OXFORD ECONOMICS

The influence of the availability of menthol cigarettes on youth smoking prevalence

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A report for Philip Morris International

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Executive Summary

Background

Menthol has been used as a cigarette flavour for almost 90 years. It has been argued that menthol, by making cigarettes easier to smoke, affects smoking behaviour, in particular by increasing initiation among young people. It has been suggested that banning menthol in cigarettes would make cigarettes less attractive to youth and therefore reduce youth smoking prevalence. However, very little is known about the relationship between the availability of menthol cigarettes (market share) and youth smoking behaviour.

Aims

The aim of the study is to investigate whether, globally, there is any statistically significant relationship between the availability of menthol cigarettes (market share) and youth smoking prevalence rates – measured as the share of young people aged 13-15 who smoke. A positive and significant relationship between the two variables would imply that more young people aged 13-15 smoke where menthol cigarettes represent a larger share of the cigarettes market. This would support the hypothesis that the availability of menthol cigarettes has an impact on youth smoking rates. Alternatively, a negative and significant relationship might imply lower rates of youth smoking in countries with a high market share of menthol cigarettes, or there may be no statistically significant relationship between youth smoking and the market share of menthol cigarettes.

Study design

The study uses simple correlation and then more sophisticated multiple regression analysis to examine the relationship between publicly available youth smoking rates, the market share of menthol cigarettes and additional control variables, such as GDP and level of education.

The study is cross-sectional in design, with a sample of 52 countries. The main limiting factor for the number of countries included in the study is the availability of data for youth smoking prevalence and tobacco control measures. The sample includes both developed and developing countries. The data are for the year 2010.

Results

We find that the market share of menthol cigarettes has no statistically significant relationship with 13-15 years old overall youth smoking prevalence in most of the equations estimated using the sample of 52 countries considered. This result also holds for most equations estimated using male and female youth smoking separately. Whenever a statistically significant relationship is found (either for overall or female youth smoking), it is negative. This implies that higher market shares of menthol cigarettes would be associated with lower levels of youth smoking. Our analysis suggests that economic, social and institutional variables such as GDP per capita, level of education and certain tobacco control measures can explain a significant part of the cross-country variation in youth smoking.

Conclusion

If menthol cigarettes affected youth smoking behaviour, we would expect to find a systematic statistical relationship between youth smoking prevalence and the market share of menthol cigarettes across countries.

We found no evidence of any statistically significant relationship between the market share of menthol cigarettes and male youth smoking. For overall youth smoking and female youth smoking, our estimated equations suggest no statistically significant relationship or a significant, negative statistical relationship, contradicting the notion that youth smoking increases where menthol cigarettes are more prevalent. These findings hold after controlling for social and economic factors.

Hence, there is no evidence, for the countries in our sample, to support the proposition that greater availability of menthol cigarettes (as represented by market share) is associated with higher youth smoking prevalence. Instead, our analysis shows that the cross-country differences in youth smoking prevalence can be substantially explained by socio-economic factors (social, institutional and economic characteristics of a country).

1 Introduction

Menthol has been used as a cigarette flavour for almost 90 years (TPSAC, 2011). Recently, it has been argued that menthol, by making cigarettes easier to smoke, affects smoking behaviour, in particular by increasing initiation among young people. This hypothesis forms the background to this study, which Oxford Economics has undertaken at the request of Philip Morris International (PMI).

The US Food and Drug Administration's (FDA) Tobacco Products Scientific Advisory Committee (TPSAC) recently carried out an extensive study of the impact of the use of menthol in cigarettes on public health in the US (TPSAC, 2011). With regard to youth smoking, the Committee concluded that, in the US, "The evidence is sufficient to conclude that a relationship is more likely than not that the availability of menthol cigarettes increases the likelihood of addiction and the degree of addiction in youth smokers." However, the American Council on Science and Health report (ACSH, 2010) provides another extensive review of the literature and concludes that "the evidence…does not suggest that mentholated cigarettes are associated with any independent reduction in age of starting to smoke ('starter product for youth')".

Only a few studies have been carried out outside the US. In New Zealand, Li et al. (2011) found that young (14- to 15-year-old) females have a preference for menthol cigarettes, using New Zealand national surveys on youth smoking. However, their statistical analysis also allowed them to conclude that menthol cigarettes do not have any impact on smoking dependence among young smokers.

In Australia, King et al. (2012) reported that menthol cigarettes use in Australia declined markedly in popularity among adolescent smokers (12-17 years old) in the 1980s and 1990s, and concluded that menthol cigarettes do not currently play a significant role in smoking initiation in Australia.

To our knowledge, no study has been conducted focusing on the cessation behaviour of youth smokers of menthol and non-menthol cigarettes.

This study is aimed at investigating if the availability (market share) of menthol cigarettes has a statistically significant relationship with youth smoking prevalence using cross-country data. Our cross-sectional analysis is based on a sample of 52 countries for the year 2010 for which youth (aged 13-15) smoking prevalence data were reported in the latest edition of the Tobacco Atlas[1]. The dependent variable used for the regression analysis is youth smoking prevalence, defined as the share of young people aged 13-15 who smoke. We also use data for male and female youth smoking prevalence, in order to assess if the impact of menthol cigarettes is different between the two groups. The data

[1] 'The Tobacco Atlas – fourth edition' by M.Eriksen, J.Mackay and H.Ross, American Cancer Society & World Lung Foundation (2012).

on the market share of menthol cigarettes in different countries is sourced from Philip Morris International Management SA.

We first use simple correlation analysis to investigate the relationship between youth smoking prevalence and the market share of menthol cigarettes. We then move to multiple regression analysis, with the construction of more complex equations that are able to control for the impact of key economic, social and institutional factors on youth smoking prevalence, such as GDP per capita, the level of schooling and a measure of tobacco control, which have all been shown to have an impact on youth smoking initiation (in, for example Nelson (2003), de Walque (2007), Tworek (2010) and Jensen and Lleras-Muney (2012)).

The simple correlation does not show any statistically significant relationship between the availability (market share) of menthol cigarettes and male youth smoking prevalence across the 52 countries considered in this study, while a negative and statistically significant relationship is found between overall and female youth smoking and the market share of menthol cigarettes.

The regression analysis confirms the result of the simple correlation.

We find no statistically significant relationship between overall youth smoking and the market share of menthol cigarettes in most of our equations. The exception is one equation, where the estimated relationship is negative and significant. We find that economic and social factors are able to explain a significant part of the cross-country variation in youth smoking prevalence in the sample of countries.

When youth smoking is broken down by gender we find no significant statistical relationship between male youth smoking and the menthol market share, and no significant relationship between female youth smoking and the menthol market share in three out of four estimated equations. The exception was one equation showing evidence of a negative relationship between female youth smoking and the menthol market share.

Notably, negative relationships between overall and female youth smoking and the menthol market share are not supportive of the contention that the availability of menthol cigarettes encourages youth smoking. Neither is the absence of a correlation between male youth smoking and menthol market share.

Our results do not support the notion that menthol cigarettes contribute to an increased smoking prevalence among young people, neither male, nor female. Overall, the results point strongly towards the cross-country differences in youth smoking prevalence in our sample, among both males and females, being driven mainly by socio-economic factors.

The layout of the rest of the study is as follows. Section 2 describes the data and the sample used in the study. Section 3 uses simple correlation and multiple regression analysis to examine the relationship between our main dependent variables, youth smoking prevalence (overall, male and female), the market share of menthol cigarettes and a range of other social and economic variables. Section 4 concludes.

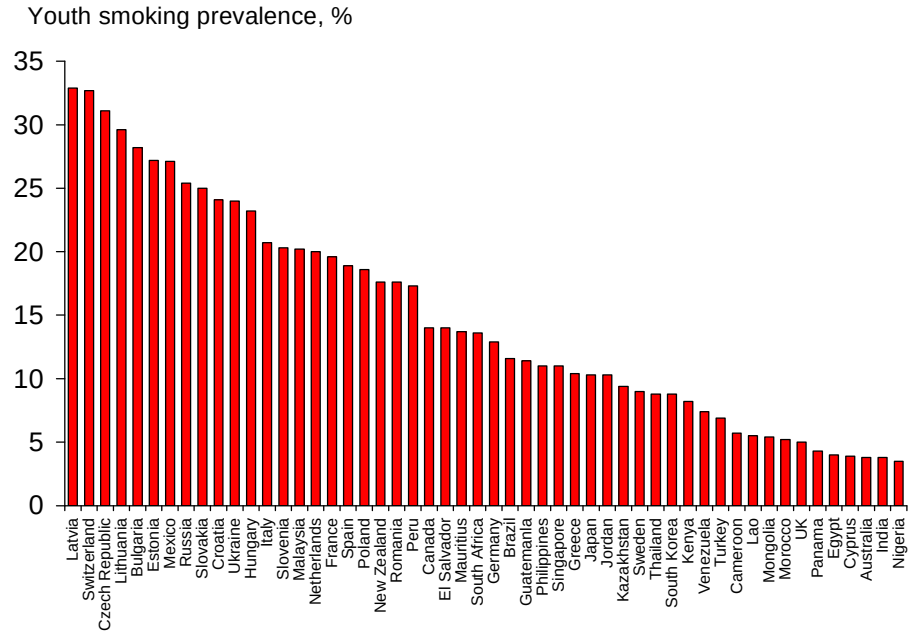
2 Data and sample description

We constructed a cross-sectional database which covers 52 countries, with the aim being to develop an econometric model for youth smoking. The selection of the sources and the data was aimed at obtaining the largest possible representative sample and ensuring the integrity and quality of the data. The availability of data for our two main variables of interest, youth smoking prevalence and the market share of menthol cigarettes, determined the choice of the countries included in the analysis. The resulting sample includes both developed and developing countries.

The variable for youth smoking used in this study is defined as the number of current smokers of cigarettes per 100 of the youth population aged 13-15. The data were obtained from the Tobacco Atlas Fourth Edition[2]. The data refer to the year 2010 – or earlier, if 2010 was not available[3].

Chart 2.1 shows youth smoking prevalence for our sample of countries. On average, 14.9% of the youth population aged 13-15 were current smokers of cigarettes in 2010 in the 52 countries considered. The sample also shows a high degree of variability of youth smoking prevalence, with the highest level recorded in Latvia (32.9%) and the lowest level recorded in Nigeria (3.5%).

Chart 2.1: Sample by youth (13-15) smoking prevalence (2010)



Source : Based on Tobacco Atlas

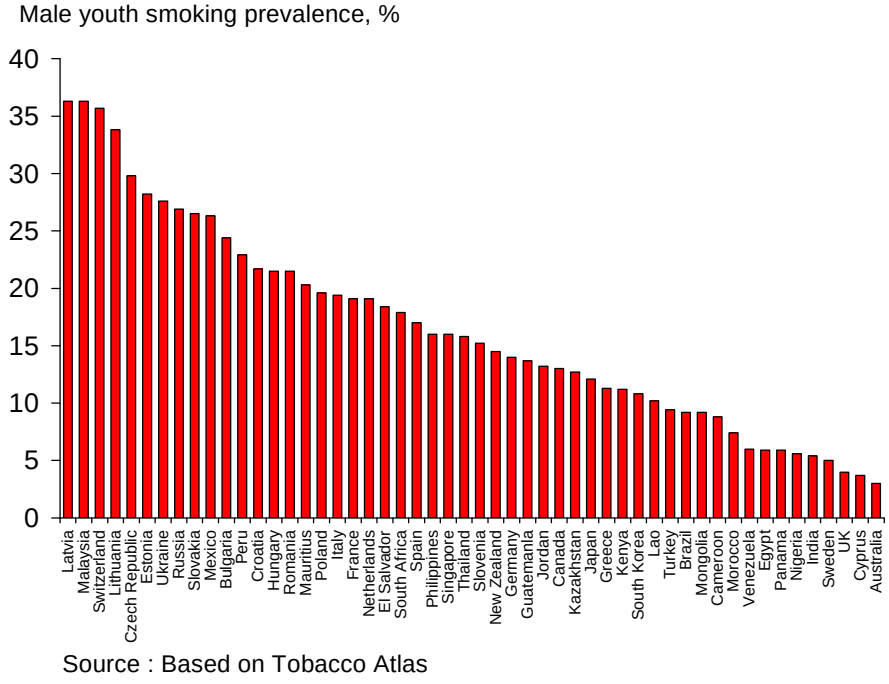
[2] 'The Tobacco Atlas – fourth edition' by M.Eriksen, J.Mackay and H.Ross, American Cancer Society & World Lung Foundation (2012).

[3] The details on the sources for each country can be found in the Tobacco Atlas Fourth Edition.

In order to explore the relationship between youth smoking behaviour and menthol cigarettes further, we used data for male and female youth smoking prevalence. The data were obtained from the same source as overall youth smoking prevalence, the Tobacco Atlas Fourth Edition. The data cover the same sample of 52 countries.

Chart 2.2 shows the level of male youth smoking prevalence for our sample of countries. On average, 16.5% of the male youth population aged 13-15 were current smokers of cigarettes in 2010 in the 52 countries considered. Latvia still topped the ranking of smoking prevalence, with 36.3% of young males being current smokers in 2010. The lowest level of male youth smoking prevalence is recorded in Australia, at 3%.

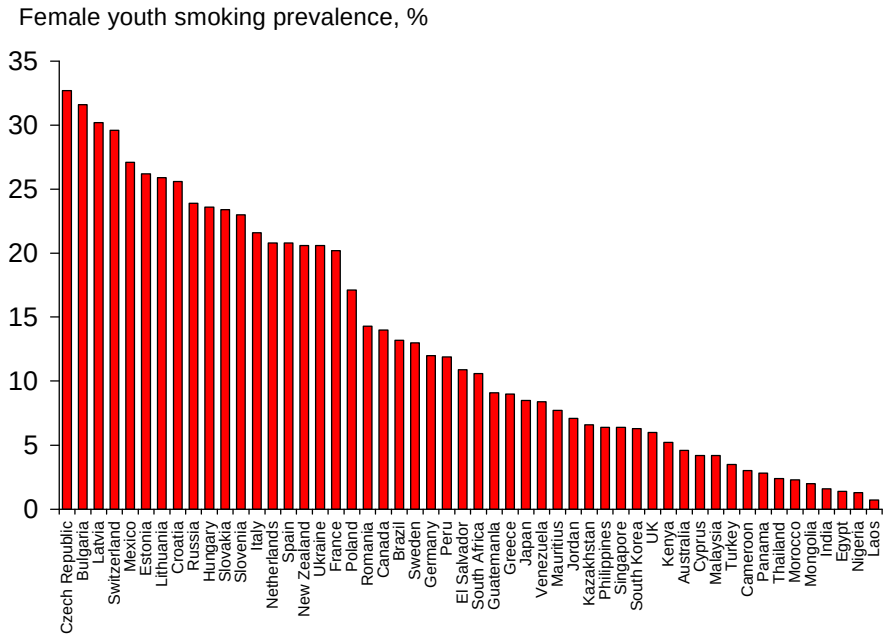
Chart 2.2: Sample by male youth (13-15) smoking prevalence (2010)



Source : Based on Tobacco Atlas

Chart 2.3 shows the level of female youth smoking prevalence for our sample of countries. On average, 13.2% of the female youth population aged 13-15 were current smokers of cigarettes in 2010 in the 52 countries considered – the average female smoking prevalence rate is lower than the average male smoking prevalence rate. The Czech Republic topped the ranking of female youth smoking prevalence, with 32.7% of young females being current smokers of cigarettes in 2010. Laos had the lowest female youth smoking prevalence (0.7%) in 2010 in our sample.

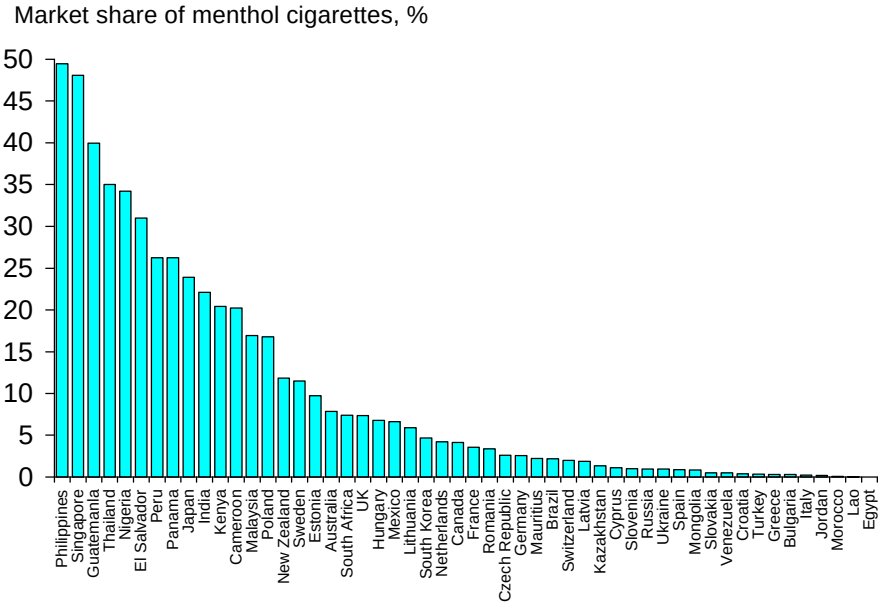
Chart 2.3: Sample by female youth smoking prevalence (2010)



Source : Based on Tobacco Atlas

In order to examine the relation of youth smoking with menthol cigarettes, we used data on the market share of menthol cigarettes available in the 52 markets considered in this study. The data were provided by Philip Morris International. The variable is summarised in Chart 2.4.

Chart 2.4: Sample by market share of menthol cigarettes (2010)



Source : Philip Morris estimates based on AC Nielsen and in-market sales data

In 2010, menthol cigarettes represented on average 10.2% of the market across the 52 countries considered in this study. There is a very large variation across countries. The market share of menthol cigarettes was 49.4% in the Philippines in 2010 while menthol cigarettes were virtually absent from Egypt's market and represented only 0.2% of the total in Italy.

In order to develop a robust econometric model for youth smoking prevalence, we used a set of explanatory variables which control for the impact of other economic, social and institutional factors on youth smoking behaviour. These factors were chosen on the basis of the existing literature on the determinants of youth smoking.

In particular, we used GDP per capita in US$ at purchasing power parity (PPP) as a measure of the level of income in each country. This variable has been used in other cross-country studies of smoking behaviour such as Schaap et al (2008) and in the context of youth smoking by Nelson (2003). This variable can be seen as capturing total demand for consumer goods – including cigarettes. However, GDP per capita also reflects the level of a country's economic development, which in turn has been suggested to affect people's awareness of the risks related to smoking. As a result, the coefficient on GDP could be either positive or negative (Nelson, 2003). This variable has been computed by Oxford Economics using nominal GDP in PPP terms from International Monetary Fund data[4] and real GDP, nominal GDP and population data from national sources.

We used the level of schooling as an additional control variable for the level of economic and social development. Given that education is a key determinant of cross-country differences in the level of human capital among young people and the consequent increase in awareness of health risks related to smoking, we believe it is useful to help explain the differences in youth smoking observed across countries. Previous studies (e.g. de Walque (2007) and Jensen and Lleras-Muney (2012)) suggest education can lead to a healthier lifestyle and lower smoking prevalence among young people, so we would expect a negative relationship between secondary schooling and youth smoking prevalence. However, since schooling increases with income, the coefficient on school enrolment could also be positive, depending on the correlation between income and youth smoking. We used the gross secondary school enrolment ratio from the World Bank World Development Indicators[5], defined as the total enrolment in secondary education, regardless of age, expressed as a percentage of the population of official secondary education age.

A measure of tobacco control was added to the model, to account for the widespread assumption that stricter tobacco control environments would be likely to reduce youth smoking prevalence. Previous studies looking at the relationship between youth smoking and tobacco control measures include

[4] IMF World Economic Outlook, April 2012

[5] World Bank, World Development Indicators Report April 2012

Chaloupka & Grossman (1996) and Tworek et al (2010). Strict tobacco controls may also reflect a high level of anti-smoking sentiment in a country, and such sentiment has been found to be a significant influence on youth smoking in, for example, Kostova et al. (2011).

Our tobacco control indicator was constructed using data from the WHO MPower report[6], following a similar approach to that in Joosens & Raw (2006, 2010). We used the WHO rankings for four different tobacco control indicators: smoke free areas, cessation programmes, advertising bans and health warnings.

The smoke free areas indicator captures the degree of legislation relating to smoke free areas and the compliance with those regulations. In particular, a point is given for each area and facility where smoking is either banned or where there is substantial regulation, e.g. health-care facilities, universities, government facilities etc. The indicator ranges between zero and 9.

The cessation programmes indicator is a measure illustrating both the aids available to those who want to quit and the degree to which they are cost-covered. A score of zero is given if no services are provided while a maximum of three points are assigned to countries where a national quit line exists and some cessation services are cost-covered. This score is then scaled up to a maximum score of 9 to allow equal weighting in the final overall index.

The advertising bans indicator measures the degree to which advertising of tobacco products is restricted. A point is given for each aspect of advertising, e.g. bans on direct advertising, local magazines and newspapers, etc. This score is also scaled up to a maximum score of 9.

Finally, the health warning indicator reflects the percentage covering and type of health warning on tobacco products. One point is given if there is no warning sign on the cigarette pocket or if it covers less than 30% of the pack surface. A maximum of four points are assigned if the warning message covers 50% or more of the pack surface. The score is then scaled up to a maximum score of 9.

The scores for the four indicators were combined into an index between zero and 9. An equal weight was assigned to the four indicators when computing the overall index, which is reported in the Appendix.

Another variable often cited as important as a determinant of youth smoking prevalence is price, as noted in the US Report of the Surgeon General on (2012) which stated ‘most of the research over the past decade has concluded that increases in cigarette prices lead to reductions in the prevalence of smoking and its intensity among youth and young adults’[7]. As a result, a price variable was also experimented with in our regressions.

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[6] WHO MPower *Report on the Global Tobacco Epidemic* (2011)

[7] Preventing Tobacco use Among Youth and Young Adults: A Report of the Surgeon General (2012) US Department of Health & Human Services

We also considered several regional dummies, in order to capture structural differences in smoking prevalence which were not accounted for by the other indicators. We found that a dummy variable for Central and Eastern European (CEE) countries (with the value set at one for the CEE countries, and zero for other countries) significantly improved the regression results. The coefficient on this variable measures the difference in youth smoking prevalence between the CEE countries and the rest of the sample and is expected to be positive.

The use of this dummy variable reflects the fact that the CEE countries are considered to be in 'stage 3' of the "smoking epidemic"[8] . Typically, a "smoking epidemic" in a population develops in four stages featuring a rise and then decline in smoking prevalence. Smoking prevalence in 'stage 3' countries has just started to decrease among both males and females and is higher than in countries that have reached 'stage 4' of the smoking epidemic, including countries in western Europe. This in turn reflects the particular historical development of these societies: the relatively closed societies of the former Soviet bloc were largely cut off from public education on the harmful effects of smoking in the post-war period, with awareness of the harmful effects of smoking remaining low until the 1980s. This left these countries with very high levels of tobacco consumption[9] (especially compared to their western European neighbours).

[8] See Lopez et al (1994) and Edwards (2004) for a detailed description of the four stages of the smoking epidemic. The original categorisation of these countries as 'stage 3' countries was by Lopez (1994), almost twenty years ago. A study by Bank of America/Merrill Lynch (2011) suggests that assigning the eastern European countries to 'stage 3' remains relevant.

[9] See McNeill (2004)

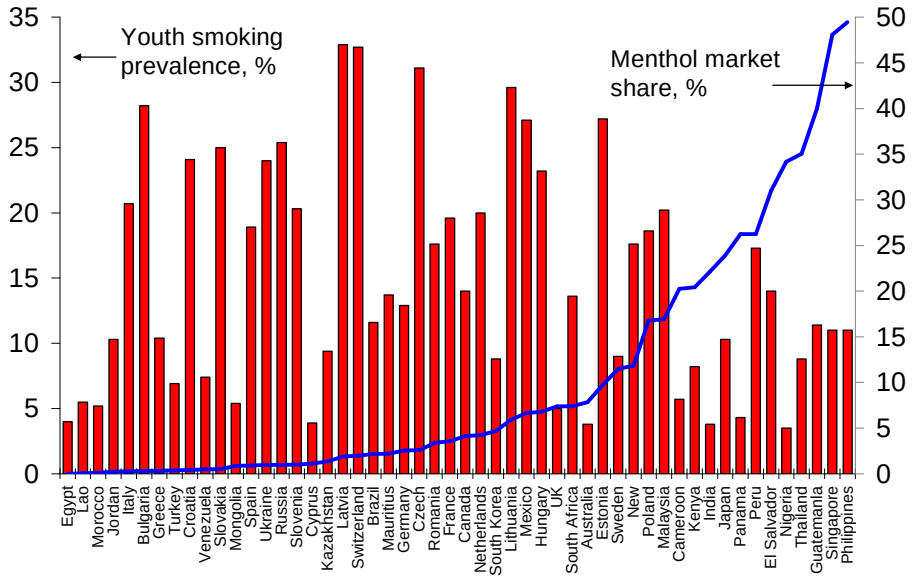
3 Regression analysis

In section 3.1 we show the results of a simple correlation analysis between youth smoking prevalence and the market share of menthol cigarettes. In sections 3.2 and 3.3 we summarise the results of the regression analysis on the determinants of youth smoking prevalence in the countries included in our sample. In particular, we first discuss the equations estimated using the overall youth smoking prevalence. We then move to the illustration of the results obtained using male and female youth smoking prevalence.

3.1 Simple linear correlation analysis

This section introduces our investigation of the relationship between youth smoking and menthol cigarette market share using charts and simple correlation analysis. Chart 3.1 shows the level of youth smoking prevalence after the countries have been ordered by increasing market share of menthol cigarettes. We would expect to see an increasing or decreasing trend in the height of the bars, if there was a relationship (positive or negative) between the market share of menthol cigarettes and youth smoking prevalence. The chart shows some evidence of a downward trend in the height of the bars from left to right, but the overall picture is quite noisy. Nigeria, India and Australia, which had the lowest youth smoking prevalence rates in 2010, had market shares of menthol cigarettes higher than the sample median. Similarly, Latvia and Switzerland, which had the highest levels of youth smoking prevalence in 2010, had market shares of menthol cigarettes below the sample median.

Chart 3.1: Youth smoking prevalence and menthol share (2010)

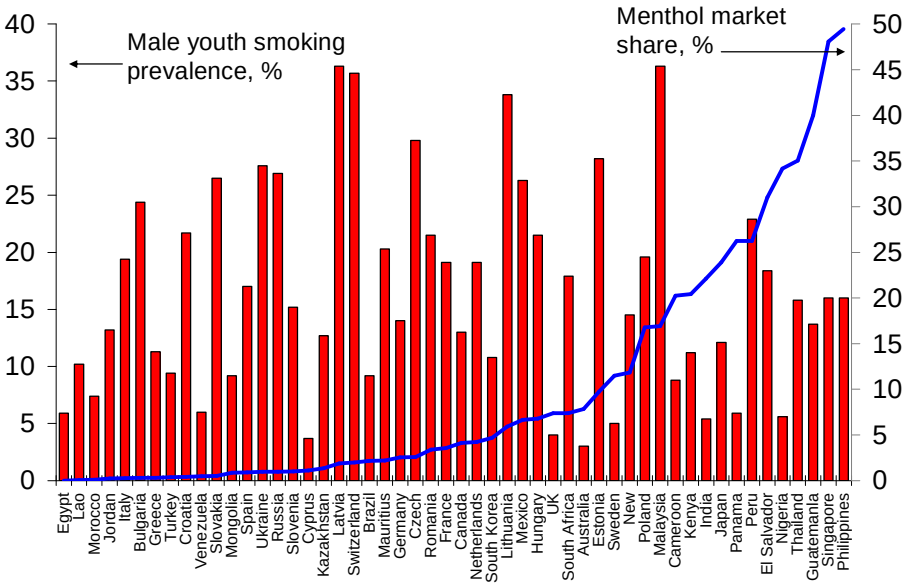


Source : based on Tobacco Atlas, Philip Morris estimates based on AC Nielsen and in-market sales data

Chart 3.1 also shows countries with low youth smoking prevalence scattered along the x-axis, with some (Egypt, Laos) having very low menthol market shares, while others (Panama, Nigeria) have relatively high menthol market shares. Countries with high rates of youth smoking also appear very scattered across the x-axis. The simple correlation coefficient between youth smoking and menthol market shares is negative, at -0.3 and is just statistically significant at the 5% level of confidence. This suggests that higher market shares of menthol cigarettes would be associated with lower levels of youth smoking.

In Charts 3.2 and 3.3 we show the level of the male and female youth smoking prevalence, respectively, after sorting the countries by increasing market share of menthol cigarettes. Again, there is no clear pattern visible in these charts, suggesting a lack of any statistical relationship between male/female youth smoking prevalence and the market share of menthol cigarettes.

Chart 3.2: Male youth smoking prevalence and menthol share (2010)

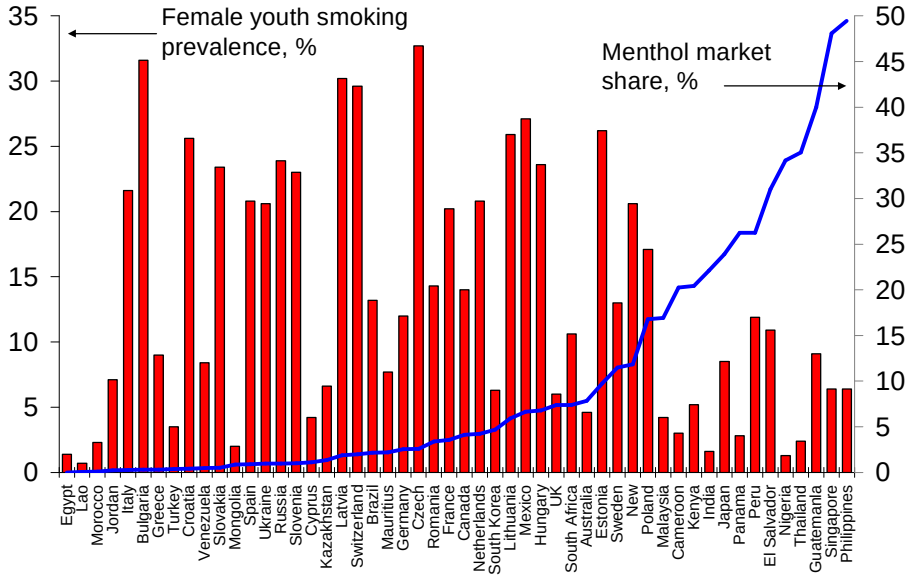


Source : based on Tobacco Atlas, Philip Morris estimates based on AC Nielsen and in-market sales data

The correlation coefficient between the market share of menthol cigarettes and the male youth smoking prevalence is -0.1 and is not statistically significant. The correlation coefficient between the market share of menthol cigarettes and the female youth smoking prevalence is also negative at -0.4, and is statistically significant. Again, this result suggests that youth smoking prevalence among females would be lower the higher the market share of menthol cigarettes.

Although no final conclusion on the causal relationship between the two variables can be drawn from the simple correlation analysis, the result does not support the notion that menthol cigarettes contribute to an increased smoking prevalence among young people, in particular females.

Chart 3.3: Female youth smoking prevalence and menthol share (2010)



Source : based on Tobacco Atlas, Philip Morris estimates based on AC Nielsen and in-market sales data

The charts and the simple correlation coefficients do not show any statistically significant relationship between the market share of menthol cigarettes and male youth smoking prevalence, while they show a negative and statistically significant relationship between overall and female youth smoking and the market share of menthol cigarettes. However, in order to properly assess the statistical relationship between these variables, we need to take into account the possible interaction between youth smoking and other relevant variables. Multiple regression analysis allows us to estimate the correlation between our main two variables, after taking into account additional economic, social and institutional factors. The regression analysis is the focus of the next two sections.

3.2 Menthol cigarette market share and youth smoking prevalence

In this section we summarise the results of the regression analysis of overall youth smoking prevalence. The regression analysis was undertaken using our 52-country sample and the regression technique used was ordinary least squares (OLS) with robust standard errors to control for heteroskedasticity. Table 3.1 reports the results of the equations estimated using the overall youth smoking prevalence variable (YOUTH) as the dependent variable in all equations.

In Equation 1 we estimated the interaction of youth smoking prevalence (YOUTH) with the market share of menthol cigarettes (MENTH), GDP per capita (GDPCAP) and the tobacco control indicator (TCI). We found that the market share of menthol cigarettes (MENTH) is negatively and significantly correlated

with youth smoking, even after controlling for GDP per capita and tobacco control measures, confirming the results obtained using the simple correlation analysis in section 3.1.

Regarding the other variables, we found that GDP per capita has a positive – and statistically significant – coefficient, which is interpreted to measure the impact of income on cigarette demand (as in Nelson, 2003). Specifically, we found that an increase by 10% in GDP per capita implies an increase by half a percentage point in youth smoking prevalence. Meanwhile, the tobacco control measure has a negative and significant coefficient. This implies that certain tobacco control measures such as smoke free areas and cessation programmes are associated with lower levels of youth smoking.

Table 3.1 – Youth smoking regression equations

		Constant			Independent variables														
Equation 1																			
YOUTH =		-18.9	–	0.12	* MENTH	+	4.97	* LOG(GDPCAP)	–	2.71	* TCI								
T-statistics		[-1.91]		[-2.16]			[4.22]			[-4.10]									
R-squared	0.33																		
Observations	52																		
Equation 2																			
YOUTH =		-17.9	–	0.03	* MENTH	+	4.02	* LOG(GDPCAP)	–	1.71	* TCI	+	9.78	* CEE					
T-statistics		[-2.25]		[-0.66]			[3.84]			[-2.68]			[4.47]						
R-squared	0.53																		
Observations	52																		
Equation 3																			
YOUTH =		-18.5	–	0.05	* MENTH	+	0.84	* SCHOOL	–	0.004	* SCHOOL^2	–	2.14	* TCI					
T-statistics		[-3.20]		[-0.73]			[6.17]			[-5.36]			[-3.63]						
R-squared	0.32																		
Observations	52																		
Equation 4																			
YOUTH =		-11.9	–	0.01	* MENTH	+	0.56	* SCHOOL	–	0.002	* SCHOOL^2	–	1.29	* TCI	+	9.22	* CEE		
T-statistics		[-1.95]		[0.19]			[3.18]			[-2.38]			[-2.37]			[3.86]			
R-squared	0.49																		
Observations	52																		

Variables:
YOUTH=youth smoking prevalence, age 13-15 (% of population aged 13-15)
MENTH=market share of menthol cigarettes
GDPCAP=GDP per capita 2009 in US$, PPP exchange rates
TCI=tobacco control index (smoking free areas and cessation programmes)
SCHOOL=secondary school enrollment ratio (% gross)
CEE=Central and Eastern Europe dummy

We then tested several regional dummies and found that Central and Eastern European countries (CEE) have an average youth smoking prevalence that is 10% points higher than in the rest of the sample. As mentioned in section 2, a higher smoking prevalence in the region reflects the fact that these countries are experiencing a phase of the cigarette epidemic where smoking prevalence has just started to decrease among both males and females and is higher than in countries that have reached Stage 4 of the smoking epidemic, including countries in western Europe (Lopez et al. (1994), Edwards (2004), Bank of America/Merrill Lynch, (2012)). Equation 2 shows the results obtained after adding this variable to the regression. This equation explains cross-country youth smoking better than equation 1, capturing 53% of the variation in youth smoking prevalence across countries in the sample. While the coefficient on the

market share of menthol cigarettes remains negative it is not now statistically significant.

We investigated further the relationship between youth smoking, the market share of menthol cigarette and development levels across our country sample by using an educational variable (following de Walque (2007) and Lleras-Muney (2012)). Specifically, we used the secondary school enrolment ratio (SCHOOL) as a measure of economic and social development. When using this variable in the equation, the coefficient on the market share of menthol cigarettes remains negative and is not statistically significant (equations 3 and 4).

We found that the relation between the secondary school enrolment ratio and youth smoking prevalence is non-linear - the coefficient on the level of schooling is positive while the coefficient on the square of the variable is negative. These regression results imply that youth smoking initially increases with education, as the "income effect" (reflecting the fact that education tends to rise with income levels, see section 2) prevails at lower levels of economic and social development. However, after a certain threshold the effect of schooling on youth smoking becomes negative, i.e. higher education leads to lower youth smoking prevalence. We may perhaps attribute this to a rising "awareness effect" of health risks at higher levels of development[10]. This non-linear effect is robust to the addition of the CEE dummy (see equation 4 in Table 3.1).

Equation 4 explains almost half of the variation of the youth smoking prevalence across countries. Although the R-squared – at 0.49 – is lower than in equation 2, implying the fit of the model to the actual data is slightly weaker, the equation provides additional insight on the transmission between development and youth smoking behaviour.

We also experimented with a price variable in our equations, reflecting the fact that much of the existing literature on youth smoking points to price as an important determinant of youth smoking behaviour.

We found that cigarette prices (for 2010, in US$ and purchasing power parity exchange rates) had no significant statistical relationship with youth smoking for our country sample. Given the wide variation of development levels across the countries in our sample we also constructed a price variable adjusted for differences in purchasing power, by dividing the 2010 price of the most sold brand of cigarette in our sample of countries by GDP per capita. Both variables were in US$ and purchasing power parity (PPP) terms. Tables A.1 and A.2 in the Appendix show the results of the estimations, adding this price variable to our regression equation. The coefficient on the price variable is not significant in any of the estimated equations. Moreover, the addition of this variable does not alter our results - the coefficients on the other variables and the overall fit of the equations are broadly unchanged.

[10] This non-linear effect in our cross-country sample differs from the results for single country studies, which mostly show youth smoking declining as education levels rise. See Kenkel et al. (2006) for a study on US data and Jensen and Lleras-Muney (2012) for a study on Dominican Republic data.

Overall, the coefficient on the market share of menthol cigarettes was not statistically significant in 3 out of 4 equations, including those which best explain cross-country patterns of youth smoking. In the one equation where the coefficient on the market share of menthol cigarettes was statistically significant, the coefficient was negative – suggesting lower rates of youth smoking where the market share of menthol cigarettes is higher. Overall, the empirical evidence from our sample of 52 countries suggests that smoking patterns among young people are mostly determined by economic, social and institutional factors and our best equations are capable of accounting for around half of the cross-country variability of youth smoking prevalence. The empirical evidence does not support the notion that menthol cigarettes contribute to an increased smoking prevalence among young people.

3.3 Male and female youth smoking

Having considered the relationship between menthol cigarette market share and overall youth smoking in section 3.2, this section analyses the relationship between menthol cigarette market share and male and female youth smoking in our sample of 52 countries. The aim of this section is to assess if menthol cigarettes have an impact on smoking prevalence for either males or females when controlling for relevant factors.

We followed the same estimation approach used for the analysis of overall youth smoking prevalence. In particular, the multiple regression analysis was carried out using the ordinary least squares estimator with standard errors robust to heteroskedasticity. Moreover, we used the same structure for the equations, as the main objective of the analysis remained to examine the relationship between youth smoking prevalence and the market share of menthol cigarettes. This method allowed us to highlight the differences between the two gender groups.

In Table 3.2 we summarise the results of the estimations using male and female youth smoking prevalence. Equations 1-4 contain the estimated coefficients for male youth smoking prevalence, while equations 5-8 contain the coefficients estimated using female youth smoking prevalence.

In equations 1-4, dealing with male youth smoking, the coefficient on the market share of menthol cigarettes is in all cases very low and not statistically significant. This is in line with the earlier results which used overall youth smoking prevalence as the dependent variable.

The results for equations 5-8 based on female youth smoking prevalence also mostly show no statistically significant relationship between youth smoking and the menthol market share. The exception is equation 5, where the coefficient on the menthol market share variable is negative and statistically significant. This suggests that higher market shares of menthol cigarettes would be associated with lower levels of female youth smoking. This negative relationship between female youth smoking and the menthol market share also explains the negative relationship between overall youth smoking and the menthol market share found in equation 1 of Table 3.1.

Overall, our set of explanatory variables appears to capture the variability of the female youth smoking prevalence better – the adjusted R-squared reaches 59% in equation 6, while the R-squared is only 36% on our best equations using male youth smoking. However, the coefficients on all the explanatory variables (excluding the menthol market share) in the male youth smoking equations are significant, confirming the robustness of our simple model.

The coefficient on the tobacco control index remains generally significant and negative in both sets of equations, pointing to a potentially important role of some of the policies aimed at reducing smoking in our sample of countries. Moreover, the coefficient on the CEE dummy remains positive and significant in both sets of equations. The coefficient on the dummy variable measures the difference of the average youth smoking rate between the countries included in the dummy and the rest of the sample. The coefficient is above 10 in equations 6 and 8, implying average female youth smoking rates in CEE countries are about 10% points above the average in the other countries in the sample. The coefficient is between 8 and 9 in equations 2 and 4, implying the average male youth smoking prevalence in CEE countries is around 8.5% points above the average in the other countries in the sample. As a result, the discrepancy between smoking prevalence in the CEE region and the other countries included in the sample appears to be larger for females.

Table 3.2: Male and female youth smoking regression equations

		Constant				Independent variables												
Equation 1																		
YOUTH_M =		-5.4	–	0.07	* MENTH	+	3.66	* LOG(GDPCAP)	–	2.77	* TCI							
T-statistics		[-0.51]		[-1.09]			[2.87]			[-4.17]								
R-squared	0.19																	
Observations	52																	
Equation 2																		
YOUTH_M =		-4.4	–	0.02	* MENTH	+	2.77	* LOG(GDPCAP)	–	1.83	* TCI	+	9.16	* CEE				
T-statistics		[-0.49]		[0.29]			[2.31]			[-2.80]			[3.69]					
R-squared	0.36																	
Observations	52																	
Equation 3																		
YOUTH_M =		-15.2	+	0.01	* MENTH	+	0.86	* SCHOOL	–	0.004	* SCHOOL^2	–	2.27	* TCI				
T-statistics		[-2.40]		[-0.08]			[6.50]			[-6.53]			[-3.75]					
R-squared	0.23																	
Observations	52																	
Equation 4																		
YOUTH_M =		-9.2	+	0.05	* MENTH	+	0.61	* SCHOOL	–	0.003	* SCHOOL^2	–	1.52	* TCI	+	8.28	* CEE	
T-statistics		[-1.46]		[0.92]			[3.86]			[-3.59]			[-2.66]			[3.27]		
R-squared	0.36																	
Observations	52																	

		Constant				Independent variables												
Equation 5																		
YOUTH_F =		-32.0	–	0.16	* MENTH	+	6.22	* LOG(GDPCAP)	–	2.69	* TCI							
T-statistics		[-3.21]		[-2.73]			[5.26]			[-3.61]								
R-squared	0.40																	
Observations	52																	
Equation 6																		
YOUTH_F =		-30.9	–	0.07	* MENTH	+	5.22	* LOG(GDPCAP)	–	1.63	* TCI	+	10.32	* CEE				
T-statistics		[-3.91]		[-1.34]			[5.14]			[-2.34]			[4.60]					
R-squared	0.59																	
Observations	52																	
Equation 7																		
YOUTH_F =		-22.1	–	0.08	* MENTH	+	0.82	* SCHOOL	–	0.003	* SCHOOL^2	–	2.07	* TCI				
T-statistics		[-2.99]		[-0.97]			[4.41]			[-3.17]			[-3.09]					
R-squared	0.35																	
Observations	52																	
Equation 8																		
YOUTH_F =		-14.8	–	0.01	* MENTH	+	0.52	* SCHOOL	–	0.002	* SCHOOL^2	–	1.15	* TCI	+	10.04	* CEE	
T-statistics		[-1.85]		[-0.23]			[2.20]			[-1.31]			[-1.87]			[3.84]		
R-squared	0.52																	
Observations	52																	

Variables:
YOUTH_M=male youth smoking prevalence, age 13-15 (% of male population aged 13-15)
YOUTH_F=female youth smoking prevalence, age 13-15 (% of female population aged 13-15)
MENTH=market share of menthol cigarettes
GDPCAP=GDP per capita 2009 in US$, PPP exchange rates
TCI=tobacco control index (smoking free areas and cessation programmes)
SCHOOL=secondary school enrollment ratio (% gross)
CEE=Central and Eastern Europe dummy

The set of regressions described in this section confirm the results obtained using overall youth smoking prevalence. We found no statistically significant relationship between the market share of menthol cigarettes and male youth smoking prevalence in any of the estimated equations, and no statistically significant relationship between the market share of menthol cigarettes and female youth smoking prevalence in three out of four estimated equations. The exception was one equation showing a significant, negative relationship between female youth smoking and the menthol market share. This would suggest lower

female youth smoking prevalence as the menthol market share rises. Overall, the results point strongly towards cross-country differences in youth smoking prevalence in our sample, among both males and females, being driven mainly by socio-economic factors. Our results do not support the notion that the availability of menthol cigarettes contribute to an increased smoking prevalence among young people, neither male, nor female.

4 Conclusions

The purpose of this study has been to investigate if the availability (market share) of menthol cigarettes has a statistically significant relationship with youth smoking prevalence across countries; it is aimed at testing whether menthol cigarette market share affects youth smoking prevalence rates. We also examined if the market share of menthol cigarettes could affect male and female youth smoking prevalence in different ways. We conclude that there is no evidence to support the hypothesis that greater availability of menthol cigarettes (as represented by market share) is associated with higher youth smoking prevalence – overall, male and female.

A sample of 52 countries was used to examine the selected determinants of youth smoking. The main limiting factor for the number of countries included in the study, were the availability of data for 13-15 years old youth smoking prevalence and tobacco control measures.

Using overall youth smoking prevalence as a dependent variable, we found no evidence of a statistically significant relationship between this variable and the market share of menthol cigarettes in 3 out of 4 estimated regression equations. In the simplest estimated equation we found a statistically significant, negative relationship between the two variables, implying lower rates of youth smoking as menthol market share increases.

Meanwhile, socio-economic variables such as GDP per capita and level of education appeared to have a strong relationship with youth smoking prevalence, as has been repeatedly shown in the literature. An indicator of tobacco control measures and a dummy for Central and Eastern European countries were found to significantly improve the regression results. A cigarette price variable was not significant in any of the estimated equations. Our best equations were able to explain around half of the cross-country variation in youth smoking in our sample.

These results also held when male and female youth smoking prevalence were examined separately. There was no evidence of a statistically significant relationship between male youth smoking and the market share of menthol cigarettes in any of the estimated equations. For female youth smoking, this was also true for three of four estimated equations, including those that best fitted the data. As with overall youth smoking, in the one equation which showed evidence of a statistically significant relationship between female youth smoking and the market share of menthol cigarettes, that relationship was negative - implying that a higher market share of menthol cigarettes would be associated with lower levels of female youth smoking.

The estimated equations using male and female youth smoking also continued to show the importance of economic, social and institutional factors in explaining the cross-country variations in youth smoking. The regression models worked particularly well when used to describe the variation of female youth smoking prevalence: although we included only a small number of explanatory variables

in the multiple regression analysis, we were able to explain almost 60% of the variation of youth smoking in our best performing equations.

We conclude that there is no evidence for the 52 countries in our sample to support the hypothesis that greater availability of menthol cigarettes (as represented by market share) is associated with higher youth smoking prevalence. There is no evidence of any statistically significant relationship between the market share of menthol cigarettes and male youth smoking. For female youth smoking and overall youth smoking, most of our estimated equations also suggest no statistically significant relationship between youth smoking and the market share of menthol cigarettes. In those equations where a significant statistical relationship between youth smoking and the market share of menthol cigarettes is found, the relationship is negative - which contradicts the notion that youth smoking increases where menthol cigarettes are more prevalent.

Instead, our results suggest that economic, social and institutional factors, such as income level and education, as well as certain tobacco control measures, explain up to 60% of the cross-country variation in youth smoking. Overall, our results support the findings of previous scientific studies of menthol and youth smoking prevalence such as King et al. (2012) and ACSH (2010), which have suggested no link between menthol cigarettes and increased youth smoking. The importance our results attach to economic, social and institutional variables as drivers of cross-country differences in youth smoking prevalence are meanwhile in line with studies such as Nelson (2003) and (for adult smoking prevalence) Schaap et al. (2008).

5 Appendix

List of variables used in regressions

YOUTH = youth smoking prevalence, age 13-15

Source: The Tobacco Atlas – fourth edition (2012)

YOUTH_M/YOUTH_F = male/female youth smoking prevalence, age 13-15

Source: The Tobacco Atlas – fourth edition (2012)

MENTH = market share of menthol cigarettes

Source: Philip Morris International Management SA

GDPCAP = GDP per capita in US$, at purchasing power parity

Source: Oxford Economics/IMF World Economic Outlook

SCHOOL = secondary school enrolment ratio, % gross

Source: World Bank World Development Indicators (WDI)

TCI = tobacco control index (smoking free areas and cessation programmes)

Source: Oxford Economics/WHO

PRICE= cigarette price in US$, PPP (most sold brand)

Source: WHO

CEE = Central and Eastern Europe dummy (Bulgaria, Czech, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine)

Source: Oxford Economics

Dependent and explanatory variables in the youth smoking regressions

COUNTRY	YOUTH	YOUTH_M	YOUTH_F	MENTH	GDPCAP	SCHOOL	TCI	PRICE	CEE
Australia	3.8	3.0	4.6	7.8	36409.8	149.3	7.16	7.74	0
Brazil	11.6	9.2	13.2	2.2	9444.3	90.2	5.74	1.96	0
Bulgaria	28.2	24.4	31.6	0.3	11525.4	88.6	2.93	5.58	1
Cameroon	5.7	8.8	3.0	20.2	2031.3	42.2	2.33	1.99	0
Canada	14.0	13.0	14.0	4.1	34587.4	101.3	6.94	6.61	0
Croatia	24.1	21.7	25.6	0.4	16141.0	95.3	5.10	4.20	1
Cyprus	3.9	3.7	4.2	1.1	25822.6	98.3	5.35	3.73	0
Czech Republic	31.1	29.8	32.7	2.6	22023.3	94.9	2.99	4.35	1
Egypt	4.0	5.9	1.4	0.0	5366.8	79.3	6.24	1.66	0
El Salvador	14.0	18.4	10.9	31.0	6250.7	65.0	2.44	3.51	0
Estonia	27.2	28.2	26.2	9.7	16146.8	99.3	2.91	3.53	1
France	19.6	19.1	20.2	3.6	29503.2	113.2	6.13	6.15	0
Germany	12.9	14.0	12.0	2.6	31352.2	101.7	3.75	5.74	0
Greece	10.4	11.3	9.0	0.3	26595.9	101.8	4.00	4.37	0
Guatemanla	11.4	13.7	9.1	40.0	4360.0	58.5	2.29	2.88	0
Hungary	23.2	21.5	23.6	6.8	16778.2	97.4	3.28	4.27	1
India	3.8	5.4	1.6	22.1	2805.1	60.0	3.24	3.95	0
Italy	20.7	19.4	21.6	0.2	26253.2	100.5	6.00	4.21	0
Japan	10.3	12.1	8.5	23.9	29439.0	101.5	2.63	2.71	0
Jordan	10.3	13.2	7.1	0.2	5023.0	91.1	4.41	3.06	0
Kazakhstan	9.4	12.7	6.6	1.3	10488.8	97.0	3.60	1.03	1
Kenya	8.2	11.2	5.2	20.4	1440.3	60.2	3.34	2.59	0
Lao	5.5	10.2	0.7	0.1	2067.3	44.7	3.19	1.46	0
Latvia	32.9	36.3	30.2	1.9	13112.2	98.0	2.87	3.91	1
Lithuania	29.6	33.8	25.9	5.9	15158.4	99.0	4.53	4.55	1
Malaysia	20.2	36.3	4.2	16.9	12724.6	68.7	4.89	5.54	0
Mauritius	13.7	20.3	7.7	2.2	12137.2	89.4	5.70	4.39	0
Mexico	27.1	26.3	27.1	6.6	11918.6	86.9	3.28	3.61	0
Mongolia	5.4	9.2	2.0	0.9	3150.0	92.9	3.69	1.94	0
Morocco	5.2	7.4	2.3	0.1	4193.6	56.1	2.86	3.44	0
Netherlands	20.0	19.1	20.8	4.2	36463.0	120.7	3.07	5.80	0
New Zealand	17.6	14.5	20.6	11.8	25364.4	116.5	8.16	6.95	0
Nigeria	3.5	5.6	1.3	34.2	2012.8	44.0	2.90	3.02	0
Panama	4.3	5.9	2.8	26.2	10753.0	74.1	7.97	5.23	0
Peru	17.3	22.9	11.9	26.2	7863.0	91.6	2.38	2.87	0
Philippines	11.0	16.0	6.4	49.4	3244.2	82.0	3.27	0.90	0
Poland	18.6	19.6	17.1	16.8	16427.1	99.6	4.59	4.09	1
Romania	17.6	21.5	14.3	3.4	10852.8	91.6	5.66	4.88	1
Russia	25.4	26.9	23.9	1.0	13818.4	84.8	1.45	1.53	1
Singapore	11.0	16.0	6.4	48.1	48513.0	58.4	6.48	11.30	0
Slovakia	25.0	26.5	23.4	0.5	19297.9	92.1	4.50	4.38	1
Slovenia	20.3	15.2	23.0	1.0	24645.4	96.8	4.20	3.96	1
South Africa	13.6	17.9	10.6	7.4	9253.8	93.9	3.73	4.31	0
South Korea	8.8	10.8	6.3	4.7	25746.2	97.1	4.46	-	0
Spain	18.9	17.0	20.8	0.9	26969.8	119.9	4.50	4.41	0
Sweden	9.0	5.0	13.0	11.5	32710.5	103.5	4.19	5.39	0
Switzerland	32.7	35.7	29.6	2.0	36725.8	96.1	3.64	4.22	0
Thailand	8.8	15.8	2.4	35.0	7259.0	75.6	5.33	3.38	0
Turkey	6.9	9.4	3.5	0.4	10706.0	82.0	4.97	3.88	0
UK	5.0	4.0	6.0	7.4	31355.3	99.0	7.03	9.36	0
Ukraine	24.0	27.6	20.6	1.0	5799.7	94.4	2.30	1.54	1
Venezuela	7.4	6.0	8.4	0.5	11292.7	82.5	5.03	5.64	0

Variables:
YOUTH/_M/_F=overall/male/female youth smoking prevalence, age 13-15 (% of population aged 13-15)
MENTH=market share of menthol cigarettes
GDPCAP=GDP per capita 2009 in US$, PPP exchange rates
TCI=tobacco control index (smoking free areas and cessation programmes)
SCHOOL=secondary school enrollment ratio (% gross)
CEE=Central and Eastern Europe dummy
PRICE= cigarette price in US$, PPP (most sold brand)

Estimation results using a price variable

As noted in section 3.2 above, we also experimented with a price variable in our equations, reflecting the fact that much of the existing literature on youth smoking points to price as an important determinant of youth smoking behaviour.

Tables A.1 and A.2 shows the results of the estimations adding this price variable to our regression equation. The coefficient on the price variable is not significant in any of the estimated equations. Moreover, the addition of this variable does not alter our results - the coefficients on the other variables and the overall fit of the equations are broadly unchanged.

Table A.1: Youth smoking regression equations using price variable

		Constant	Independent variables														
Equation 1																	
YOUTH =		-18.3	–	0.13	* MENTH	+	5.86	* LOG(GDPCAP)	–	2.85	* TCI	+	1.01	* LOG(PRICE/GDPCAP)			
T-statistics		[-1.44]		[-1.98]			[2.98]			[-4.11]			[0.38]				
R-squared	0.34																
Observations	51																
Equation 2																	
YOUTH =		-14.0	–	0.05	* MENTH	+	5.653	* LOG(GDPCAP)	–	1.96	* TCI	+	9.69	* CEE	+	2.21	* LOG(PRICE/GDPCAP)
T-statistics		[-1.30]		[-0.78]			[2.81]			[-2.98]			[4.55]			[0.81]	
R-squared	0.54																
Observations	51																
Equation 3																	
YOUTH =		-25.86	–	0.06	* MENTH	+	0.76	* SCHOOL	–	0.004	* SCHOOL^2	–	2.09	* TCI	–	1.515	* LOG(PRICE/GDPCAP)
T-statistics		[-1.90]		[-0.84]			[3.99]			[-4.24]			[-3.51]			[-0.60]	
R-squared	0.32																
Observations	51																
Equation 4																	
YOUTH =		-16.83	–	0.004	* MENTH	+	0.52	* SCHOOL	–	0.002	* SCHOOL^2	–	1.29	* TCI	+	8.88	* CEE – 0.99 * LOG(PRICE/GDPCAP)
T-statistics		[-1.24]		[0.07]			[2.74]			[-2.34]			[-2.41]			[3.57]	[-0.41]
R-squared	0.49																
Observations	51																

Variables:
YOUTH=youth smoking prevalence, age 13-15 (% of population aged 13-15)
MENTH=market share of menthol cigarettes
GDPCAP=GDP per capita 2009 in US$, PPP exchange rates
TCI=tobacco control index (smoking free areas and cessation programmes)
SCHOOL=secondary school enrollment ratio (% gross)
CEE=Central and Eastern Europe dummy
PRICE= cigarette price in US$, PPP (most sold brand)

Table A.2: Male and female youth smoking regression equations using price variable

		Constant			Independent variables															
Equation 1																				
YOUTH_M =		-5.507	–	0.07	* MENTH	+	4.21	* LOG(GDPCAP)	–	2.85	* TCI	+	0.55	* LOG(PRICE/GDPCAP)					
T-statistics		[-0.40]		[-1.07]			[2.09]			[-4.26]			[0.20]							
R-squared	0.19																			
Observations	51																			
Equation 2																				
YOUTH_M =		-1.517	–	0.01	* MENTH	+	4.01	* LOG(GDPCAP)	–	2.02	* TCI	+	9.09	* CEE	1.67	* LOG(PRICE/GDPCAP)				
T-statistics		[-0.12]		[0.09]			[2.00]			[-3.07]			[3.62]		[0.60]					
R-squared	0.35																			
Observations	51																			
Equation 3																				
YOUTH_M =		-19.27	–	0.01	* MENTH	+	0.83	* SCHOOL	–	0.004	* SCHOOL^2	–	2.25	* TCI	–	0.79	* LOG(PRICE/GDPCAP)		
T-statistics		[-1.42]		[-0.15]			[4.63]			[-5.40]			[-3.66]			[-0.32]				
R-squared	0.23																			
Observations	51																			
Equation 4																				
YOUTH_M =		-11.11	+	0.05	* MENTH	+	0.61	* SCHOOL	–	0.003	* SCHOOL^2	–	1.53	* TCI	+	8.02	* CEE	–	0.31	* LOG(PRICE/GDPCAP)
T-statistics		[-0.79]		[0.79]			[3.67]			[-3.80]			[-2.70]			[3.00]			[-0.13]	
R-squared	0.34																			
Observations	51																			

		Constant			Independent variables															
Equation 5																				
YOUTH_F =		-30.72	–	0.18	* MENTH	+	7.46	* LOG(GDPCAP)	–	2.88	* TCI	+	1.45	* LOG(PRICE/GDPCAP)						
T-statistics		[-2.39]		[-2.46]			[3.41]			[-3.61]			[0.50]							
R-squared	0.42																			
Observations	51																			
Equation 6																				
YOUTH_F =		-26.25	–	0.09	* MENTH	+	7.24	* LOG(GDPCAP)	–	1.95	* TCI	+	10.19	* CEE	+	2.71	* LOG(PRICE/GDPCAP)			
T-statistics		[-2.49]		[-1.37]			[3.22]			[-2.63]			[4.79]			[0.89]				
R-squared	0.60																			
Observations	51																			
Equation 7																				
YOUTH_F =		-31.72	–	0.09	* MENTH	+	0.71	* SCHOOL	–	0.003	* SCHOOL^2	–	2.00	* TCI	–	2.02	* LOG(PRICE/GDPCAP)			
T-statistics		[-2.08]		[-1.10]			[2.89]			[-2.55]			[-2.95]			[-0.72]				
R-squared	0.36																			
Observations	51																			
Equation 8																				
YOUTH_F =		-21.95	–	0.02	* MENTH	+	0.45	* SCHOOL	–	0.002	* SCHOOL^2	–	1.14	* TCI	+	9.61	* CEE	–	1.44	* LOG(PRICE/GDPCAP)
T-statistics		[-1.46]		[-0.36]			[1.77]			[-1.19]			[-1.88]			[3.61]			[-0.55]	
R-squared	0.52																			
Observations	51																			

Variables:
YOUTH_M=male youth smoking prevalence, age 13-15 (% of male population aged 13-15)
YOUTH_F=female youth smoking prevalence, age 13-15 (% of female population aged 13-15)
MENTH=market share of menthol cigarettes
GDPCAP=GDP per capita 2009 in US$, PPP exchange rates
TCI=tobacco control index (smoking free areas and cessation programmes)
SCHOOL=secondary school enrollment ratio (% gross)
CEE=Central and Eastern Europe dummy
PRICE= cigarette price in US$, PPP (most sold brand)

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