

ECONOMIC ASPECTS OF SMOKING IN EUROPE

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EUROPEAN NETWORK FOR
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SMOKING PREVENTION
PREVENTION DU TABAGISME



Europe against cancer



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1. Aim of the project

The aim of the project was for a team of researchers from countries across the European Union to work collaboratively –to collect data, to assess trends and to develop econometric models to evaluate the impact of price, income and other economic and tobacco control factors on cigarette consumption and prevalence across Europe.

We see economic issues as central to tobacco use. Economic considerations drive the supply of tobacco products while prices, taxes and advertising modify demand. Externalities related to extra health care, premature mortality and fires may be borne by others members of society or members of other societies. Trade agreements or restrictions, tax harmonisation or variations in interstate tax rates, affect levels of tobacco use. These issues all impinge positively or negatively on tobacco use and related disease and mortality across the continent and the aim of this study is to quantify some of these effects to inform policy. Cigarette prices and consumption across Europe vary both absolutely and relative to per capita incomes; even when prices are standardised for cost of living, the range of price is four-fold. Tobacco price and taxation are likely to have different effects on different income and socio-economic groups. Those on low income tend to smoke more, but reduce their smoking more in response to tax increases. Conversely, they are more likely to be encouraged to smoke by a reduction in the real price. A cross-sectional study of smoking and price in Europe from the project's co-leader, reported in 1988 a price elasticity of demand for cigarettes in Europe of -0.4 and an income elasticity of demand of 0.5 .

The study will re-estimate these cross Europe elasticities in the light of current changes and carry out analyses for the individual countries involved in the project.

2. Executive summary

- Each national team has collected data on the trends in tobacco consumption, smoking prevalence, and prices in each country.
- Each national team has made a summary overview of the most recent data on tobacco consumption and smoking prevalence, economic aspects, policy aspects, and available trends in each country.
- At the first project meeting, participants presented the main characteristics of the tobacco epidemic and the current situation of policy control, advertising bans, tobacco consumption, smuggling, and prices in their country. The participants discussed in-depth the analysis to be conducted. It was agreed that this would include 1) a “cross-sectional” analysis on price and income elasticity (consumption as predicted variable), including as many European countries as possible (EU and accession countries). This type of analysis uses data for different countries for a given year in the same model; and 2) a “national analysis” (within each country) of the relationship between price and consumption/prevalence, to assess price and income elasticity in each country.
- Elasticity is the standard economic measure of response to change in an economic variable –price or income in this study–, and is defined as the percentage change in quantity consumed or bought –cigarette consumption and prevalence of smoking in this study– for a 1% change in these variables.
- At the second project meeting, the results of the cross-sectional analysis and the national elasticity analyses were presented and discussed.
- *Results from the cross-sectional analysis.* This study included 17 Western European countries, excluding, some European former Socialist Economies States for lack of reliable data. This model explains cigarette consumption per adult in Europe in terms of price (foreign or most popular cigarette price adjusted for Gross Domestic Product), women's smoking level (smoking prevalence in females was included to adjust the data for the wide variation across Europe in the ratio between the prevalence of smoking by men and by women), and legislation pressure (proxied by a

variable generated from the available information as low/intermediate/high according to the different laws and policies on tobacco control in each country). The most effective model included both price and correction for female prevalence, and explained 60% of the variation in cigarette consumption per head between countries. Price was therefore shown to have a significant effect on a country's per capita cigarette consumption. The cross country price elasticity at -0.67 ($p < 0.001$) is higher than that reported in the previous analysis with 22 European countries. So that on average across the European countries considered, smoking consumption decreased 6.7% for a 10% increase in the real price of cigarettes. It is at the higher range of estimates in the literature based on national elasticity analysis (mainly ranging between -0.35 and -0.79). The coefficient for smoking among females is 0.55 ($p < 0.05$) indicating the expected positive adjustment for female smoking to explain a country's per capita consumption. No effect of tobacco control legislation was identified by the model including the dummy variables for legislation. It was not possible to make allowance for smuggling in the cross sectional analysis, as data was not available and this may have inflated the estimate of price elasticity.

- *Results from the national analyses.* Changes in cigarette price had an appreciable impact on smoking consumption in several countries. Price elasticity of demand for cigarettes in the **United Kingdom** over the period 1972-2000 was -0.36 (-0.43 for women and -0.27 for men; statistically significant at $p < 0.05$). Price elasticities of demand for cigarettes in **Italy** over the period 1970-2001 were -0.30 for prevalence and -0.43 for cigarette consumption ($p < 0.05$). Price elasticity in **Spain** over the period 1965-1995 was -0.32 ($p < 0.05$) and -0.66 ($p < 0.05$) for prevalence (blond tobacco price) among males and females. Price elasticity in **Portugal** over the period 1980-2000 was -0.29 and -0.13 for cigarette consumption of national and foreign brands, respectively. Price elasticity in **Greece** over the period 1987-1998 was -0.27 for cigarette consumption. Price elasticity in **Ireland** over the period 1989-1999 was -0.14 for cigarette consumption. Price elasticities in Portugal, Greece, and Ireland were not significant mainly due to the shortage of relevant data.
- *Conclusions.* The estimated price elasticities of demand for cigarettes in each of the participant countries ranged from -0.13 to -0.70 for cigarette consumption per capita

or for prevalence. The results from the cross-sectional analysis indicate a high price elasticity of cigarette consumption. Differences in estimates may be attributed partly to the existing differences in the time period studied and the availability (and quality) of the data. Although a coordinated effort was made to conduct similar analyses in each country, the scarce or variable availability of smoking data (particularly for Ireland, Greece, and Portugal) including lack of information on smuggling, to some degree limits the comparability of the results obtained.

- The present analyses however, consistently confirm the inverse association between price and prevalence/consumption of cigarettes in Europe. European coordinated effort to increase prices may therefore have important public health implications for tobacco control.
- There is a need to co-ordinate collection and presentation of data on cigarette consumption, including estimates of smuggled cigarettes, to allow improved monitoring and evaluation of economic trends and influences, and to help contain the problem of smuggling and to inform policy.

3. Economics of smoking: an overview

Economics and tobacco are inextricably linked. Economic considerations drive the supply of tobacco products while prices, taxes and advertising modify demand. Externalities related to extra health care, premature mortality and fires may be borne by others members of society or members of other societies. Trade agreements or restrictions, tax harmonisation or variations in interstate tax rates affect levels of tobacco use. These issues all impinge positively or negatively on tobacco use and related disease and mortality across the continent. In Europe approximately 30% of adults smoke regularly and some 1.3 million deaths per year are caused by smoking, losing 20 years of life each on average. Deaths from smoking are highest in Eastern Europe and at current rates 20% of all deaths in 2020 will be from smoking. Some 550 000 people in the European Union die from their smoking habit¹.

3.1 Trends in Smoking in Europe

It would be wrong to think that smoking is decreasing in Europe. In fact cigarettes consumed per person each year has been static or slightly rising over recent years, rising particularly in Portugal, Greece, Russia, Czech Republic, Croatia and Slovakia. Wide variations still exist between European countries from some 1.5 cigarettes per day per head of population in Sweden to 10 per day per head of population in Greece. Despite attempts to harmonise tobacco tax rates across Europe there are still wide differences – a four fold difference in price and tax between Spain and UK.

As smoking levels vary widely across the continent, so too do tobacco related disease rates, such as lung cancer mortality rates. Over the last decade female lung cancer rates have risen in almost all countries, and while male lung cancer rates have fallen in some countries they are still rising in others and in some cases such as in Spain and Portugal, Greece, Italy and France rising rapidly.

¹ WHO Europe. The European report on tobacco control policy. Copenhagen: WHO; 2002.

3.2 Price and Consumption in Europe

Cigarette prices and consumption vary absolutely and relative to per capita incomes. If prices are standardised for cost of living, the range narrows to four-fold. A cross-sectional study of smoking and price in 27 European countries (including all EU countries) reported a price elasticity of demand for cigarettes in Europe of -0.4 and an income elasticity of demand of 0.5 ². This means that cigarette consumption will rise with incomes unless there are counter policies.

3.3 Smoking and income level/socio-economic group

Although in high income countries, those on high incomes were initially more likely to smoke, this reversed in many countries particularly after the health risks were published and made known in the 1960s and 1970s. For example in Norway smoking among high income men fell from 75% to 28% between 1955 and 1990, while for low income men it fell from 60% to 48% over the same period. In the UK there was little difference in smoking by income or socio-economic group in 1960, but by 2000 only 14% women and 17% of men in the highest socio-economic group smoked, compared with 35% women and 40% men in the lowest socio-economic group. The prevalence of smoking among women has been lower in southern Europe than in northern Europe, with a wider gender and socio-economic gap compared to most other developed countries. Deaths from smoking related diseases including lung cancer and coronary heart disease have diverged rapidly between income groups reflecting these differences in smoking prevalence trends.

It is apparent from UK government data that smoking increased during periods when the price of cigarettes fell in real terms, during the early 1970s and late 1980s, and fell when real cigarette prices rose in the mid 1970s and during the early 1980s and 1990s. Similar counter movements of smoking with relative cigarette price have been shown now for many countries including France, Canada, South Africa, Turkey, and China.

² Townsend J. Tobacco price and the smoking epidemic. *Smoke-free Europe*: 9. Geneva: WHO; 1988.

People in low income countries are likely to respond more to cigarette price rises than are people in high income countries³. As well as the income effect, the age structure of most low income countries' populations is generally younger and research from the high income countries suggest that, on the whole, young people are more price responsive than older people^{4,5}. This is partly because they have lower disposable incomes, partly because some may, as yet, be less heavily addicted to nicotine, partly because of their more 'present oriented' behaviour, and partly because they are more susceptible to peer influences. Thus if one young person stops smoking because he or she can no longer afford to, friends are also more likely to quit.

Similarly tobacco price and taxation are likely to have different effects on different income and socio-economic groups⁵. Low income groups tend to smoke more, but reduce their smoking more in response to tax increases. Conversely, they are more likely to be encouraged to smoke by a reduction in the real price. A UK analysis of cigarette consumption reported that men and women in the highest socio-economic groups did not respond to changes in cigarette price. Adults in socio-economic groups 3 and 4 (clerical workers, skilled and semi-skilled manual workers) responded in the middle range with a price elasticity of about -0.5 to -0.7 . Unskilled manual workers and their wives (socio-economic group 5) showed the highest response with elasticities of -1.0 for men and -0.6 for women². There has been much debate about whether cigarette price affects the prevalence of smoking as well as the average adult consumption. This UK analysis reported significant elasticities of prevalence of -0.6 for men in socio-economic group 5 (unskilled manual workers), -0.23 for all women and -0.5 for women in socio-economic group 5. These are important results as socio-economic group 5 is the groups for whom health education has been least effective.

Other authors have also reported significantly different responses to tobacco price in UK households with different incomes and by factors related to socio-economic group, such as house ownership. There has been little work on smoking by income and socio-

³ Prabha J, Chaloupka FJ. Curbing the epidemic: governments and the economics of tobacco control. Washington: The World Bank; 1999.

⁴ Chaloupka FJ. Macro-social influences: the effect of prices and tobacco-control policies on the demand for tobacco products. *Nic Tob Res* 1999;1: S105-S109.

economic group for other countries, and it is important that relevant data are collected, so that the impact of price changes may be more fully understood.

3.4 How addiction affects the response to higher prices

Nicotine addiction is a powerful element in the demand for tobacco. Models that attempt to assess the impact of nicotine addiction on the effects of price increases make varying assumptions about whether smokers look ahead at the consequences of their actions or not. However, all addiction models agree that, for an addictive substance such as nicotine, an individual's current consumption levels will be determined by his or her past consumption levels as well as by the current price of the goods. This relationship between past consumption and current consumption has important implications for modelling the impact of price rises on demand for tobacco. If smokers are addicted, they may respond relatively slowly to price increases, but their response may be greater in the long term. The economics literature suggests that a real and permanent price increase will have approximately twice the impact on demand in the long run as in the short run.

3.5 The potential impact of tax increases on demand for tobacco

Researchers have modelled the potential impact of a range of tax increases on demand for cigarettes world-wide for a report to the World Bank⁵. The assumptions on which the model was based, concerning price elasticity, health impact, and other variables were highly conservative, and so the results are likely to underestimate the potential. The model revealed that even modest price increases could have a striking impact on the prevalence of smoking and on the number of tobacco related premature deaths among those alive in 1995. It is calculated that a 10% increase over the average estimated price in each region, 40 million people world-wide would quit smoking, and many more who would otherwise have taken up smoking would be deterred from doing so³. Given that

⁵ Townsend J, Roderick P, Cooper J. Cigarette smoking by socioeconomic group, sex, and age: effects of price, income, and health publicity. *BMJ* 1994; 309: 923-927

not all quitters would avoid death, the number of premature deaths avoided is still extraordinary by any standards – 10 million, or 3% of all tobacco related deaths –from this price increase alone.

4. Project implementation

The project has been led by Prof. E. Fernandez from Barcelona (Spain), and Prof. J. Townsend from London (UK), in collaboration with Prof. C. Kelleher from Galway, Eire; Dr. N. Kordiolis from Greece; Prof. C. La Vecchia from Italy; Prof. H. Barros from Portugal and their respective national research teams. Dr. T. Demjén from Hungary was included as an observer (no EC funding for the project) and participated in the e-mail discussions.

All members of the research team have provided data, not always available from official sources. These include data on prices, prevalence and consumption where possible by age, sex and income or socio-economic group and morbidity rates, not otherwise available. A working data file was compiled of official data from EU and WHO statistical sources together with the data provided by the national research teams. A literature search was undertaken of recent economic studies of cigarette consumption in the collaborating countries of Europe and others and members of the research team contributed relevant reports.

4.1 Tasks and phases of the research project:

1. Initial planning of the project by the research leaders by telephone and frequent e-mail communication between them and the national leaders. Aim: to plan, prepare and co-ordinate the stages of the project. Preparation of the first meeting in Barcelona. Dates: September 2001-January 2002.
2. First meeting of the research collaborators in Barcelona (February 2002). Aim: to present the current smoking trends and economic aspects in each country, to standardise procedures, to review the data collection, the literature, review the planned analysis and discuss further data collection (see annex I “smoking highlights in each participating country” and annex II “minutes of the first meeting”)
3. Second meeting of the research collaborators in Barcelona (July 2002) Aim: to present and to review the results of the study (cross-sectional and national analyses),

to discuss the dissemination of results, drafting of papers and final scientific and financial reports (see annex III “minutes of the second meeting”)

5. Summary of results

5.1 European cross-sectional analysis of price elasticity

The aim of this part of the analysis was to explain the variation in the consumption of cigarettes across Europe. The variables included in the analysis are price of cigarettes and income (Gross Domestic Product per capita). We also took into account another important cigarette-smoking variable between the countries, namely the level of smoking among women within each country, measured as the prevalence of their smoking. Thus, the *objective* of this part of the project was to analyse price and income elasticity of demand across as many European countries as possible including mainly EU and accession countries. Elasticity is the standard economic measure of response to change in an economic variable –price or income in this study–, and is defined as the percentage change in quantity consumed or bought –cigarette consumption in this study– for a 1% change in these variables.

Data collection and statistical methods.

We have used a variety of different sources of data to compile as much information as possible, and corresponding to as many countries as possible. The main sources of information have been the “Tobacco Control Country Profiles”¹ (TCCP) compiled by the World Health Organization (WHO) and the American Cancer Society (ACS), the “Tobacco or Health: A Global Status Report Country Profiles by Region, 1997” from the WHO Tobacco or Health Programme². In addition, we have used other sources such as the website from the Organisation for Economic Cooperation and Development³ or the CDC’s National Tobacco Information Online System (NATIONS)⁴, as well as other

¹ Corrao MA, Guindon GE, Sharma N, Shokoohi DF (eds). Tobacco Country Profiles, American Cancer Society, Atlanta, GA, 2000. URL: <http://www5.who.int/tobacco/page.cfm?sid=57>

² Available at <http://www.cdc.gov/tobacco/who/whofirst.htm>

³ <http://www.oecd.org/std/ppp2.pdf>

⁴ <http://apps.nccd.cdc.gov/nations/index.asp>

websites to find out ad hoc information from specific countries not available from the above mentioned sources (ie., web sites from ministries of health, ministries of finance or universities from specific countries).

The “Tobacco Control Country Profiles” includes socio-demographic information, data on smoking prevalence, and data on the tobacco economy, including annual per capita and total cigarette consumption from different checked and verified sources. Data on tobacco production, trade, and tobacco control measures (legislation) was obtained mainly from the WHO “Tobacco or Health” website.

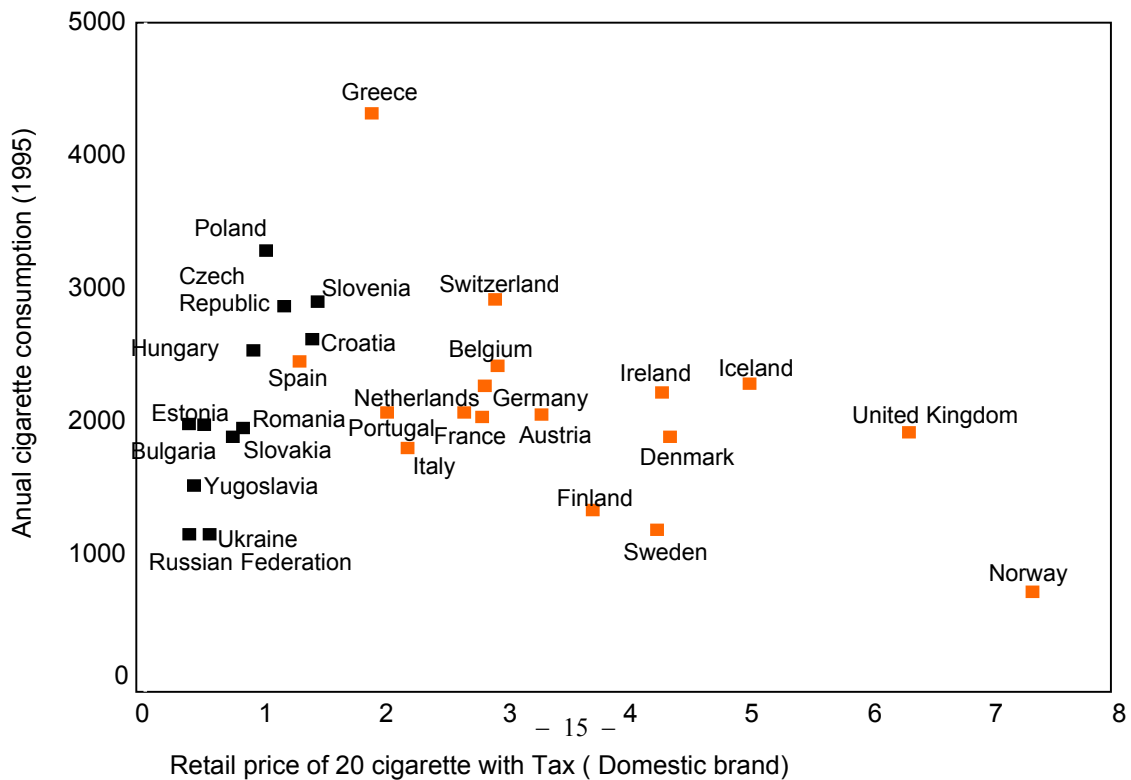
We collected data on *Annual per capita cigarette consumption* for the year 1995, considering 1 cigarette stick as 1 gram in weight; *the smoking prevalence* (males, females) for the years 1995 to 1999, as the proportion (%) of the population >15 years who are smokers of any type of tobacco product, the *price* (retail price) of 20 cigarettes with tax in 1995 (\$US) for most popular domestic and foreign brand; the *Gross Domestic Product* (GDP) of each country in 1995 (\$US), the *Purchasing Power Parities* (PPP), and the population >15 years of each country (1995). We therefore derived the price of cigarettes adjusted for GDP-PPP. We also derived a dummy variable representing the legislation for tobacco control in each country (low/intermediate/high).

Initially, we tried to include as many European countries as possible, and we collected the information for the 33 countries represented in Table 1 and Figure 1. In the preliminary analysis, a variable pattern was apparent in the relationship between cigarette consumption and price of cigarettes as shown in Figure 1; western European countries, including EU countries, show a different pattern of price and consumption than do the former Socialist and East European countries. Thus, we decided to restrict the analysis to the 17 Western and European Union countries for which there was near complete information (in italics in Table 1).

Table 1. Countries initially considered for the cross-sectional analysis.

- *Austria*
- *Belgium*
- *Bosnia*
- *Bulgaria*
- *Croatia*
- *Czech Republic*
- *Denmark*
- *Estonia*
- *Finland*
- *France*
- *Georgia*
- *Germany*
- *Greece*
- *Hungary*
- *Iceland*
- *Ireland*
- *Italy*
- *Latvia*
- *Lithuania*
- *Luxembourg*
- *Netherlands*
- *Norway*
- *Poland*
- *Portugal*
- *Romania*
- *Russian Federation*
- *Slovakia*
- *Slovenia*
- *Spain*
- *Sweden*
- *Switzerland*
- *Ukraine*
- *United Kingdom*
- *Yugoslavia*

Figure 1. Aggregation of countries according to cigarette consumption and price of cigarettes.



We fitted a model to explain cigarette consumption per adult in the European countries in terms of price in each country adjusted for GDP-PPP per capita, women's smoking levels (prevalence of smoking among women), and a legislation pressure (proxied by the dummy variable). From previous research, it is known that these influences are likely to have a proportional effect on cigarette consumption and hence a logarithmic model was used:

$$\ln \mathbf{CigCons}_i = \alpha + \beta_1 \ln \mathbf{Price}_i + \beta_2 \ln \mathbf{FPreval}_i + \beta_3 \ln \mathbf{Legisl}_i + \epsilon_i$$

Where **CigCons_i** is annual cigarette consumption for country *i*, **Price_i** is price of 20 cigarettes in US\$ (adjusted for GDP-PPP) in country *i*, **FPreval_i** is the prevalence (proportion) of smoking among adult (>15 years) females, **Legisl_i** the dummy variables indicating the degree of antismoking legislation, , and **ε_i** is a random error term (consumption not explained by the other variables). From this model, β₁ is the price elasticity (constant to be estimated), β₂ is the effect of women's smoking (constant to be estimated), β₃ is the effect of legislation (constant to be estimated), and α is a constant consumption unrelated to the variables.

Results and discussion.

We explored the effect of inclusion of other explanatory variables of cigarette consumption, including the proportion of persons employed in the tobacco industry in each country and the Gross Domestic Product (GDP) itself. We finally adjusted the price

by GDP (GDP adjusted by PPP), in order to reflect the effect of affordability of cigarettes in each country.

We fitted nested models by introducing the independent variables, in order to evaluate the fit of the model, the variation in cigarette consumption between the 17 European countries considered (Figure 2), and the estimation of the parameters (price elasticity).

Table 2 shows the results of the three models fitted. Model 1 (with only price as explanatory variable) explained only 41% of the variation in annual cigarette consumption per capita, models 2 and 3 which included female smoking prevalence and the effect of legislation explained 60% of cigarette consumption. Since the effect of level of legislation was low (-0.15 , i.e. those countries with "high" pressure will decrease by 0.15% the consumption of cigarettes) and statistically non significant, we select model 2. We checked the selected model in terms of error specification, normality, homoscedasticity, multicollinearity, and self-correlation.

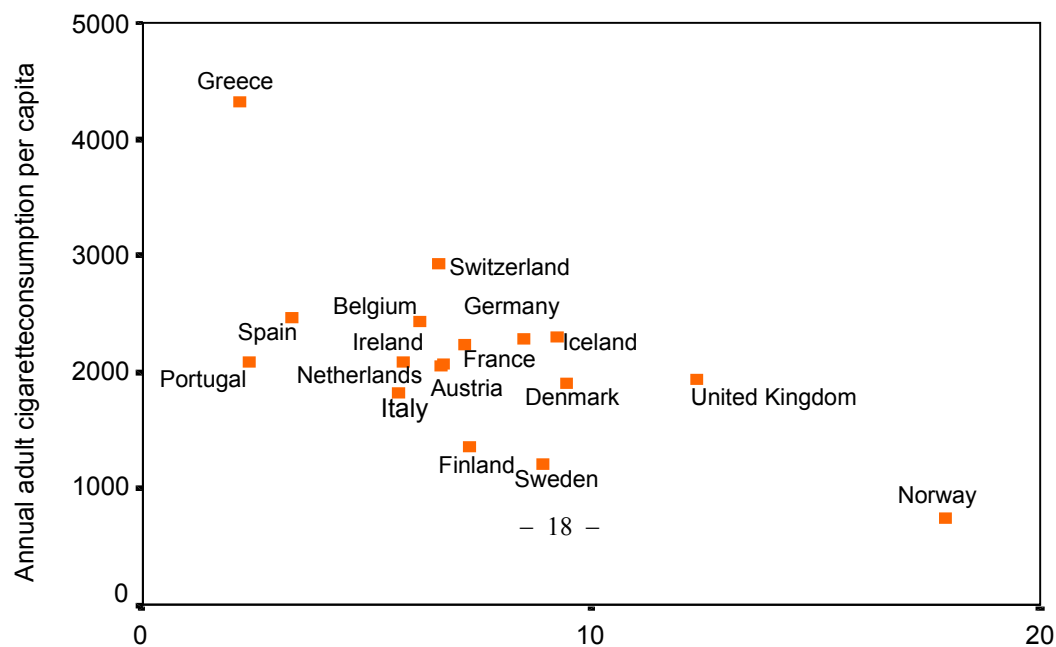
From model 2 (significant at 1%), we estimated that the price elasticity of demand for cigarettes in Europe is -0.67 (significant at 1%), so that on average across the European countries considered, smoking consumption decreased 6.7% for a 10% increase in the real price of cigarettes. The adjustment coefficient for smoking among females was 0.55 ($p < 0.05$). No clear effect of legislation was observed in model 3 including the dummy variables.

Although price elasticities are mostly estimated for individual countries, from time series data as prices do not usually vary across countries with the exception of states in the US, this can also be estimated from cross-sectional data at one period of time from different countries (or other units of analysis) assuming there are similar responses to price changes between them. The estimate of price elasticities for the 17 countries analysed, is not significantly different from the mean price elasticities estimated over time for the individual countries and reported in the latter part of this report. Data for most countries excluded the effects of smuggling, which is thought to be high in several of the countries included in the analysis, and this may have biased the results.

Table 2. Model of cigarette consumption in 17 European countries (1995).

Dependent variable: Annual Cigarette Consumption (CigCons)	Model 1		Model 2		Model 3	
	β	p	β	p	β	p
Constant (α)	8,49	$p<0,001$	9,64	$p<0,001$	9,53	$p<0,001$
Foreign price adjusted for GDP-PPP (Price)	-0.47	$p<0,001$	-0,67	$p<0,001$	-0,57	$p<0,001$
Smoking prevalence in females (Fpreval)			0,55	$p<0,05$	0,57	$p<0,001$
Legislation: Interm. (Legisl ₁)					0,07	$p=0.703$
Legislation: High (Legisl ₂)					-0,15	$p=0.491$
Corrected R^2	0,41		0,60		0,61	
Signification of model	12,21 ($p<0,001$)		12,85 ($p<0,001$)		7,3 ($p<0,001$)	

Figure 2. Price of cigarettes and annual adult cigarette consumption per capita in 17 European countries.



5.2 National time-series analyses of price elasticity

In Europe there is a wide divergence in price levels and habits of smoking. While the main aim of this EU study was to investigate the role of economic variables in smoking across the continent, individual country studies were also carried out to see how variation in economic variables over time affected smoking in each country. In this part of the project we aimed to explain the variation in the consumption of cigarettes (from legal sales or surveys) or in the prevalence of smoking (from health surveys) according to the price of cigarettes and income in each of the participating countries. This means that each national team was in charge of obtaining the necessary data within each country and as far as possible standardised methods agreed at the planning meetings and in active electronic correspondence between the participants.

It is well known that the price of cigarettes is a determinant of tobacco consumption, and changes in cigarette price have had an appreciable impact on smoking prevalence in some countries^{5,6}. Since there has been no such research for most European countries, we decided to conduct a coordinated research in the UK, Spain, Italy, Portugal, Greece, and Ireland to assess effects of price of cigarette on tobacco consumption in the last decades.

In this report we present the most relevant results from each of these countries where the analysis has been conducted. More information on the historical development and current status of the tobacco epidemic in each of the participating countries can be found

⁵ Townsend J, Roderick P, Cooper J. Cigarette smoking by socioeconomic group, sex, and age: effects of price, income, and health publicity. *BMJ* 1994; 309: 923-927

⁶ Hu TW, Ren QF, Keeler TE, Barlett J. The demand for cigarettes in California and behavioural risk factors. *Health Econ* 1995;4:7-14.

in Annex I. Although we devoted considerable effort to harmonizing the methodology to obtain comparable results, this was limited by the different levels of completeness of the data available in each country. This refers to the time period considered in each country (ie. 1972-2000 for the UK, 1965-1995 for Spain, 1980-2000 for Portugal, etc) and the type of data in each country (ie, while biennial data on smoking prevalence is available in the UK for the entire study period, only 12 health surveys were conducted in Italy or 4 in Spain).

In general terms, we have used multiple regression analysis to examine how price and income influenced smoking patterns. We used a single equation model, under the assumption that the consumption (demand) function is log-linear, following the methodology used by Townsend et al.⁷ in order to obtain price elasticities of demand for cigarettes (i.e., percentage change in cigarette consumption for a 1% change in price):

$$\log q_t = (\alpha) + (\beta) \log Y_t + (\gamma) \log P_t + \varepsilon_i \quad [t=\text{year}]$$

Where q_t denotes average cigarette consumption per adult per day for year t , P_t denotes real price of cigarettes in year t , Y_t denotes annual per capita gross domestic product, and ε_i is a random error term (consumption not explained by the other variables). The coefficients (β) and (γ) give the income and price elasticities of demand. Elasticity is the standard economic measure of response to change in an economic variable –price or income in this study–, and is defined as the percentage change in quantity consumed or bought –cigarette consumption and prevalence of smoking in this study– for a 1% change in these variables.

When possible, the same model was considered to evaluate how smoking prevalence (for the years in which prevalence was available) was influenced by price and income. According to the availability of data, expanded models were fitted when possible (i.e., including data on smuggling or health publicity) and by sex or socioeconomic groups.

⁷ Townsend J, Roderick P, Cooper J. Cigarette smoking by socioeconomic group, sex, and age: effects of price, income, and health publicity. *BMJ* 1994; 309: 923-927

5.2.1 United Kingdom

Two different data sets of cigarette consumption have been used in the analysis. The UK General Household survey provides biennial data from 1972, on prevalence of smoking, defined as the proportion of adults answering, 'yes' to the question, 'do you smoke at all nowadays'. It gives numbers of cigarettes smoked per smoker since 1972 by gender, age and socioeconomic group. Prevalence and level of smoking per smoker, have been combined in our analysis to give average consumption per adult in each group. There is thought to be under reporting of cigarette smoking in this survey but this may not be a serious problem for analysis as long as it does not vary systematically over time. Importantly, as this is a consumer survey, the data are likely to include consumption of both legally purchased and smuggled cigarettes. The other major data source is from customs and excise data, based on UK tobacco released for consumption. These data are published annually as part of consumers' expenditure in the National Accounts, are priced and the unevenness of the series smoothed, as tobacco released for sale is not necessarily for immediate consumption but may be released some time ahead of consumption for commercial reasons.

We used multiple regression analysis as discussed above to examine how smoking patterns of each group were influenced by price, income, a trend factor to represent the net effects of health publicity, and other social trends including social acceptability and restrictions in workplace and public places. We also included a variable to represent the level of smuggling since 1994 (smuggling of cigarettes into the UK was low before 1994). A detailed description of the methods and data used is available in Annex IV.

The very high rates of cigarette smoking during the mid half of the twentieth century resulted in the United Kingdom having the highest rates of smoking related disease in the world. However in the years since the risks first became known, there has been very substantial reduction in smoking in the UK. For example, between 1962 and 2000 prevalence of cigarette smoking fell from 57% for men and 42% for women to 29% for men and 25% for women. The average weekly consumption halved between 1972 and the year 2000 from 65 to 32 cigarettes per week for men and from 42 to 22 for women. In all socio-economic groups, both prevalence and consumption of smoking decreased over this

time, although to varying degrees. Whereas 29% of men and 25% of women in socio-economic group I (professional workers) smoked in 1974 compared with 61% of men and 43% of women in socio-economic group V (unskilled manual workers), by the year 2000 the respective smoking rates had fallen to 17% for men and 14% for women in socio-economic group I and 39% for men but 35% for women in socio-economic group V, showing less reduction by lower SEG women (further data are available in Annex IV). The multiple regression model explained a high proportion ($R^2 > 0.90$ in all models) of the annual variation in cigarette consumption during the period 1972-2000 (Table 3). The estimates of price elasticities are significant and comparable to recent estimates for developed countries. For men and women, the real price of cigarettes was significantly and inversely associated with cigarette consumption with a price elasticity of -0.36 (i.e., on average, cigarette consumption decreased 0.36% for a 1% increase in the price of cigarettes). Price elasticities are higher for women (-0.43) than for men (-0.27). Income elasticities are high and significant for both men and women (Table 3). The smuggling variable is significant for men and for all adults but not for women, and implies that by the year 2000, cigarette consumption was some 12.5% higher than it would have been without smuggling, and that men's consumption was some 17% higher than without smuggling. The health publicity/trend effect is significant for all adults and for men and accounts for a steady reduction in consumption of some 3% per year.

Table 3. Elasticities for UK cigarette consumption per adult and per man and per woman (General Household Survey data, 1972-2000)

	Price elasticity	Income elasticity	Health publicity	Smuggling	R ²
All adults	-0.36**	0.66	-0.032**	0.005*	0.973
Males	-0.27*	0.53	-0.04***	0.008***	0.987
Females	-0.43**	0.74*	-0.02	0.002	0.918

* effect significant at $p < 0.05$

** effect significant at $p < 0.01$

***effect significant at $p < 0.001$

The equations were also estimated separately by gender for each of five socio-economic groups and six age groups. The price elasticities by socio-economic group for men are significant only for groups 3- skilled manual and 5- unskilled manual, and are lower than those estimated for the previous study of data for 1972-1990, although of a similar order (Table 4). Health publicity/trend effects are significant for all groups, are very similar to results for 1972/90 and show a marked trend, being higher for higher socioeconomic groups. The smuggling variable is significant for all socio-economic groups for men with the exception of group 4 (semi-skilled manual workers), with effects at 2000 varying up to over 40% of cigarette consumption for some groups. Multi-colinearity between variables has led to some instability in the estimates of health publicity and smuggling effects for group 1 and unexpected high estimates of income elasticity. For women price and affordability elasticities are higher than for men (Table 5), and significant for all but groups 1 and 2. For both men and women this confirms findings from previous studies that lower socio economic groups are more responsive to cigarette price changes. In women, health publicity/trend effects were less than for the men as expected but significant for all socioeconomic groups but group 5. Smuggling effects were also lower in women and mostly non significant.

Table 4. Elasticities for UK cigarette consumption by socioeconomic group in males (General Household Survey data, 1972-2000)

Socioeconomic group (SEG)	Price	Income	Health Pub	Smuggling	Adj R ²
SEG 1	0.21	1.87*	-0.087***	0.017***	0.89
SEG 2	0.25	1.25***	-0.076***	0.0076***	0.99
SEG 3NM	-0.62	-1.0	0.038***	0.011*	0.939
SEG 3M	-0.38**	0.35	-0.023***	0.011***	0.980
SEG 4	-0.21	0.12	-0.023***	0.004	0.916
SEG 5	-0.76**	0.61*	-0.015	0.013*	0.835

Significance of effects : * p<0.05, **p<0.01, *** p<0.001

Table 5. Elasticities for UK cigarette consumption by socioeconomic group in females (General Household Survey data, 1972-2000)

Socioeconomic group (SEG)	Price	Income	Health Pub	Smuggling	Adj R ²
SEG 1	-0.11	1.75	-0.076**	0.012	0.81
SEG 2	0.58	2.00***	-0.011**	0.007	0.984
SEG 3NM	-0.61**	-0.34	-0.005	0.011*	0.884
SEG 3M	-0.42***	-0.36***	0.004	0.001	0.950
SEG 4	-0.63***	0.07	0.007	0.006*	0.685
SEG 5	-0.59***	0.50**	0.004	-0.000	0.60

We also fitted the equations for men and women by age groups. In men, price effects were significant for the age groups 20-24 (elasticity of -0.71), 35-49 (elasticity of -0.37) and those over 60 years (elasticity of -0.44). Income elasticities were variable with some high positive and negative values and showed correlation with the health publicity variable. Health publicity /trend was significant at all ages, offset in recent years by the effects of smuggling, which were strongly evident at most ages. The equations for women by age fitted well. Again price effects tended to be higher than for men at about -0.5 to -0.7 for every age except the oldest. The health publicity effect was significant at every age at about 2%. There is indication of a smuggling effect at some ages but less so than for men.

Consumers' expenditure per adult on cigarettes was fitted using the standard equation (model 1 in Table 6), using an adjusted price variable giving an average price index including estimates of smuggled cigarettes (model 2), and an equation using the tobacco manufacturers' published estimates of smuggling in place of the government estimates (model 3). These equations all fit well, and they give significant price elasticities and high income elasticities. The health publicity and smuggling effects are higher than those estimated from the GHS data. There are more data points for this than for the General Health Survey as the series is available on an annual basis, and so there may be more short term variation being picked up. However the General Health Survey data is considered more reliable and is itself the basis for adjustment for this series, so we suspect that the adjustments made to these figures have created some spurious effects, although the reasons for the differences are not altogether clear.

Table 6. Elasticities for UK cigarette consumption based on Analysis of Consumer Expenditure on cigarettes (UK National Accounts 1972-2000)

	Price	Income	Health Publicity	Smuggling	Adj R²
Model 1	-0.56***	1.14***	-0.05***	0.010***	0.98
Model 2	-0.56***	1.12***	-0.05***	0.008***	0.99
Model 3	-0.60***	1.06***	-0.05***	0.010***	0.97

Model 1 refers to the standard equation as in previous tables

Model 2 refers to an equation using an adjusted price variable giving an average price index including smuggled cigarettes

Model 3 refers to an equation using the tobacco manufacturers' published estimates of smuggling in place of the government estimates

Significance of effects - ** p<0.01, *** p<0.001

This analysis is the first to attempt to investigate the effects of smuggling on UK consumption of cigarettes and to explain the patterns of smoking in the last decade. The variation has, for the most part, been very well explained by the model, despite the small data sets, and the coefficients have been fairly consistent and robust to changes in the variables and assumptions.

The results suggest that the effects of smuggling have been to inflate cigarette consumption by probably some 12.5% to 15%, particularly for men. The effects of smuggling cigarettes seem to be highest amongst younger men and women but similar across socioeconomic groups, and has considerably countered the effects of health publicity and other tobacco control measures including increased tobacco tax.

5.2.2 Italy

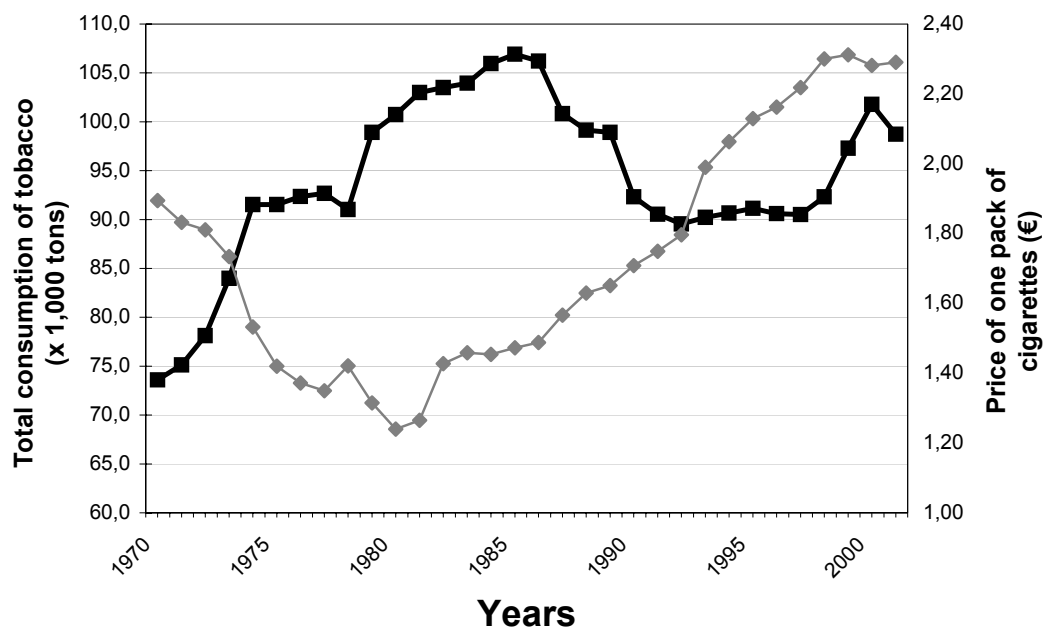
Two different datasets were collected on smoking prevalence over the period 1970-2000. For the period 1970-1980 two surveys conducted by DOXA (the Italian branch of GALLUP International Association) were considered to obtain the estimates of the smoking prevalence for the years 1970 and 1975. The surveys were based on more than 2,000 individuals aged 15 years or over. During the period 1980-2000, the Italian National Institute of Statistics (ISTAT) conducted 12 National Health Surveys, based on more than 20,000 families (58,000 individuals aged 14 years or more), representative of the whole Italian adult population. Through datasets from ISTAT we obtained the annual tobacco official legal sales, the total revenues from tobacco products, and additional data (populations, gross domestic product, etc) to compute the annual consumption of

cigarettes per adult per day, and the real price of a pack of cigarettes (in euro, standardized at the year 2000). (Please see more details on the methodology employed in Annex V).

We used multiple regression analysis to examine how price and income influenced smoking patterns. We used a single equation model, in order to obtain price elasticities of demand for cigarettes (i.e., percentage change in cigarette consumption for a 1% change in price). The same model was considered to evaluate how smoking prevalence (for the years in which prevalence was available) was influenced by price and income.

Smoking prevalence among Italian males declined from about 70% in the 1950's to 55% in the 1970's, and to 30-35% in 2000. In women, smoking prevalence increased from less than 10% in the 1950's up to 15-20%, in the 1980's and remained approximately stable subsequently. The National Health Survey, conducted from ISTAT in 2000, reported a smoking prevalence of 31.5% in males aged 15 years or over, 17.2% in women, and 24.1% in both sexes combined. According to legal sales data, the average number of cigarettes per Italian adult rose in the period 1970-1975 from 5 to 6 cigarettes per day, remained stable for the following quinquennium, and rose again to 6.3 cigarettes per day in 1985. It declined to around 5 cigarettes per day in the period 1987-90, was stable in 1991-1996, and rose again over the last few years. Figure 4 shows the total consumption of tobacco (in tons) for the period 1970-2001 in Italy.

Figure 4. Tobacco consumption and real price of one pack of cigarettes (data from official legal sales). Italy, 1970-2001.



It has been estimated that smuggling accounted for around 10% to 30% of cigarettes sales in Italy, but more precise estimates are not available for the last three decades. Available information suggests that this phenomenon had increased in the late 1980's, but decreased in the last few years. This reduction, confirmed by annual variations of sales in areas more or less affected by smuggling, has been related to the military intervention in 1999 in Kosovo, which led to a reduction of illegal activity in the Adriatic Sea area and to a stricter control of Italian coasts.

Table 7 shows the price and income (per capita Gross Domestic Product, GDP) elasticities for smoking prevalence and cigarette consumption in Italy over the period 1970-2001. The multiple regression equation explained almost the totality of the annual variation in smoking prevalence (adjusted $R^2 = 0.97$). The real price of cigarettes were significantly and inversely associated with the prevalence of current smokers with a price elasticity of -0.30 (i.e., on average, smoking prevalence decreased 0.30% for a 1% increase in the real price of cigarettes).

Table 7. Elasticities for Italian smoking prevalence and cigarette consumption per adult (from official legal sales), 1970-2001.

	Annual prevalence of current smokers		Annual cigarette consumption per adult	
	Coefficient (standard error)	P (test T)	Coefficient (standard error)	P (test T)
Constant	6.53 (0.33)	P<0.001	-6.88 (0.39)	P<0.001
Real Price	-0.30 (0.05)	P<0.001	-0.43 (0.06)	P<0.001

Per capita GDP	-0.31 (0.04)	P<0.001	0.10 (0.04)	P=0.030
Adjusted R ²	0.97		0.67	
F value (p)	183.40 (p<0.001)		32.75 (p<0.001)	

Data on smoking prevalence were not available for all the years within the period 1970-2001, because of the lack of survey data in several years, especially in the 1970's and 1980's. Moreover, survey-based prevalence was suspected to be under-reported, particularly in the last few years. Although this could lead to an overestimation of the prevalence price elasticity, the regression model restricted to data until 1995 showed a similar price elasticity of -0.37 ($p=0.001$).

When considering the price and per capita GDP elasticities in relation to cigarette consumption per adult, over the last three decades, the model continued to explain a high proportion of the annual variation in cigarette consumption (adjusted $R^2 = 0.67$). A 1% increase in price of cigarettes led to a decline in consumption of 0.43%, i.e., a price elasticity of -0.43 ($p<0.001$). The relation between total consumption of tobacco (in tons) and real price of one pack of cigarettes in Italy during 1970-2001 is shown in Figure 4.

Lack of reliable information on smuggling did not allow us to consider this important factor in the model. Smuggling probably increased in 1985-1990, when legal cigarette consumption declined, while illegal sales declined in the last few years. Difficulties in estimating smuggling at a national level in the last decades would suggest it may be useful to consider the issue in smaller regions or defined areas where it is possible to obtain more accurate estimates of illegal tobacco trading.

5.2.3 Portugal

In Portugal, the prevalence of smoking has been studied through different approaches and data of relatively good quality is available for the last 20 years (1980-2000). Representative national samples of adults were evaluated, namely by means of the National Health Surveys that took place in 1987, 1995-96 and 1998-99. In 1984, a national survey ($n=1040$; males-445, females-595), showed a prevalence of smokers of

37.3% among males and 10.1% in females. There was a lower prevalence in the north and the interior of the country and a higher prevalence in litoral and southern regions. Defining a smoker as a person that smokes at least a cigarette per day, the National Health Survey showed a small decrease in male smoking (33.3% in 1987, 29.2% in 1995-6, and 29.3 in 1998-9) but women smokers increased during the same period (5.0%, 6.5% and 7.9%, respectively).

Current cigarette or tobacco consumption, measured as legal sales and as annual per capita consumption, using the level of 1970 as the reference consumption (100), increased to 134.8 in 1980, and to 152.5 in 1995. Trends in apparent per capita consumption (cigarettes per capita per week) increased from 26.2 in 1971 to 41.3 in 1998. There is no good quality data available at the moment describing smuggling. The most popular brand in Portugal is named “SG Ventil”. Its price increased from 1.25 € in 1994 to 1.95 € in 2002. During the same period, a Marlboro pack increased from 1.50 € to 2.15 €. These prices are not adjusted by inflation (they are in the formal analysis), but the increases were clearly lower than general price increases.

As the data from the National Health Interview Surveys was insufficient for analysis, we have used the data from the annual cigarette consumption per adult derived from official legal sales for the period 1980-2000. We used multiple regression analysis as discussed above, to examine how price and income influenced smoking patterns. We used a single equation model, in order to obtain price elasticities of demand for cigarettes (i.e., percentage change in cigarette consumption for a 1% change in price). Given the particularity of a “dual” tobacco market with national and foreign brands of cigarettes, we fitted different equations for price elasticity of demand according to the price of the most popular national and foreign brands.

Figure 5 shows the relation between total annual consumption of cigarettes per capita and real price of one pack of national and foreign cigarettes in Portugal during 1980-2000. Table 8 shows the price and income (per capita Gross Domestic Product, GDP) elasticities for cigarette consumption in Portugal over the period 1980-2000. In Portugal, the multiple regression equations explained a low percentage of the annual variation in smoking prevalence (adjusted $R^2 < 0.20$). The real price of cigarettes was inversely

associated with the annual consumption with a price elasticity of -0.29 (i.e., on average, smoking consumption decreased 2.9% for a 10% increase in the real price of cigarettes) for the national brand and a price elasticity of -0.13 for the foreign brand.

Figure 5. Tobacco consumption and real price of one pack of cigarettes (foreign and national brands). Portugal, 1980-2001.

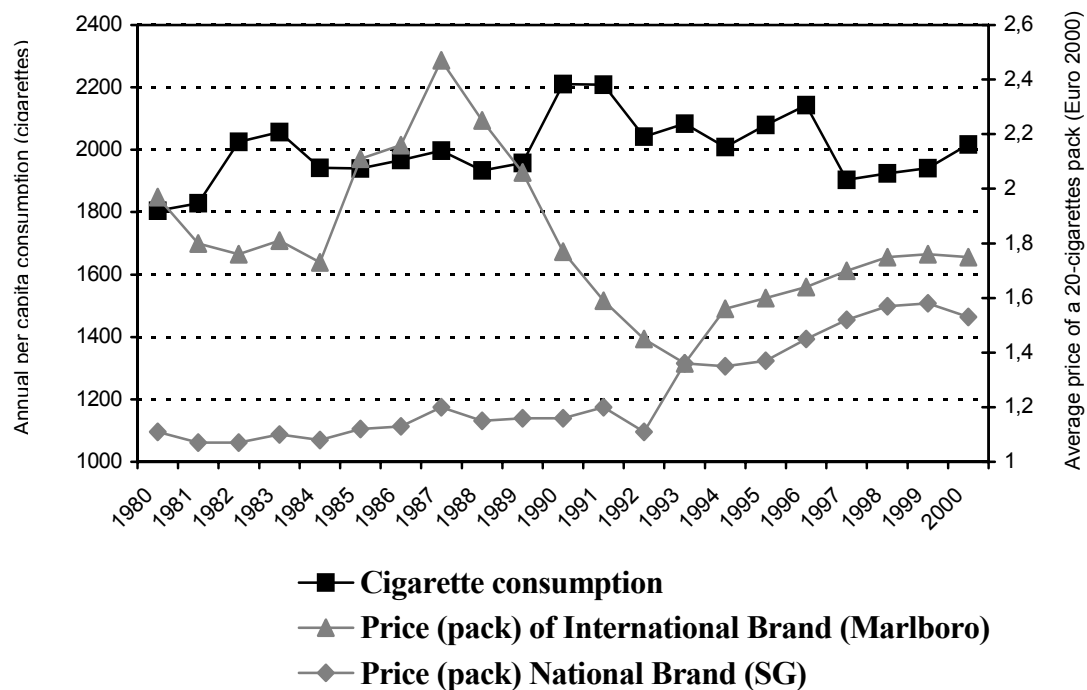


Table 8. Elasticities for cigarette consumption per adult (from official legal sales) in Portugal, 1980-2000.

	Annual cigarette consumption per adult (national brand)		Annual cigarette consumption per adult (foreign brand)	
	Coefficient (standard error)	P (test T)	Coefficient (standard error)	P (test T)
Constant	6.14 (0.64)	P<0.001	7.43 (0.39)	P<0.001
Real Price	-0.29 (0.16)	P=0.097	-0.13 (0.09)	P=0.156
Per capita GDP	0.17 (0.08)	P=0.036	0.03 (0.01)	P=0.513
Adjusted R ²	0.14		0.11	
F value (p)	2.69 (p=0.095)		2.20 (p=0.140)	

Lack of reliable information on smuggling did not allow us to consider this important factor in the model. Smuggling probably increased in the 1980s and early 1990s, but has declined in the last few years. Moreover, the prevalence of smoking within Portugal presents huge variation between the different regions of the country, and also smuggling is likely to have geographical variations. The analyses presented have the limitation of the available data. First, no model based on estimates of the prevalence (i.e., the proportion of smokers in the population) have been fitted given the lack of Health Interview Surveys (only 3 surveys in the last 20 years). Moreover, the equations based on prevalence rates might allow to compute price elasticities for males and females separately. Second, although price elasticity has been computed for annual cigarette consumption per capita, the time period with reliable data is relatively short, accounting only for the last 20 years.

5.2.4 Greece

The prevalence of smoking increased between 1984 and 1998 from 34.8 % to 37.6% of the Greek general population (age 12–64). This increase is attributed to the increase of females smoking from 19.5 % to 29%. On the other hand, the percentage of smoking by males has decreased from 54% in 1984 to 47% in 1998. More epidemiological data on the tobacco epidemic according to selected populations (teachers, doctors, young people, pregnant women, etc.) in Greece are available in Annex VI.

Greece is a tobacco producing country as are other South European countries. Controversial feelings were raised during the last decade mainly after the EU directives and a lot of published arguments can be seen quite often in Greek daily press and the magazines. Tobacco exports represent 3.9% of the total amount of exportation in Greece: this represents 80% of the annual tobacco products, while the remaining 20% is used by the national tobacco manufacturers.

Annual consumption of cigarettes has increased over the last decades from 1011 cigarettes per adult (>15 years) in 1957 to 3358 cigarettes in 1998 (Figure 6). Retail prices of cigarettes have increased over the last decades, although prices are still lower in Greece as compared with other EU Countries. Regarding smuggling, it is estimated that the overall smuggling may represent 8–10% of total sales, but there are no more precise data on smuggling.

As the data from the National Health Surveys are scarce, we have used the data from the annual cigarette consumption per adult derived from official legal sales for the period 1987-1998. We used multiple regression analysis to examine how price and income influenced smoking patterns. We used a single equation model, in order to obtain price elasticities of demand for cigarettes (i.e., percentage change in cigarette consumption for a 1% change in price).

Figure 6. Tobacco consumption and real price of one pack of cigarettes. Greece, 1988-1998.

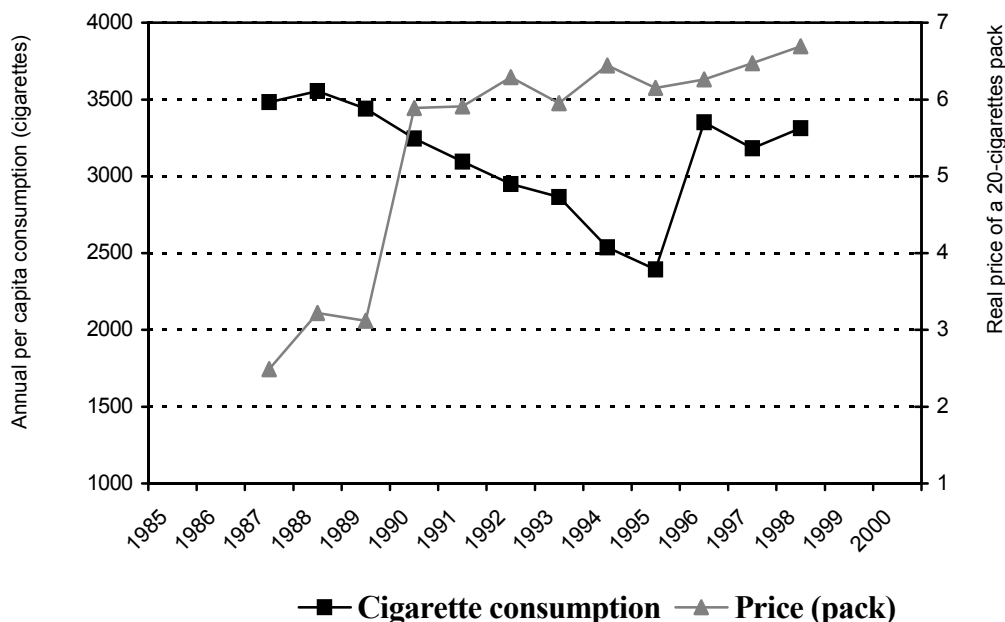


Figure 6 shows the relation between total annual consumption of cigarettes per capita and real price of one pack of cigarettes in Greece during 1988-1998. Table 9 shows the price and income (per capita Gross Domestic Product, GDP) elasticities for cigarette consumption in Greece over the period. The multiple regression equations explained a 36% percentage of the annual variation in smoking prevalence (adjusted $R^2 = 0.36$). Smoking consumption decreased 3.5% for a 10% increase in the real price of cigarettes, this is, the real price of cigarettes was inversely associated with the annual consumption with a price elasticity of -0.36 , although this price elasticity was not statistically significant.

Table 9. Elasticities for cigarette consumption per adult (from official legal sales) in Greece, 1988-1998.

	Annual cigarette consumption per adult (national brand)	
	Coefficient (standard error)	P (test T)
Constant	-4.48 (-0.57)	P=0.576
Real Price	-0.36 (-2.79)	P=0.131
Per capita GDP	1.26 (1.66)	P=0.021
Adjusted R^2	0.357	
F value (p)	P=0.055	

5.2.5 Ireland

Studying Irish smoking patterns and their economic aspects is difficult because of the scarcity of data available and because in general the research methods employed are insufficient to give a broad and accurate picture of Irish smoking habits. In particular

sociodemographic distribution of smoking prevalence has not been systematically recorded. The data that are available on smoking prevalence in Ireland show that progress has been made in past decades, with a considerable decline in the number of men smoking and a less considerable decline in the number of women smoking. The overall prevalence of smoking has reduced from 40% in the mid 1970s to about 28% in the early 1990s and is currently at 30%.

The most recent data available on smoking prevalence in Ireland comes from the National Health and Lifestyle Surveys (SLÁN and HBSC), which commenced in 1998 on a four yearly cycle. These surveys provide and will provide information on smoking prevalence by gender, age and social class. The first survey indicates that overall young women were more likely to report smoking than were young men and smoking is prevalent at all age groups and all social classes. Although a strong social class gradient in smoking prevalence in all age groups was evident, there was a distinct bias towards higher prevalence in young people on low incomes. Data on consumption patterns follows a similar trend to smoking prevalence. Annual adult per capita consumption of cigarettes peaked in the 1970s (3050 cigarettes) and was then followed by a rapid decline in the 1980s and decreased further during the 1990s (1722 cigarettes/adult/year) with some recent indication of a slight increase. Trends in annual cigarette consumption per capita (>14 years old) are shown in Figure 7. Additional data on the tobacco epidemic development is available in Annex VII.

In Ireland prices of tobacco products are kept high with almost 80% of the cost of a packet of cigarettes being taxes. Current tobacco prices have increased since 1987, but after adjusting for consumer price index changes, a fluctuation of real prices is apparent between 1987 and 1999, with no net increase during those years (Figure 7).

As the data from Health Surveys are scarce and provide insufficient points in the regression model for good fit, we have used the data from the annual cigarette consumption per adult derived from official legal sales for the period 1987-1999. We used multiple regression analysis to examine how price and income influenced smoking patterns. We used a single equation model in order to obtain price elasticities of demand for cigarettes (data in Figure 7). Table 10 shows the price and income (per capita Gross

Domestic Product, GDP) elasticities for cigarette consumption in Ireland over the 1989-1989 period. The multiple regression equation explained only 23.6% of the annual variation in smoking prevalence (adjusted R^2 of 0.26). Although not significantly, the real price of cigarettes was inversely associated with the annual consumption of cigarettes with a low price elasticity of -0.14 ($p=0.1318$). However the data do not allow a satisfactory analysis or for sound conclusions to be drawn.

Figure 7. Tobacco consumption and real price of one pack of cigarettes. Ireland, 1987-1999.

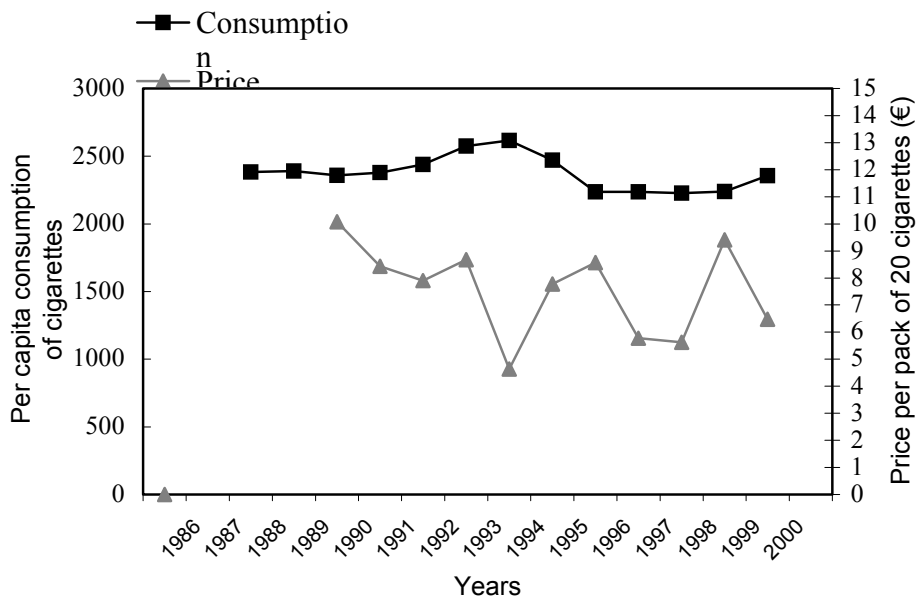


Table 10. Elasticities for cigarette consumption per adult (from official legal sales) in Ireland, 1987-1999.

	Annual cigarette consumption per adult	
	Coefficient (standard error)	P (test T)
Constant	-8.83 (0.06)	P<0.001
Real Price	-0.14 (0.08)	P=0.132
Per capita GDP	-0.09 (0.06)	P=0.200
Adjusted R ²	0.23	
F value (p)	P=0.139	

5.2.6 Spain

The prevalence of smoking is usually monitored on the basis of repeated cross-sectional surveys. In Spain, the first national, representative, cross-sectional survey on tobacco consumption was conducted in 1978. This survey showed that 53.9% of males and 16.5% of females (>8 years old) regularly smoked cigarettes. The Ministry of Health conducted two other ad hoc surveys, in 1982 and 1989, as well as a series of standardized National Health Interview Surveys (NHIS) in 1987, 1993, 1995, and 1997, which included a section on tobacco consumption. With the exception of the NHIS, the information from the other surveys is not strictly comparable given the changes in the definition of smoking and in the age-range of the target population. The prevalence of current smoking among persons over 15 years decreased from 55.1% in 1987 to 44.9% in 1997 in men whereas it increased from 22.9% to 27.2% in women.

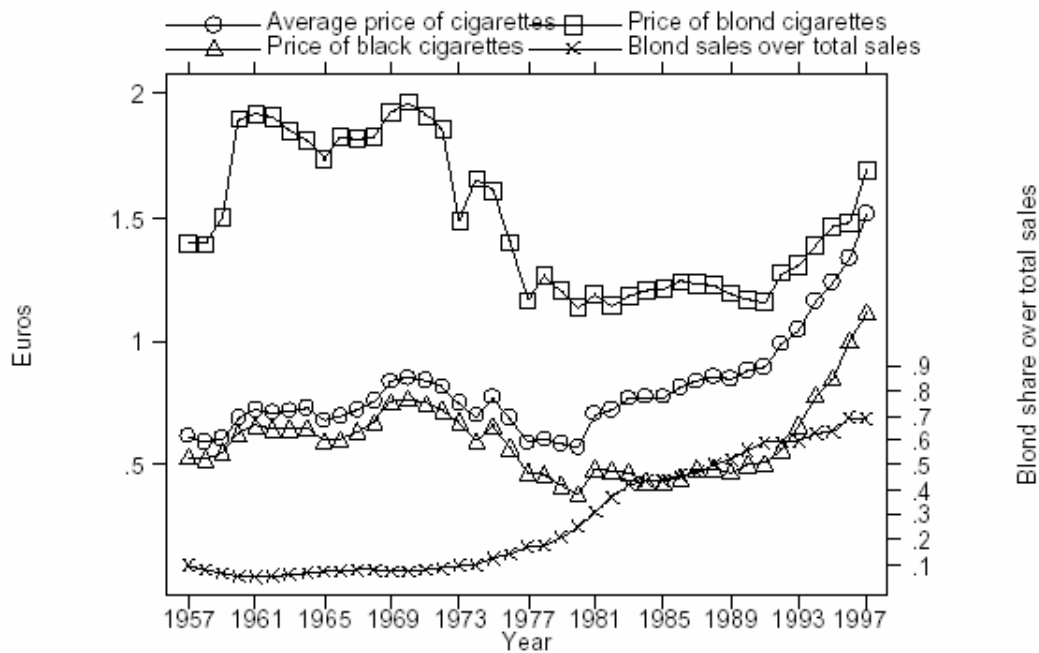
To obtain reliable data on prevalence of smoking among males and females, we derived data from the Spanish NHIS conducted in 1993, 1995 and 1997, among independent population samples of 26,400 in 1993 and 8,300 in 1995 and 1997. On the basis of each

respondent's sex and calendar year of birth, the person was classified into a particular sex-birth cohort. For each year from date of birth to date of survey, a respondent was further classified as either cigarette smoker or non-smoker. Thus, we derived for each calendar year the number of subjects alive and his or her smoking status in that given calendar year, and hence, the prevalence of smoking (for males and females aged >15 years old) in that given year for the period 1965-1995.

We have also used information on official legal tobacco sales from Tabacalera (the former Spanish monopoly⁸), for legal sales of black tobacco, of blond tobacco, and the average between them. Tabacalera offers the average price of a packet of black cigarettes and a packet of blond cigarettes separately as well as the share of each of these two over total sales starting in 1957. Figure 8 presents the evolution of the price of a packet of cigarettes (in constant 2000 euros) distinguishing between black and blond types as well as a weighted (by sales) average price of the two latter. The figure also presents the share of blond cigarettes over total cigarette sales.

Figure 8. Cigarette prices of a pack of blond and black cigarettes, average price, and blond share of sales. Spain, 1957-1997.

⁸ Spain's major cigarette producer remains the former state monopoly, Tabacalera. Even after privatization in 1998, Tabacalera continues to be the leading manufacturer and distributor of tobacco in Spain. In 1998, 80.4% of cigarettes produced in Spain were produced in Tabacalera factories on the mainland, and the remaining 19.6% were produced in joint ventures on various Spanish territories. Recently, Tabacalera merged with Seita of France to become Altadis, a conglomerate of multinational corporations, creating an ever more monolithic industry presence on the European continent.



From: López Nicolás A. How important are tobacco prices in the propensity to start and quit smoking? An analysis of smoking histories from the Spanish National Health Survey. *Health Econ* 2002;11(6):521-35.

Through datasets from the Spanish National Institute of Statistics (INE) we obtained additional data on populations, gross domestic product, and consumer price index to compute the annual consumption of cigarettes per adult per day, and the real price of a pack of cigarettes (in euro, standardized at the year 2000). (Please see more details on the methodology employed in Annex VIII).

We used multiple regression analysis to examine how price and income influenced smoking patterns. We used a single equation model, in order to obtain price elasticities of demand for cigarettes (i.e., percentage change in cigarette consumption for a 1% change in price). The same model was considered to evaluate how smoking prevalence (for the years in which prevalence was available) was influenced by price and income.

In Spain, there has been, and still is, a “dual” tobacco market: on the one hand, there are cigarette brands of national origin (called black tobacco) at relatively low prices smoked mainly by men, while, on the other hand, there also are foreign (and national) brands of blond tobacco. The Spanish tobacco market has seen major transitions in these types of

tobacco used in cigarettes in recent decades (see Figure 8, series of blond sales over total sales): blond cigarettes containing tobacco with a relatively high sugar content (grown primarily in the United States) have gradually supplanted Spain's traditionally preferred black tobacco cigarettes (a much darker and stronger tobacco variety). As in other countries, filter and "light" cigarettes have been aggressively marketed over the past 30 years. Blond tobacco, which was legally introduced in the 1970's in Spain, is mainly smoked by women (the high initiation of smoking by women in the 1970's may be due to the introduction of Fortuna, a national, cheap, blond brand of cigarettes), although young people and also male smokers who want to shift to "moderate" use are also smoking blond (and so-called "lights") brands. As previously mentioned, another particularity of the epidemics of smoking in Spain is the recent (beginning in the 1970's) spread of the habit among women. Most economically developed nations in Europe and North America began experiencing sharp increases in female smoking during the 1950's and 1960's but Spain lagged behind this trend. Nevertheless, by the 1990's Spain's cigarette market grew to be the third largest in Western Europe, surpassed only by Germany and Italy.

As shown in Figure 8, a packet of blond cigarettes was cheaper in the 1990's than in the late 50's. At the start of the 1970's the price of blond cigarettes descended markedly. In 1975 Tabacalera launched one of the most popular (and cheap) blond brands (Fortuna) coinciding with the opening of the domestic market to foreign blond brands such as Marlboro or Winston. In addition, advertising underwent a structural change in this period: women were targeted more intensely than ever before. This may explain both the evidence that women tend to smoke blond cigarettes and the marked rise in the share of the blond variety over total cigarette sales. A concurrent explanatory factor for the rising share of blond cigarettes might be an increasing preference for higher value brands associated with rising incomes.

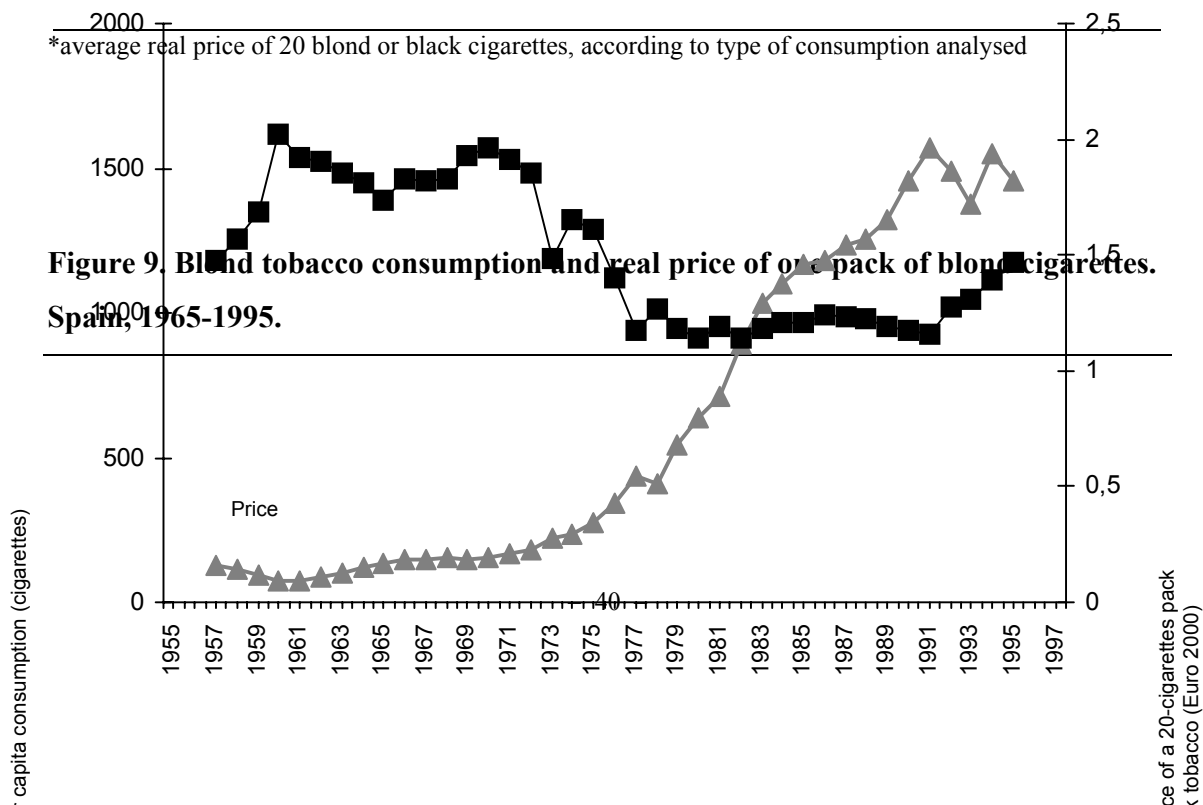
Given this particular distribution of the Spanish tobacco market and diffusion of the epidemic in Spain, and after checking the inappropriateness of models with overall consumption (blond+black tobacco) and average price, we decided to fit separate models for consumption of blond and black tobacco, and also to fit different models for the prevalence rates of males and females, and the price of blond and black tobacco. We

hypothesized that the effect of the prices on smoking prevalence will be higher in females than in males and, that this effect would be more marked for blond tobacco price.

Table 11 shows the price (of blond and black cigarettes) and income (per capita Gross Domestic Product, GDP) elasticities for blond and black cigarette consumption in Spain over the period 1965-1995. For blond tobacco, the multiple regression equation explained almost the totality of the annual variation in smoking prevalence (adjusted $R^2 = 0.98$). The real price of blond cigarettes was significantly and inversely associated with the blond cigarette consumption with a significant price elasticity of -0.71 (i.e., on average, smoking prevalence decreased 7.1% for a 10% increase in the real price of cigarettes). For black cigarettes, a lower but still high elasticity of -0.51 was found. Figures 9 and 10 show the relation between annual adult per capita consumption and price, for blond and black cigarettes, respectively.

Table 11. Price elasticities of annual cigarette consumption per adult (from official legal sales) according to type of tobacco in Spain, 1965-1995.

	Annual blond cigarette consumption per adult		Annual black cigarette consumption per adult	
	Coefficient (standard error)	p (test T)	Coefficient (standard error)	P (test T)
Constant	1.46 (0.28)	p<0.001	8.76 (0.14)	p<0.001
Real Price*	-0.71 (0.18)	p=0.001	-0.51 (0.11)	p<0.001
Per capita GDP	0.66 (0.03)	p<0.001	-0.22 (0.02)	p<0.001
Adjusted R ²	0.98		0.82	
F value (p)	980.13 (p<0.001)		67.06 (p<0.001)	



The price elasticities of smoking prevalence rates according to sex and type of tobacco are presented in Table 12. The multiple regression models explained a high proportion ($R^2 \geq 0.75$ in all models) of the annual variation in smoking prevalence rates during the period 1965-1995. The estimates of price elasticities are significant and comparable to recent estimates for developed countries. For blond tobacco, the real price of cigarettes was significantly and inversely associated with smoking prevalence with a price elasticity of -0.32 among males (i.e., on average, cigarette consumption decreased 3.2% for a 10% increase in the price of cigarettes) and of -0.66 among females. For black tobacco, the real price of cigarettes was also significantly and inversely associated with smoking prevalence with a price elasticity of -0.16 among males and of -0.34 among females.

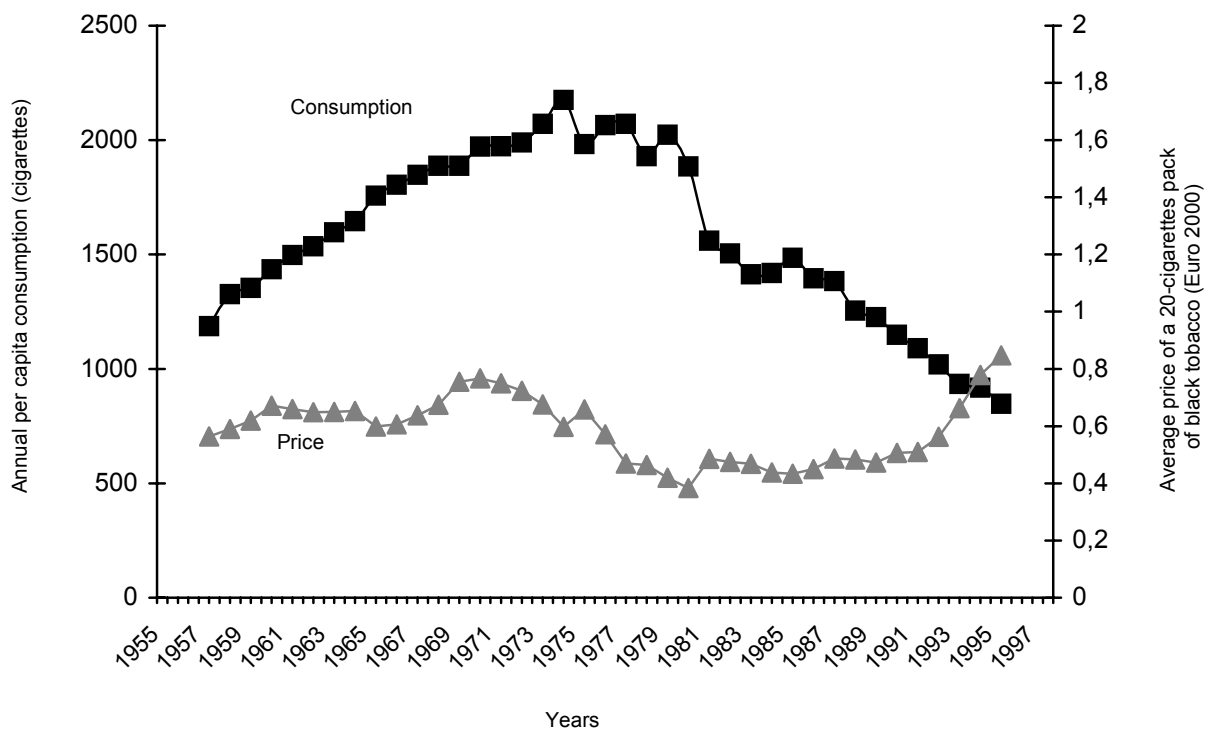
From this data, we can derive that the smoking prevalence responsiveness to the price of blond tobacco is greater than to black tobacco in Spain, and that this responsiveness is also greater (almost twofold) for women than for men.

Table 12. Price elasticities of smoking prevalence in Spain (reconstructed from National Health Surveys) according to sex and type of tobacco, 1965-1995.

	blond cigarettes' price		black cigarettes' price	
	Coefficient (standard error)	p (test T)	Coefficient (standard error)	P (test T)
MALES				
Constant	0.04 (0.06)	p=0.454	-0.38 (0.04)	p<0.001
Real Price	-0.32 (0.04)	p<0.001	-0.16 (0.02)	p<0.001
Per capita GDP	-0.07 (0.01)	p<0.001	-0.04 (0.01)	p<0.001
Adjusted R ²	0.76		0.75	
F value (p)	50.90 (p<0.001)		49.6 5(p<0.001)	
FEMALES				
Constant	-4.95 (0.17)	p<0.001	-5.85 (0.11)	p<0.001
Real Price	-0.66 (0.12)	p<0.001	-0.34 (0.07)	p<0.001
Per capita GDP	0.40 (0.02)	P<0.001	0.47 (0.01)	p<0.001
Adjusted R ²	0.98		0.97	
F value (p)	663.12 (p<0.001)		610.96 (p<0.001)	

Lack of reliable information on smuggling did not allow us to consider such an important factor in the model. Smuggling probably increased till 1995, but has significantly declined in the last few years, due to the EU and the Spanish policies to control smuggling (mainly from Andorra). Difficulties in estimating smuggling in the last decades would suggest the need for further research studies in which accurate estimates of smuggling based on legal sales and surveys be carried out i.e., the comparison of legal sales and reported consumption in family or individual consumers surveys.

Figure 10. Black tobacco consumption and real price of one pack of black cigarettes. Spain, 1965-1995.



5.3 Summary of results and discussion

From the cross-sectional study that included 17 Western European countries we derived a model of cigarette consumption per adult in Europe. The model explains the consumption in terms of price (foreign price adjusted for Gross Domestic Product), women's smoking level (smoking prevalence in females), and legislation pressure (proxied by a variable generated from the available information as low/intermediate/high according to the different laws and policies in each country). The best model (including price and female prevalence) explains 60% of the variation in cigarette consumption per head between the countries included. Price and female smoking have a significant effect on cigarette consumption. The price elasticity is -0.67 ($p < 0.001$). This is higher than a previous analysis with 22 European countries and is in the higher range of estimates based on national elasticity analysis (mainly ranging between -0.35 and -0.79). The coefficient for smoking among females is 0.55 ($p < 0.05$) indicating a positive relation between prevalence of female smoking and overall national per capita consumption. This variable was necessary to adjust for the wide variation in the ratio of male to female smoking prevalence across Europe. No effect of level tobacco control legislation was observed in the model.

The coordinated time-trends analyses for each of the participating countries (except Hungary, that acted as an external observer) demonstrate that changes in cigarette price had an appreciable impact on smoking consumption. Price elasticity in the **United Kingdom** over the period 1972-2000 was -0.36 (-0.27 for men and -0.43 for cigarette consumption of women). Price elasticities of demand for cigarettes in **Italy** over the period 1970-2001 were -0.30 (a 1% increase in price of cigarettes led to a 0.30% decline in smoking prevalence) for prevalence and -0.43 for cigarette consumption. Price elasticity in **Portugal** over the period 1980-2000 was -0.29 and -0.13 for cigarette consumption of national and foreign brands, respectively. Price elasticity in **Spain** over the period 1965-1995 was -0.32 and -0.66 for prevalence (blond tobacco price) among males and females. Price elasticity in **Greece** over the period 1987-1998 was -0.27 for

cigarette consumption. Price elasticity in **Ireland** over the period 1989-1999 was -0.14 for cigarette consumption, but this was non significant and based on inadequate data.

These results are similar across the countries and are in broad agreement with previous research, conducted mainly in the United States but also in the UK and other selected Western countries. A recent report from the US Surgeon General reviewed in detail the effect of prices on demand of cigarettes⁹. Some general conclusions can be drawn from the studies of the effects of cigarette prices on smoking. First, increases in cigarette prices lead to significant reductions in cigarette smoking; most studies, including the results of this European project, using a wide variety of data and methods with various strengths and weaknesses, predict that a 10% increase in price is associated with an overall decrease in cigarette consumption by 3 to 10%. Second, the effects of increases in cigarette prices include significant reductions in smoking prevalence, as also observed in this European project for some countries (UK, Italy, Spain) where both type was available. Hence, the reduction in smoking is not limited to reductions in average cigarette consumption among smokers but to real decreases in the population prevalence of smoking. These effects on smoking prevalence are explained both by an increase in smoking cessation and, although to a lesser extent, by a reduction in smoking initiation among potential young smokers.

5.4 Dissemination of results

All the results of this European project will be made available on the *ad hoc* created website at www.xtpt.net/econ/econsmk.hmt , including the final report and all the annexes. These annexes include intermediate products of the project itself, such as the “tobacco country highlights” or the minutes of the project meetings as well as the drafts of the national papers. The final inclusion of the results in the web site, however, is conditioned to the permission from the scientific journals where we also intend to publish

⁹ Economic approaches (Chapter 6). In: US Department of Health and Human Services. *Reducing tobacco use: a report of the Surgeon General*. Atlanta, Georgia, US: US Department of Health and Human Services. Center for Disease Control and Prevention. National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2000. URL: www.cdc.gov/tobacco/sg_r_tobacco_use.htm [accessed October 15, 2002].

the results. The results will be written up for submission to international scientific journals devoted to smoking prevention and control and to public health, such as “Tobacco Control”, “Nicotine & Tobacco Research”, the “European Journal of Public Health”, the “European Journal of Cancer Prevention”, etc. The editorial process requires more time than that usually allocated to this type of project (dissemination through scientific journals lasts between 4 and 8 months after finishing the papers). The research team will maintain up-to-date the website in the future with the final (and accepted for publication) versions of the papers.

However, we intend to disseminate the results by e-mailing a short message with the executive summary of the project (and the website address) through GLOBALink, the international electronic network for prevention and control of tobacco, as well as through related e-mail list servers (ENSP, national coalitions, etc.).

Another relevant form to disseminate the results will be through their presentation in national and international scientific tobacco control meetings (such as the meetings of the national coalitions against tobacco and the World and the European Conference on Tobacco or Health). These presentations, however, are subject to availability of funds not included in the current agreement. Presentations at meetings are compatible with the submission of the papers to the scientific journals.

6. Conclusions

- Price elasticities in each of the participant countries varied from -0.13 to -0.70 and were mostly around -0.3 , for smoking measured as cigarettes per capita or as prevalence (proportion) of consumption across countries. The results from the cross-sectional analysis also indicate a high price elasticity of cigarette consumption. Differences between countries were not significant and such differences as there were may be attributed to the availability (and quality) of the data and to random error.
- Although a coordinated effort was made to conduct similar analyses in each country, the scarce availability of smoking data (particularly for Ireland, Greece, and Portugal) including related information on smuggling, limits the comparability of the results obtained. Thus, this project highlights the need to coordinate and standardize health information systems across the European Union.
- The lack of homogeneity in data sources can be interpreted as a limitation. However, the overall agreement of the results obtained –using a similar approach but with rather different data for different periods– supports the consistency and validity of the results.
- Since individuals in lower socio-economic groups are more influenced by price (analysis from UK), any intervention on the price of cigarettes would tend to be most effective on the smoking habits of socio-economic groups with the highest smoking prevalence (as observed in most South European countries). The same applies to adolescents and young men and women, whose smoking prevalence has risen over the last few years, and who remain a key target for any tobacco control critical intervention in the long term.
- Increases in tax revenue from cigarette tax rises, could be allocated for tobacco control and prevention of tobacco-related diseases, since currently in the European countries, only limited revenue from tobacco tax revenue is spent for tobacco control.
- The present analyses confirm the existence of an inverse relation between price and prevalence/consumption of cigarettes in several European countries and indicate that interventions at the economic level may well have strong public health implications for tobacco control. It is also important to note that, with the exception of the UK, information on this issue was almost non-existent for the participating countries. This study provides an important first step in examining these relationships at an individual European country level.

7. Project partners

The project partners are located in six European Union countries (Spain, UK, Greece, Portugal, Ireland, and Italy) as well as in an accession country (Hungary). Hungary has had no specific budget for the implementation of the project but has been in contact (with different intensity) in the different phases of the project. An effective communication between the different partners (including Hungary) has been maintained from the coordinators (in Spain and UK) thru the two planned project meetings (held in Barcelona) and continuous e-mail and telephone contacts.

A list with the national research teams follows, indicating the Principal Investigator (PI) in each country and the names of the other researchers who have contributed to different phases of the project within each country.

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**Pictures of the project partners at the end of the second meeting
(Barcelona, July 11-12, 2002)**



From left to right: Anna Schiaffino, Silvano Gallus, Carlo La Vecchia, Esteve Fernandez, Ana Patricia Padrao, Henrique Barros, Lina Tsanira, Nicolas Kordiolis, Joy Townsend & Susan Griffin



From left to right: Ana Patricia Padrao Anna Schiaffino, Carlo La Vecchia, Esteve Fernandez, Silvano Gallus, Joy Townsend, Susan Griffin, Henrique Barros, Nicolas Kordiolis, & Lina Tsanira

8. Financial report

Here we present the consolidation sheet for the overall project. The detailed income and expenditures for each of the partners are presented in Annex 10.

<u>Budgeted Expenditures</u>		REAL COSTS	<u>Budgeted Income</u>		REAL INCOME
<u>Direct Eligible Costs (D)</u>			Commission funding requested	82,055.65	82,811.90
Personnel costs	72,990.00	75,888.70	Contribution pertaining to national officials		
Travelling and DSA	13,075.90	10,980.48	Applicant's financial contribution	27,579.79	36,275.29
Miscellaneous services	5,420.00	5,687.81			
Administration	14,639.27	14,826.72	Income generated by the project		
Reserve for unexpected costs	5,306.26	5,367.03			
			Other external resources	8,200.00	0.00
<u>Indirect Eligible Costs (I)</u>					
General costs	6,404.01	6,336.45	Other current funding applications		
<u>Contribution in kind (K)</u>			<u>Contribution in kind (K)</u>		
Unpaid voluntary work...	30,200.00	30,263.42		30,200.00	30,263.42
Contribution in kind essential to...					
<u>Grand Total</u>	<u>148,035.44</u>	149,350.61	<u>Grand Total</u>	<u>148,035.44</u>	149,350.61

9. Glossary

Cigarette consumption

Defined here as the mean number of cigarettes smoked per adult over 15 years (over 16 for some country analysis) (per day or per year, and in some case by sex, age, or other socioeconomic characteristic).

Current cigarette price UK

Retail price index of cigarette prices (weighted price of different brands)

Current cigarette price Italy and Spain

Retail price index of cigarette prices (average price of different brands according to legal sales and consumption). In Spain, calculated separately for blond and black tobacco.

Current cigarette price (other countries)

Price of the most popular (foreign, local) brand or the benchmark brand

Cross sectional analysis

Analysis using data for one time period across different countries (each country is a unit)

Income elasticity of demand for cigarettes

Percentage change in cigarette consumption for a 1% change in real income

Price elasticity of demand for cigarettes

Percentage change in cigarette consumption following a 1% change in real price

Prevalence of smoking

Proportion (%) of population (over 16 years Spain, over 15 years Italy, over 19 years Portugal) smoking at least 1 cigarette daily; smoking at all nowadays (UK). It is generally obtained from Health Interview Surveys or cross-sectional (“prevalence”) studies

Real price of cigarettes

Current cigarette price divided by the consumer price index

Time series analysis

Analysis using data for one country for different time periods (eg each year is a unit)

10. Annex

This report was produced by a contractor for Health & Consumer Protection Directorate General and represents the views of the contractor or author. These views have not been adopted or in any way approved by the Commission and do not necessarily represent the view of the Commission or the Directorate General for Health and Consumer Protection. The European Commission does not guarantee the accuracy of the data included in this study, nor does it accept responsibility for any use made thereof.