorem* taxation (see lines 11, 16 and 19 of Table 2a,b); (iii) 2C1 taxation favours medium alcohol content beverages (regardless of substitution effect) leading to relatively lower overall alcohol consumption compared to either specific and *ad valorem* taxation (see lines 15–20 of Table 2a,b); and (iv) because youth prefer low alcohol content beverages upon drinking initiation [23], 2C1 taxation, compared to specific taxation, leads to a barrier for drinking initiation among youth by heavily taxing the youth preferred beverages (compare line 12 to line 10 in each of Table 2a,b).

EMPIRICAL EVIDENCE

In addition to our theoretical analyses and simulation, there is also empirical evidence from Thailand that the 2C1 method has been effective. For the general relationship see [37]. The empirical evidence is as follows:

1 The overall level of abstention is higher than expected for a MIC with the GDP–PPP of Thailand (see above), and has remained stable for some years. In addition, drinking initiation of youth has not increased as expected, as evidenced by the high abstention rates in this age category (see above).
2 Adult *per-capita* consumption has stabilized in recent years (1997–2008) after a marked increase in consumption [8].
3 Time–series analyses indicated that tax increases in Thailand were associated with a decrease in alcohol consumption [38,39]. By studying the excise tax increases in Thailand in 2007 and 2009, Sornpaisarn and colleagues observed through bivariate time–series analyses that the price elasticity was −2.4 for beer and −0.8 for white spirits [39]. Additionally, Poapongsakorn and colleagues observed that alcohol consumption was associated with price changes of alcoholic

beverages using data from 1978 to 2003. In their study, the price elasticity of beer was −2.7, the price elasticity of domestic brown spirits was −1.6 and the price elasticity of imported spirits was −0.6, controlling for the effects of *per-capita* income and annual alcohol advertising budgets [38].

DISCUSSION

Specific taxation has been shown to be appropriate for countries with a high prevalence of current drinker, as it discourages harmful patterns of alcohol consumption by promoting relatively inexpensive low alcohol content beverages; in countries with a high proportion of abstainers this system may encourage drinking initiation. 2C1 taxation may be more appropriate for countries with a high prevalence of abstainers, as it may prevent drinking initiation in addition to discouraging harmful patterns of alcohol consumption. However, more and better-controlled research to test the theoretical attributes of 2C1 is necessary.

Thailand has a high prevalence of life-time abstainers potentially vulnerable to persuasion, especially at young ages. In Thailand, those beverages which are most popular with, or desired by, youth are taxed using an *ad valorem* tax method, making them more expensive than under a specific tax method. We hypothesize that the stable percentage of current drinkers among Thai people aged 15–24 years between 2001 and 2007 (see above) can be seen as a consequence of high price due to 2C1 taxation despite the expected increase due to economic factors [8]. If Thailand were to shift from 2C1 taxation to specific taxation, the price of these beverages would decrease, probably resulting in an increase in drinking initiation. Under 2C1 taxation it is counterintuitive that wine coolers (low content beverage) and white spirits (see Table 1) are taxed at a lower rate than other beverages

Table 2a Hypothetical taxation and substitution effects on alcohol consumption of four alcoholic beverages with the same alcohol content, comparison among three taxation methods: specific (Sp), *ad valorem* (AV) and 'Two-Chosen-One' (2C1) taxation.

Line	Alcohol beverage price	Perceived quality				
		Very low / Very cheap	Low / Cheap	High / Expensive	Very high / Very expensive	
	Hypothetical example: four 1-litre spirits with similar 40 degree but different years of brew which are 2, 3, 4 and 5 years, respectively					
1	Alcohol content (litre of pure alcohol—LPA) (=1 × 40%)	0.4	0.4	0.4	0.4	
2	Year of brew (year)	2	3	4	5	
3	Pure alcohol price ($/litre of beverage—LOB) (=litre × $125/LPA)	50	50	50	50	
4	Cost of perceived quality ($) (=year × $10/year)	20	30	40	50	
5	Pre-tax price of alcoholic beverage ($/LOB) (=3 + 4)	70	80	90	100	
6	Pre-tax price of alcoholic beverage ($/LPA) (=5/1)	175	200	225	250	
	Taxes and prices after tax					
7	Specific tax ($/LPA) (=$125/LPA)	125	125	125	125	
8	*Ad valorem* tax ($/LPA) (=60% (exclusive) of pre-tax alcoholic beverage)	103	118	133	147	
9	2C1 tax ($/LPA) (=higher tax between Sp and AV)	125	125	133	147	
10	Post-tax price—Sp ($/LPA)	300	325	350	375	
11	Post-tax price—AV ($/LPA)	278	318	358	397	
12	Post-tax price—2C1 ($/LPA)	300	325	358	397	
	Alcohol consumption supposed equal market share, 25% for each beverage category; total consumer money used for alcohol consumption is constant at $21 250					Total
13	Amount of pre-tax alcohol consumption (LPA)	25	25	25	25	100
14	Money used for pre-tax alcohol consumption ($)	4375	5000	5625	6250	21 250
	Consumption after tax under a scenario of no substitution					Total
15	Amount of post-tax alcohol consumption—under Sp (LPA)	14.6	15.4	16.1	16.7	62.7
16	Amount of post-tax alcohol consumption—under AV (LPA)	15.7	15.7	15.7	15.7	62.9
17	Amount of post-tax alcohol consumption—under 2C1 (LPA)	14.6	15.4	15.7	15.7	61.4
	Consumption after tax under a scenario of 10% substitution					Total
18	Amount of post-tax alcohol consumption—under Sp (LPA)	13.5	15.4	16.1	17.5	62.5
19	Amount of post-tax alcohol consumption—under AV (LPA)	16.8	15.8	15.8	14.8	63.2
20	Amount of post-tax alcohol consumption—under 2C1 (LPA)	13.5	16.4	16.7	14.8	61.4

Table 2b Hypothetical taxation and substitution effects on alcohol consumption of four alcoholic beverages with the same perceived quality, comparison among three taxation methods: specific (Sp), *ad valorem* (AV) and 'Two-Chosen-One' (2C1) taxation.

| Line | Degree of alcoholic beverage / Alcohol beverage type | Alcohol content | | | | |
		5% Regular beer	10% Strong beer	25% Light spirit	40% Usual spirit	Average
	Hypothetical example: four 1-litre alcoholic beverages with similar perceived quality but different alcohol content which are 5%, 10%, 25% and 40%, respectively					
1	Alcohol content (litres of pure alcohol—LPA) (=1 × degree)	0.05	0.10	0.25	0.40	0.2
2	Year of brew (year)	2	2	2	2	
3	Pure alcohol price ($/litres of beverage—LOB) (=litre × $125/LPA)	6.2	12.5	31.5	50.0	
4	Cost of perceived quality ($) (=year × $10/year)	20	20	20	20	
5	Pre-tax price of alcoholic beverage ($/LOB) (=3 + 4)	26.2	32.5	51.5	70.0	
6	Pre-tax price of alcoholic beverage ($/LPA) (=5/1)	525	325	205	175	
	Taxes and prices after tax					
7	Sp ($/LPA) (=$125/LPA)	125	125	125	125	
8	AV tax ($/LPA) (=60% (exclusive) of pre-tax alcoholic beverage)	310	192	121	103	
9	2C1 tax ($/LPA) (=higher tax between Sp and AV)	310	192	125	125	
10	Post-tax price—Sp ($/LPA)	650	450	330	300	
11	Post-tax price—AV ($/LPA)	835	517	326	278	
12	Post-tax price—2C1 ($/LPA)	835	517	330	300	
	Alcohol consumption supposed equal market share, 25% for each beverage category; total consumer money used for alcohol consumption is constant at $30 750					
13	Amount of pre-tax alcohol consumption (LPA)	25	25	25	25	Total 100
14	Money used for pre-tax alcohol consumption ($)	13 125	8125	5125	4375	Total 30 750
	Consumption after tax under a scenario of no substitution					
15	Amount of post-tax alcohol consumption—under Sp (LPA)	20.2	18.1	15.5	14.6	Total 68.4
16	Amount of post-tax alcohol consumption—under AV (LPA)	15.7	15.7	15.7	15.7	Total 62.9
17	Amount of post-tax alcohol consumption—under 2C1 (LPA)	15.7	15.7	15.5	14.5	Total 61.6
	Consumption after tax under a scenario of 10% substitution					
18	Amount of post-tax alcohol consumption—under Sp (LPA)	21.2	19.1	16.1	13.5	Total 69.89
19	Amount of post-tax alcohol consumption—under AV (LPA)	14.80	15.54	15.38	16.40	62.13
20	Amount of post-tax alcohol consumption—under 2C1 (LPA)	14.80	17.06	16.68	13.54	62.07

with a similar price and alcohol content. These relatively low tax rates are the result of a government decision influenced by the political process and not inherent to the 2C1 taxation system itself.

Most countries consider alcohol taxation as a revenue generating tool rather than as a policy tool to reduce alcohol-related harms and thus to achieve public health goals. However, with increasing knowledge that the social costs of alcohol-attributable harms to an economy by far outweigh the taxation income (for Thailand, see [40]), this may change. Other LMIC with a high prevalence of abstainers and increasing alcohol consumption may benefit from the 2C1 taxation system, as it may reduce and control harmful patterns of alcohol consumption and help to prevent drinking initiation among youth. It may be difficult to implement such systems in LMIC without explicit societal consensus on treating alcohol policy mainly as a public health issue, but the current World Health Organization (WHO) global strategy [1] offers a change to achieve such a consensus in other countries and regions.

Economic analyses have recommended a combination of specific and *ad valorem* taxation systems under different circumstances [24,28,33–35]. The WHO *Technical Manual on Tobacco Tax Administration* [41] compared 2C1 taxation's theoretical properties, such as tax base and its impact on prices and health benefits with those of specific, *ad valorem*, mixed specific and *ad valorem* taxation, and minimum price taxation. It concluded that 2C1 has the potential to yield health benefits as it reduces downgrading, namely the reduction in the quality of a product, for example, by keeping filters on cigarettes.

An alternative solution to deterring initiation of drinking among youth in a country is to employ a minimum pricing policy. There are two main disadvantages to using a minimum pricing system compared to 2C1 taxation. First, minimum pricing increases the income of alcohol producers, which can be used to market alcohol, i.e. resulting in a consequence not necessarily advantageous for public health. Secondly, minimum pricing has no set taxation structure and, thus, could promote initiation of alcohol consumption by setting a low minimum price for low alcohol content high image beverages.

There are some limitations to the 2C1 tax method as currently applied in Thailand. First, for the specific taxation method, excise taxes are fixed unless they are calculated taking into account changes in the Consumer Price Index. Secondly, 2C1 requires more supporting information than does either of the specific or *ad valorem* taxation systems alone, as 2C1 requires information pertaining to beverage strengths and pricing. Additionally, more research is required to determine if taxation increases on low alcohol content beverages in LMIC will result in

people switching from low alcohol content to medium alcohol content beverages. Similarly, the relationship between 2C1 taxation and unrecorded consumption [42] will have to be studied. However, until now, Thailand is estimated to have proportionally less unrecorded consumption than other LMIC [8].

Although taxation is one of the most effective measures to reduce alcohol consumption and the resulting harms, countries should formulate explicit and comprehensive alcohol policies on a national level (where appropriate, local and/or regional strategies may also be required) [1,43]. These strategies should not only rely on taxation but should include other measures, such as controlling the availability of alcohol, implementation and enforcement of advertising bans, and deterring alcohol-attributable harms through measures such as drink-driving programmes [43]. Additional research is required on the impact of a variety of factors, including the religious and/or cultural make-up of a country, to determine the potential effectiveness of different alcohol control measures.

CONCLUSION

Neither the *ad valorem* nor the specific taxation systems alone have the desired effects of decreasing harmful consumption of alcohol and deterring drinking initiation. 2C1 taxation targets both objectives simultaneously by applying the lowest tax to medium alcohol content beverages. The 2C1 taxation method may be an effective way of reducing alcohol-attributable harms in the short- and middle-term in LMIC with a high prevalence of abstainers, often life-time abstainers. Better-controlled research on the effectiveness of 2C1 taxation in various settings is necessary.

Declarations of interest

Both Kevin Shields and Jurgen Rehm have received money from the pharmaceutical industry in the form of unrestricted grants. Jurgen Rehm has received resources from the alcohol industry to present at conferences.

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Of course, the United States differs from Thailand in myriad respects, including income level and drinking patterns, but these national contexts are perhaps not so different that they cannot learn from each other.

Declarations of interest

None.

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TWO-CHOSEN-ONE TAXATION: EXAMINING ITS POTENTIAL EFFECTIVENESS TO REDUCE DRINKING INITIATION AND HEAVY ALCOHOL CONSUMPTION IN LOW- TO MIDDLE-INCOME COUNTRIES

We would like to thank the commentators for their thoughtful comments in response to our for debate contribution [1]. All commentators were in agreement that 'two-chosen-one' (2C1) taxation may have the potential to reduce alcohol consumption and drinking initiation in low- and middle-income countries (LMIC) which have a high prevalence of abstainers [1–5]. However, as noted in the paper and by the commentators, 2C1 taxation may have limitations in terms of unrecorded consumption, tax rate implementation and potential changes in beverage preferences.

Medina-Mora raises the concern of a potential shift in alcohol consumption towards unrecorded alcoholic beverages as taxation increases [5]. Such a shift may be associated with all taxation increases [6,7], and is not specific to 2C1 taxation. Our evidence base for control of unrecorded alcohol consumption is limited, but some measures exist and should be the subject of further study [7].

Sarntisart notes that *specific* taxation rates should be linked to an inflation index [3,8]; otherwise, the relative cost of the tax will decrease with inflation. 2C1 taxation has an advantage over specific (only) taxation in that the *ad valorem* component of 2C1 taxation will act as a taxation floor, which creates inflation-binding taxation. None the less, 2C1's specific tax rate should be linked with inflation. Sarntisart also raises the issue of companies reporting abnormally low ex-factory prices to reduce the *ad valorem* tax rate [9]. To resolve this problem, governments should implement measures to verify the accuracy of the ex-factory prices reported by the manufacturing companies and/or base *ad valorem* taxation on the retail price.

We agree with Österberg regarding the need for consistent taxation rates for similar beverages [4]; otherwise, the effectiveness of taxation will be less due to substitution effects [10]. In Thailand, differential tax rates have been the result of the political influence of alcohol companies [11], and such influences in general often hinder the implementation of best practices around the world. Österberg also raises the concern that changes in beverage preferences will decrease the effectiveness of the 2C1 taxation system. As 2C1 taxation levies a specific tax based on alcohol content on the cheapest alcoholic beverages which heavy consumers of alcohol purchase, 2C1 taxation will be effective in decreasing alcohol consumption among heavy drinkers.

We disagree with Cook's conclusion that age restrictions may be better than taxation in reducing drinking initiation in Thailand, as the US data upon which this conclusion was based examined the effects of taxation on 30-day abstinence, which is different from life-time abstention. Life-time abstention is an embedded value in the culture of Thailand and other LMIC countries, and half of drinkers in Thailand do not consume alcohol before the age of 20 years [12]. Although higher tax rates on beverages preferred by youth and on high-alcohol content beverages can be achieved through methods such as minimum pricing [13], this may lead to fair trade violations [14] and has the potential downside of increased profits going to the alcohol industry.

In summary, because LMICs typically have a high prevalence of life-time abstainers, an alternative view of alcohol control policies may be required which addresses simultaneously the issues of drinking initiation prevention among youths and of harmful alcohol consumption among heavy drinkers [15]. 2C1 taxation is a system which may accomplish both objectives. However, to implement 2C1 taxation effectively, governments need to implement equal tax rates among similar beverages, bind specific taxation rates to inflation, and either verify the accuracy of ex-factory price declarations or tie *ad valorem* taxation to alcohol retail prices.

Declarations of interest

None.

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