KOÇ UNIVERSITY-TÜSİAD ECONOMIC RESEARCH FORUM
WORKING PAPER SERIES

AN ECONOMIC ANALYSIS OF TOBACCO CONTROL POLICIES IN TURKEY

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Working Paper 1116
June 2011

KOÇ UNIVERSITY-TÜSİAD ECONOMIC RESEARCH FORUM
Rumeli Feneri Yolu 34450 Sarıyer/Istanbul

An economic analysis of tobacco control policies in Turkey

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ABSTRACT

Objective: To evaluate the costs and benefits of various anti-smoking policy alternatives including taxation and four cessation programs, accounting for the demographic projections in 2011-2050 in Turkey.

Methods: Demographic projections are combined with incidence and mortality rates of four major cigarette related diseases, price elasticity of cigarette demand and unit costs of nonprice measures to reduce demand in order to estimate the net present discounted values of policy alternatives.

Results: Among policy alternatives that yield the same amount of cigarette consumption, cessation programs yield lower costs to households and the society at large than taxation, while taxation is preferred by the public sector. Net benefit to the public sector as a function of the tax rate is a single-peaked Laffer curve. The public sector can obtain the highest net benefit if it raises the special consumption tax rate from its current level by nearly 9 percentage points.

Conclusion: Although intervention programs emerge as the preferred anti-smoking alternatives, more research is needed on estimating the cost-effectiveness and social desirability of taxation and intervention programs in Turkey.

Turkey has become one of the major consumers of cigarettes with nearly 16 million adult smokers and as the 10th in the world in terms of the amount of tobacco products consumed (MoH, 2010).

Demographic projections of the Turkish population point to a substantial increase in the number of smokers within the next 40 years, unless smoking prevalence declines. Such an increase will undoubtedly lead to a surge in healthcare expenditures and a drop in productivity and income tax revenue. In the literature on the economics of smoking, government intervention is recommended for several reasons including the existence of externalities (such as environmental tobacco smoke (ETS) or the financial burden of smokers on non-smokers) and information problems about the health consequences of smoking (such as addiction). (See, for example, Warner, Chaloupka, Cook, et al., 1995; Ross, Chaloupka, 2002.)

Since the 1990s, Turkish governments have enacted several laws to regulate smoking. However, with an overall smoking rate of 31% and a declining average age of uptake, cigarette consumption is still a major health problem in Turkey (MoH, 2010). Clearly, it is essential that effective tobacco control policies be implemented without delay to discourage smoking and to reduce prevalence especially among young people.

In this study we present a detailed analysis of the costs and benefits of various anti-smoking policy alternatives including taxation and four different smoking cessation programs. The impacts of these policies on the public sector, households, and the whole society are estimated for a simulation period of 2011-2050, using the expected demographic transition of Turkey. One of our main findings is that the function that relates the public sector's net benefit to the tax rate on cigarettes is a single-humped Laffer curve. The prevailing tax rate on smoking is suboptimal for both the public sector and the society as a whole. Therefore, policy intervention in the form of higher cigarette prices seems correct, although at the expense of further increasing net household cost. Another contribution is our comparison, in terms of the induced net benefits, of taxation with the smoking cessation programs. We consider two distinct anti-smoking plans and four intervention programs within each plan. For each anti-smoking plan, we adjust the tax rate on cigarettes to compensate for the reduction in the tax revenues due to the planned decrease in the number of smokers, and calculate the costs and benefits of each program. Next, we compare these compensated intervention programs to purely taxation-based policy alternatives. We say that a change in the tax rate on cigarettes is 'equivalent'

to an intervention program if they yield the same total quantity of cigarette consumption over the simulation period. We show that for both target plans the estimated operating costs of the compensated programs are much lower than induced costs of 'equivalent' tax rates incurred by smokers. Households prefer cessation programs; however, as expected, the public sector prefers taxation due to its higher net benefits. Since under higher tax rates net costs to households always outweigh net benefits of the public sector, cessation programs are preferred by the society as a whole as well.

There are only a few studies on smoking in Turkey; no comprehensive analyses of the costs and benefits of smoking and of various anti-smoking policies exist. Bilir and Onder (2000) estimated the effect of the ban on smoking in public places based on survey data. Onder (2002), Onder, Yurekli (2007) and Yurekli, Onder, Elibol, et al. (2010) estimated price elasticity of cigarette demand and showed by simulation that the government could increase total tax revenues by increasing taxes. The few studies that have been conducted on other countries use micro-level survey data in a particular year and base their estimates on the concept of smoking attributable fraction (SAF). (See, for example, Sung, Wang, Jin, et al, 2006; John, Sung, Max, 2009).

Our study takes a different path. Instead of individual level expenditure data, our estimates are based on more meso-level variables. We conduct a more detailed analysis using variables such as the estimated incidence and mortality rates of smoking related diseases, the projected numbers of smokers and quitters and the predicted days of absenteeism from work. We compare policy options. A major contribution of our study is that we run simulations for a 40-year time frame, which enables us to incorporate the effects of demographic change in Turkey.

METHODS

We estimate the extent to which the costs and benefits of smoking in Turkey will change during the period of 2011-2050 in response to alternative tobacco control policies. To this end, we follow the expenditure-based cost analysis approach (see Lightwood et al., 2000), which defines costs and benefits as monetary expenditures and revenues that occur because of tobacco use. Intangible costs are excluded, as is the economic value of lost life or the monetary value of suffering due to a smoking-related illness. The cost and benefit items included are explained in detail later in this section.

To measure the impacts of alternative tobacco control policies, we consider a dynamic simulation model that uses projections of smoking prevalence, keeping in mind the demographic transition of the country. For details on all data sources and methods, please see the Appendix.

Demographic transition

Turkey's population, which was 72,698 million in 2010, is expected to increase by about 10.4% in 10 years to reach 80,257 million by year 2020. Within the following decades, the growth rate of the population is expected to taper off; the estimates are 7.9% in 2020-2030, 5.7% in 2030-2040 and 3.2% in 2040-2050. The decline in the growth rate of population is expected to change the age decomposition of the country. This is the well-known demographic transition that many countries, including those in Eastern Europe and the Former Soviet Union, have been going through. (Chawla, Betcherman, Banerji, 2007).

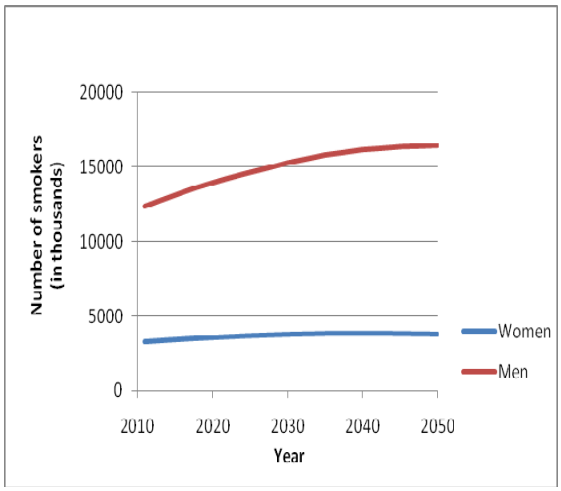
Turkey is a young country. As of 2010, 51.9% of the population is younger than 30 years old. The 30-60 year old group constitutes 38% of the population. But the population is expected to get older in time. The share of the 0-30 year old group is expected to go down from 46.6% in 2020 to 35.5% by 2050. Meanwhile, the share of the 45-60 year old group is expected to rise from 15.5% in 2010 to 19% in 2050. The share of the 60-75 year old group is projected to rise from 7.4% in 2010 to 17.9% by year 2050.

Cigarette consumption

Cigarette consumption in Turkey went up by 80.95% between years 1990 and 2000. While population growth was partly responsible, the more important reason was the increase in per capita consumption (Onder, 2002).

We observe that smoking is more common among men than women, and among the young and the middle aged than the elderly. Among adult males, 48.8% are current smokers, 16.8% are quitters and 34.4% are never smokers. The corresponding figures for adult females are 12.8%, 5.2% and 82%. Among adult males, 51.7% of 18-34 year olds, 50.2% of 35-64 year olds and 26.5% of 65+ year olds are current smokers. The corresponding figures for adult females are 17.9%, 10.9% and 1.4%. (Can, Çakırbay, Topbaş, et al., 2007 and OECD Health Data 2009.)

Figure 1: Projected number of smokers during 2011-2050



Source: Authors' calculations.

The number of smokers is related to both the prevalence of smoking within age groups and the shares of the age groups. We assume that (with no change in tobacco control policies) smoking prevalence will remain the same in time within each age group (as specified above). Figure 1 shows the estimated number of smokers in years 2011-2050 under this assumption.

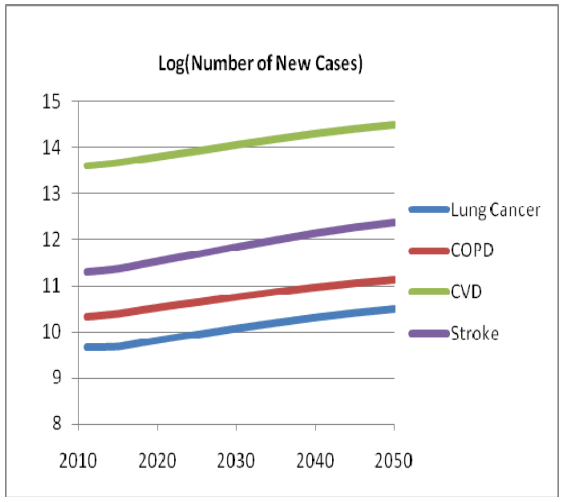
Incidence and mortality rates of some smoking-related diseases

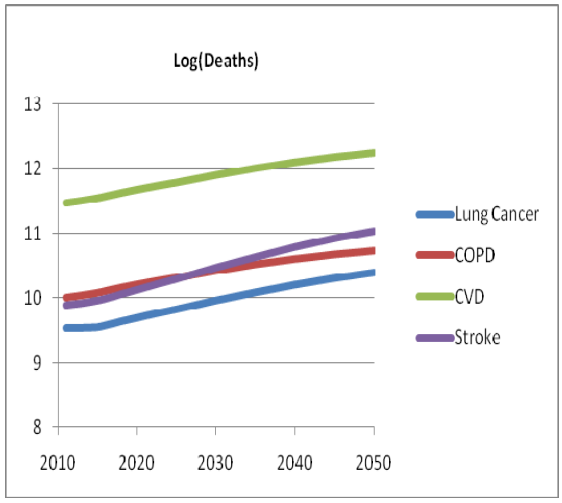
It is well-known that incidence and mortality rates of some diseases are substantially higher among smokers than non-smokers. In our study, we take lung cancer, chronic obstructive pulmonary disease (COPD), chronic cardiovascular disease (CVD) and stroke as the most prominent diseases that are associated with smoking and for which data are available.

In order to estimate the costs incurred due to these diseases while incorporating the effects of demographic change, we need to know the incidence and mortality rates for age groups, differentiated by smoking status. We estimate these rates by using: (1) number of smokers, quitters and never-smokers by sex and age group, (2) incidence and mortality rates of smoking-related diseases by age group, (3) risk ratios by smoking status, sex and age group.

Based on the estimated incidence and mortality rates by sex, age group and smoking status, we estimate the number of new cases and deaths. In Figure 2 we plot the logarithms of these numbers.

Figure 2: Estimated numbers of new cases and deaths during 2011-2050





Source: Authors' calculations.

Costs and benefits

For each cost or benefit item, the total amount is computed as the present discounted value of the amounts in years 2011-2050. The discount rate is the real interest rate in Turkey in 2010 (1.5%).

1. Expenditures for illness and income loss from premature death of smokers due to smoking:

To estimate the expenditures for illness in each year, we multiply the estimated number of new cases of the four diseases by the per case treatment costs of these diseases. Expected cost to the public sector is 84% (the share of the public sector in total health expenditures) of this total.

By using the expected number of deaths in each year, we estimate the expected total income loss assuming that people who died prematurely could

have worked until age 65 and earned an average salary.

2. Productivity loss due to absenteeism of smokers and non-smokers:

Studies have shown that absenteeism and work related accidents are more common among smokers than non-smokers. We estimate total productivity loss by multiplying the estimated sex-specific additional number of annual absent days among smokers relative to non-smokers, by the sex-specific employment rates and by the average employment cost per day.

We know that ETS can be as damaging as occasional smoking. We estimate total productivity loss by multiplying the estimated sex-specific additional number of sick days among non-smokers exposed to ETS relative to those who are not exposed to ETS, by the sex-specific employment rates and by the average employment cost per day.

In both cases, tax loss is estimated by multiplying the productivity loss by the average income tax rate.

3. Costs of tobacco control policies:

We assume that implementing taxation is costless and that the tax elasticity of cigarette prices is 100%, i.e., any change in the tax rate affects the price at the same rate.

We consider two anti-smoking plans, with distinct target prevalence rates. For each plan, we evaluate four smoking intervention programs. 'Class', 'Contest' and 'Self-Help' are borrowed from Altman, Flora, Fortmann (1987). These are community-based programs that were used between 1981 and 1983 in the Stanford Five City Project. 'Class' included sessions on quitting techniques, 'Contest' entitled the right to attend a lottery with several prizes, and 'Self-Help' contained some practical tools to support quit attempts. The quit rates for 'Class', 'Contest' and 'Self-Help' were 35%, 22% and 21% respectively. The per-quitter costs of these programs are 698.64, 382.23, and 126.57 in 2010 USD, respectively.

The fourth intervention, 'Awareness', is borrowed from Stevens, Thorogood, Kayıkkı (2002). This program, which included a play, a poster and media campaign, and purpose-designed leaflets, was used between 1996 and 1997 in London in a Turkish community with a population around 8,500. The 1-year quit rate for this program is around 2.9%. The average cost per quitter, after adjusting for inflation and exchange rate, is 1,631 USD.

Given a smoking prevalence target (of 25% or 20%), we estimate the expected number of quitters in each campaign year. We multiply these estimates with the 1-year per-quitter cost of each intervention program to calculate thereby the discounted sum of annual operating costs over the campaign period.

4. Tax revenues from cigarette sales:

To calculate the estimated tax revenue, we multiply the estimated number of smokers by the average per smoker consumption (304.31 packages per year), by average price of cigarettes (3.41 USD in 2010, including taxes) and by the average tax rate in each year. The average tax rate on smoking in Turkey is composed of the special consumption tax (SCT) and the value added tax (VAT), which were 63.4% and 15.3% in 2010, respectively.

Aggregating costs and benefits

We look at three aggregate measures: We define 'net public benefit' as the tax revenues from cigarette sales net of the sum of publicly financed expenditures for illness of smokers due to smoking, income tax loss from premature death of smokers due to smoking, income tax loss associated with productivity loss due to absenteeism, and cost of tobacco control policies in effect. To evaluate the social impacts of the alternative tobacco control policies, we also define 'net household cost' as the sum of publicly non-financed part of expenditures for illness of smokers due to smoking, after-tax income loss from premature death of smokers due to smoking, productivity loss (net of income tax) due to absenteeism, and tax revenues of the public from cigarette sales; and 'net social cost' as the difference between "net household cost" and "net public benefit".

RESULTS

Effects of tax increases

For our simulations, we fix the VAT rate at its 2010 level (15.3%). As we vary SCT rate from 0.0% to 75.8%, the total tax on cigarettes as a percentage of tax-included retail selling price ranges between 15.3 and 91.1. Given the current prevalence of smoking, we calculate for each tax rate the resulting number of smokers in each simulation year and their total cigarette consumption, using the tax (price) elasticity of smoking prevalence (-20%) borrowed from Onder, Yurekli (2007) and assumed

to be fixed in the simulation period. The results in Table 1 show that public cost, net social cost and cigarette consumption are decreasing functions of the tax rate. But, the relationship between net public benefit and the tax rate on cigarettes is a left-skewed and single-hump shaped Laffer curve.

When the tax rate is at 15.3%, public cost due to smoking exceeds tax revenues. Net public benefit is positive only for tax rates between 40.3% and 91.1%. For the status quo in Turkey where the tax rate is 78.7%, net public benefit over the period 2011-2050 is a strikingly high figure yet found to be suboptimal. Net public benefit reaches its maximum of 384,636 million USD at the tax rate of 84.5%, which, if implemented, would imply a drastic increase of the SCT from its current level of 63.4% to 69.2%. We should notice that cigarette consumption under the current tax rate significantly falls to 171,392 million packages under the optimal tax rate. Finally, net public benefit becomes zero when the tax rate is 91.1%. We should note that the change in the average price of cigarettes with respect to its 2011 level is 37.4% at the public's optimal tax rate and as high as 139% when the tax rate reaches 91.1%. Due to a high price elasticity of cigarette consumption, the nearly four-fold difference in price variation over a very narrow interval of tax rates leads to the dramatic tax sensitivity of net public benefit over the right tail of the Laffer curve.

Effects of smoking intervention programs

Next, we consider two alternative plans to reduce smoking prevalence to targeted rates by 2016. In both plans, average per-smoker consumption is assumed to remain the same. The first plan aims to decrease the ratio of smokers in the population from 30.6% to 25%, by reducing the number of smokers by 3.9% each year. The second plan is more ambitious as the number of smokers decline by 8.0% each year, creating a prevalence rate of 20% by 2016.

We combine each target plan with a tax hike so as to compensate for the tax loss caused by the reduction in the number of smokers. The tax increase required to keep tax revenues intact is 2.9% for the first plan and 5.8% for the second. These tax adjustments lead to an increase in the average cigarette price by 16.0% and 37.8% for the first and second plans, respectively.

Given these compensation schemes, we estimate, for each plan, costs and benefits under four alternative intervention programs. Our simulation results reported in Table 2 show that the five-year discounted costs of the compensated intervention programs are quite low under both plans (about 0.01%-0.11% of 2010 Turkish GDP for the first plan and 0.02%-0.20% for the second). For comparison, total health expenditures were about 5.9% of GDP in 2010. We observe that total cigarette consumption over 2011-2050 reduces to 189,086 million packages and to 154,034 million under the first and second plans, respectively. Net social cost declines by 9%-10% for the first plan and by 18%-19% for the second plan.

To compare the effects of compensated smoking intervention programs to those of purely taxation-based policy options, we calculate for each target plan the unique tax rate that would - in the absence of any intervention programs - yield the same total quantity of cigarette consumption as the programs over 2011-2050, as reported in item (9) of Table 2. This consumption-equalizing tax rate is found to be 83.0% and 85.7% for the first and second target plans, respectively. We observe that for both plans, net social cost due to smoking is significantly lower under intervention programs than under consumption-equalizing taxation, simply because of the greater induced reductions, under intervention programs, in items (1a), (1b) and (2) of Table 2. The public sector, unlike the society at large, prefers purely taxation-based anti-smoking plans to intervention programs. This preference does not arise, however, without an enlarged conflict of interest between the households and the public sector. Taxes collected under equivalent taxation are higher by 9.5% and 8.7% than in the first and second target plans, respectively; evidently raising both net public benefit and net household cost drastically.

Table 1: Costs and benefits under different tax rates on cigarettes (million USD)

	Tax rate on cigarettes (%)											
	15.3	**25.3**	**35.3**	**40.3**	**50.0**	**60.0**	**70.0**	**78.7**	**80.0**	**84.5**	**90.0**	**91.1**
(1a) Expenditures for illness of smokers due to smoking	62,852	62,561	62,179	61,941	61,342	60,420	58,884	56,374	55,811	53,135	46,594	44,345
(1a') Publicly financed expenditures for illness of smokers due to smoking	52,796	52,551	52,231	52,030	51,527	50,753	49,462	47,354	46,881	44,633	39,139	37,250
(1b) Income loss from premature death of smokers due to smoking	327,667	326,355	324,639	323,566	320,869	316,721	309,808	298,512	295,981	283,938	254,500	244,381
(1b') Income tax loss from premature death of smokers due to smoking	65,533	65,271	64,928	64,713	64,174	63,344	61,962	59,702	59,196	56,788	50,900	48,876
(2) Productivity loss due to absenteeism	50,474	50,439	50,393	50,364	50,292	50,182	49,998	49,697	49,629	49,308	48,524	48,254
(2') Income tax loss associated with productivity loss due to absenteeism	10,095	10,088	10,079	10,073	10,058	10,036	10,000	9,939	9,926	9,862	9,705	9,651
(3) Cost of tobacco control policies	0	0	0	0	0	0	0	0	0	0	0	0
(4) Tax revenues from cigarette sales	44,622	71,801	106,107	126,817	176,374	245,632	342,299	449,766	465,264	495,918	271,224	95,777
(5) Public cost	128,424	127,910	127,237	126,816	125,759	124,133	121,423	116,996	116,003	111,283	99,743	95,777
(6) Net public benefit	-83,802	-56,109	-21,130	0	50,615	121,499	220,875	332,770	349,261	384,636	171,481	0
(7) Net household cost	357,190	383,246	416,081	435,871	483,118	548,822	639,564	737,353	750,682	771,017	521,099	336,981
(8) Net social cost	440,992	439,355	437,211	435,871	432,503	427,323	418,689	404,583	401,421	386,381	349,618	336,981
(9) Cigarette consumption (million packages)	338,696	333,679	327,112	323,007	312,689	296,818	270,368	227,153	217,467	171,392	58,764	20,050

Notes: (1a')=0,84*(1a) , (1b')=0.20*(1b), (2')=0.20*(2), (5)= (1a')+ (1b')+(2')+(3), (6)=(4)-(5), (7)=(1a)-(1a')+(1b)-(1b')+(2)-(2')+(4), (8)=(7)-(6).

Table 2: Costs and benefits of alternative intervention programs under target plans I and II (million USD)

	Status Quo	Target Plan I (Smoking Rate = 25%)					Target Plan II (Smoking Rate = 20%)				
		Class	Contest	Self-Help	Awareness	Equivalent Taxation	Class	Contest	Self-Help	Awareness	Equivalent Taxation
(1a) Expenditures for illness of smokers due to smoking	56,374		48,982			54,163		42,174			52,127
(1a') Publicly financed expenditures for illness of smokers due to smoking	47,354		41,144			45,497		35,426			43,787
(1b) Income loss from premature death of smokers due to smoking	298,512		265,467			288,563		235,013			279,401
(1b') Income tax loss from premature death of smokers due to smoking	59,702		53,093			57,713		47,003			55,880
(2) Productivity loss due to absenteeism	49,697		48,820			49,432		48,012			49,187
(2') Income tax loss associated with productivity loss due to absenteeism	9,939		9,764			9,886		9,612			9,837
(3) Cost of tobacco control policies	0	1,673	916	303	3,907	0	3,045	1,666	552	7,108	0
(4) Tax revenues from cigarette sales	449,766		449,766			492,564		449,766			489,010
(5) Public cost	116,996	105,675	104,917	104,305	107,909	113,096	95,076	93,697	92,582	99,139	109,504
(6) Net public benefit	332,770	344,090	344,848	345,461	341,857	379,468	354,691	356,070	357,184	350,627	379,505
(7) Net household cost	737,353		709,033			771,625		682,934			760,221
(8) Net social cost	404,583	364,942	364,184	363,572	367,175	392,157	328,244	326,865	325,750	332,307	380,715
(9) Cigarette consumption (million packages)	227,153		189,086			189,086		154,034			154,034

Notes: The compensating tax rate that keeps tax revenues from cigarette sales intact under four intervention programs is 81.6% for the first target plan and 84.5% for the second plan. The tax rate that yields the same cigarette consumption as the smoking intervention programs do is estimated to be 83.0% for the first target plan and 85.7% for the second plan.

CONCLUSION

The demographic transition in Turkey is predicted to generate a rapid increase in the number of smokers in the next four decades. Simulations of the costs and benefits of various tobacco control policies show that smoking cessation programs in which tax revenues are kept constant by the help of tax increases yield lower costs to households than the purely taxation-based policy alternatives that yield the same quantities of cigarette consumption. Furthermore, estimated net benefits of compensated smoking cessation programs are higher for the society at large, rendering these programs the socially more desirable policy option.

Another finding of this paper is that the optimization of net public benefit implies an increase of the SCT rate from its current level by almost 6 percentage points, raising the tax rate from 78.7% to 84.5% and consequently the average price of cigarettes from 3.41 USD (5.30 TL) to 4.68 USD (7.28 TL). The current Turkish tax rate is the 16th highest in the EU. The same rate applies in the Netherlands, where the average retail price of a pack of cigarettes is 6.36 USD (4.73 €). We also note that the highest tax rate (91.1%) the Turkish government can charge (and still achieve positive net public benefit) is close to the rate charged by the UK (90.14%), where the average price is 8.42 USD (5.44 £). Apparently, there seems to be a large room to reduce smoking in Turkey by taxation.

We should note that we make two assumptions: First, we assume that price increases do not affect average consumption of non-quitters, since we do not know how smoking intensity is related to incidence and mortality rates. Second, we assume that intervention programs have no effect on the average cigarette consumption (as well as illness, mortality, and absenteeism) of non-quitters among participants, as there are no reported estimates of these effects in the literature. It is possible that the two assumptions balance each other to keep the social ranking of taxation and intervention programs the same. However, one factor that clearly strengthens the support for purely taxation-based anti-smoking plans is that we are likely to underestimate the costs of operating countrywide programs by simply replicating small community-based programs, assuming away resource constraints and technical challenges. Such concerns definitely encourage further research in designing and implementing countrywide interventions, with the collaboration of the public health authority, to reduce smoking in Turkey.

We should finally note that the estimation method we suggest in this paper can be used to study the cases in other developing countries where incidence and mortality rate data differentiated by smoking status are not available.

What this paper adds

Previous literature on tobacco control policies in Turkey lacks a thorough economic analysis of alternative anti-smoking policies.

This study evaluates, from the viewpoints of the public sector, households, and the society at large, the costs and benefits of several policy options including tax increases on cigarettes on one side and four smoking cessation programs on the other side. Our simulations show that taxation is preferred by the public sector, while smoking cessation programs are more desirable for households and the society at large. Moreover, we find that in Turkey, net public benefit from taxation of smoking is a Laffer curve, where the optimal tax rate implies increasing cigarette prices by nearly 37%.

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Acknowledgements

We are grateful to TUBITAK (the Scientific and Technological Research Council of Turkey) for supporting this research project, numbered 106G133.

Competing Interests None

REFERENCES

1 **Altman DG,** Flora JA, Fortmann SP. The cost-effectiveness of three smoking cessation programs. *American Journal of Public Health* 1987; **77**:162-165.

2 **Bilir N,** Onder Z**.** Impact of ban on smoking in public places in Turkey. Proceedings II. The 7th International Conference on System Science in Health Care. 29 May-2 June 2000, Budapest, Hungary, 2000.

3 **Buist SA**, McBurnie MA, Vollmer WM, et al. International variation in the prevalence of COPD (The BOLD Study): a population-based prevalence study. Lancet 2007; **370**:741–750.

4 **Can G**, Çakırbay H, Topbaş M, et al. Dogu Karadeniz Bolgesi'nde sigara icme prevalansi, *Tuberkuloz ve Toraks Dergisi* 2007; **55(2)**: 141-147.

5 **Chawla M,** Betcherman G, Banerji A. From red to gray. "The third transition" of aging populations in Eastern Europe and the former Soviet Union. (Washington, The World Bank), 2007.

6 **Edis EC**, Karlıkaya C., 2007. The cost of lung cancer in Turkey. *Tuberkuloz ve Toraks Dergisi* 2007; **55(1)**: 51-58.

7 **Ferlay J,** Bray F, Pisani P, et al. GLOBOCAN 2002: Cancer incidence, mortality and prevalence worldwide. IARC CancerBase No. 5. version 2.0, IARC Press, Lyon, 2004.

8 **Hacettepe Universitesi.** Saglik hizmetleri finansman yapisinin guclendirilmesi ve yeniden yapilandirilmasi icin altyapi gelistirilmesi projesi. En sık görülen ve pahalı tıbbi ve cerrahi DRG'lerin mevcut paket uygulamalarına alternatif sağlayacak şekilde fiyatlandırılması (D.B.2.3). 2005.

9 **Hacettepe Universitesi.** Saglik hizmetleri finansman yapisinin guclendirilmesi ve yeniden yapilandirilmasi icin altyapi gelistirilmesi projesi. Rapor, DRG uygulamalari icin pilto hastanelerde yapilan hazirlik calismalari (D.B.3.1). 2006.

10 **John RM,** Sung H-Y, Max W. Economic cost of tobacco use in India. Tobacco Control 2009; 18:138-143.

11 **Lightwood J**, Collins D, Lapsley H, et al. Estimating the costs of tobacco use. Ch.4 in *Tobacco Control in Developing Countries*, eds. Prabhat Jha and Frank Chaloupka, the World Bank and the World Health Organization, 2000.

12 **Ministry of Health (MoH).** Türkiye hastalık yükü çalışması (Burden of disease in Turkey). Sağlık Bakanlığı Yayın No: 701. Ankara, Turkey, 2006.

13 **Ministry of Health (MoH).** Global adult tobacco survey, Turkey report. Sağlık Bakanlığı Yayın No: 803. Ankara, Turkey, 2010.

14 **Miravitlles M**, Mayordomo C, Artes M, et al. Treatment of chronic obstructive pulmonary disease and its exacerbations in general practice. *Respiratory Medicine* 1999; **93**: 173-179.

15 **Onat A.** TEKHARF 2009: Türk Halkının Kusurlu Kalp Sağlığı. Cortex iletişim hizmetleri, İstanbul, 2009. http://tekharf.org/2009.html

16 **Onder Z.** The economics of tobacco in Turkey, new evidence and demand estimates. HNP Discussion Paper, Economics of Tobacco Control Paper No.2. The World Bank, November 2002.

17 **Onder Z,** Yurekli A. Regressivity of cigarette excise taxes and tobacco control: a case study in Turkey. Working Paper, 2007.

18 **Ross H,** Chaloupka FJ. Economics of tobacco control. International Tobacco Evidence Network, 2002.

19 **Sarti C,** Birgitta S, Tolonen H, et al. Are changes in mortality from stroke caused by changes in stroke event rates or case fatality? Results from the WHO MONICA project. *Stroke* 2003; **34**: 1833-1840.

20 **Shibuya K,** Mathers CD, Lopez AD. Chronic obstructive pulmonary disease (COPD): consistent estimates of incidence, prevalence, and mortality by WHO region. Global Programme on Evidence for Health Policy, World Health Organization, Draft Paper, November 2001.

21 **Stevens W,** Thorogood M, Kayıkkı S. Cost-effectiveness of a community anti-smoking campaign targeted at a high risk group in London. *Health Promotion International* 2002; **17**:43-50.

22 **Sung H-Y,** Wang L, Jin S, et al. Economic burden of smoking in China. 2000. *Tobacco Control* 2006; **15**:(Suppl.I): i5-i11.

23 **Thun MJ,** Louis FA, Henley SJ. Smoking vs other risk factors as the cause of smoking-attributable deaths. *Journal of the American Medical Association* 2000; **284**:706-712.

24 **Tsai SP**, Wen CP, Hu SC, et al. Workplace smoking related absenteeism and productivity costs in Taiwan. *Tobacco Control* 2005; **14**: i33-i37.

25 **Vemmos KN**, Bots ML, Tsibouris PK, et al. Stroke incidence and case fatality in Southern Greece: The Arcadia stroke registry, *Stroke* 1999; **30**:363-370.

26 **Warner KE,** Chaloupka FJ, Cook PJ, et al. Criteria for determining an optimal cigarette tax: the economist's perspective. *Tobacco Control* 1995; **4**:380-386.

27 **Yurekli A,** Onder Z, Elibol M, et al. The economics of tobacco and tobacco taxation in Turkey. Paris: International Union Against Tuberculosis and Lung Disease, 2010.

APPENDIX: Data sources and methods

1) Projections of the population and the number of smokers

a) Population projections:

TURKSTAT up to year 2025. Between 2025-2050, growth rate projections of the United Nations. (Source: United Nations Department of Economic and Social Affairs, Population Division, http://esa.un.org/unpp/ index.asp).

b) Smoking rates and the number of smokers by smoking status, sex and age groups:

Can, Çakırbay, Topbaş, et al. (2007), with an adjustment to match the overall smoking rate in OECD Health Data 2009. Number of smokers in 2011-2050 = (smoking rates) x (projected population in the corresponding sex and age groups).

2) Hazard ratios by sex, age group and smoking status

Data from Thun, Louis, Henley (2000). The reported hazard ratios show the risk of death relative to never smokers.

3) Incidence and mortality rates for 18-34, 35-64 and 65+ age groups

Obtained from different data sources. Usually the source studies use slightly different age groups, requiring some adjustments to be made.

a) Lung cancer: Ferlay, Bray, Pisani et al. (2004), Turkish data.

b) Chronic obstructive pulmonary disease (COPD): Incidence rates for EURO B1 group that includes Turkey, from Shibuya, Mathers, Lopez (2001). Mortality data are from MoH (2006).

c) Chronic cardiovascular disease (CVD): Turkish data from Onat (2009) for Turkey.

d) Stroke: Country averages from Sarti, Stegmayr, Tolonen et al. (2003).

4) Incidence and mortality rates by sex, age group and smoking status: estimation method

To differentiate the rates in item 3 according to smoking status, we assume that the rates reflect the risk for smokers and quitters relative to never smokers, similar to the hazard ratios in Thun, Louis, Henley (2000). Let us define ***a*** to ***f*** as the number of people by smoking status in a particular sex-age group, as in the table below.

	Current smokers	Quitters	Never smokers
Number of new cases/deaths	***a***	***c***	***e***
Number of healthy people	***b***	***d***	***f***

What we can estimate are:
-Hazard ratio of smokers: $HR_s = (a/(a+b)) / (e/(e+f))$
-Hazard ratio of quitters: $HR_q = (c/(c+d))/(e/(e+f))$
-Within each sex-age group, the ratio of the number of smokers to never smokers, $(a+b)/(e+f)$; the ratio of the number of quitters to never smokers, $(c+d)/(e+f)$.
-Within each sex-age group, the total number of new cases/ deaths, $X = a+c+e$, estimated as the incidence/ mortality rate times the population in the corresponding sex-age group.

Knowing the above, we calculate ***a, c*** and ***e***. Incidence/ mortality rates by sex, age and smoking status groups are estimated by dividing ***a, c*** and ***e*** by the population in the corresponding sex, age and smoking status group.

5) Treatment costs of diseases

The treatment cost of lung cancer is 11,850 USD per case (in 2010 prices), adjusted using Edis and Karlikaya (2007). The costs of COPD, CVD and stroke are 3,068 USD, 1,923 USD, and 4,213 USD, respectively (Hacettepe Universitesi 2005, 2006). The cost of CVD is the average of the per-case treatment costs of unstable angina and myocardial enfarction. The cost of COPD is per exacerbation. The estimated number of exacerbations is calculated as the expected number of cases multiplied by 0.4596 (the share of Level II patients), by 0.0807 (the share of Level III and IV patients) (Buist, McBurnie, Vollmer, 2007) and by 2 (the median number of exacerbations (Miravitlles, Mayordomo, Artes, 1999)).

The public share of health expenditures is 84%, which is taken from TURKSTAT's Life Satisfaction Survey.

6) Tax loss due to premature death

We take into account the sex-specific employment rates and the average income tax rate to estimate the amount of taxes that could have been collected on earnings. Employment rates for women (22.3%) and men (60.7%) are from TURKSTAT, 2009 Household Labor Force Survey. Average gross earnings by sex and age group are from TURKSTAT, 2006 The Structure of Earnings Survey. The average income tax rate is 20% (Ministry of Finance, budget revenue statistics). Income earned until retirement is estimated as the present discounted value of annual expected incomes until age 65.

7) Tax revenues

Average cigarette consumption is based on total consumption data from Tobacco and Alcohol Market Regulatory Authority and our estimate of the number of smokers. The average price of cigarettes, 5.30 TL (3.41 USD) per pack in 2010 prices, is from TURKSTAT price statistics. The tax rate on cigarettes, 78.7%, is from the Ministry of Finance.

8) Productivity loss due to absenteeism and environmental tobacco smoke

Tsai, Wen, Hu et al. (2005, Table 1) report that absenteeism among male (female) smokers is 1.06 (1.21) days higher compared to non-smokers. Tsai, Wen, Hu et al. (2005, Table 3) report that sick days among ETS exposed male (female) non-smokers is 0.79 (0.96) days higher compared to those who are not exposed to ETS.

9) The annual discount rate for the period 2011-2050

1.5% (average real interest rate in Turkey in 2010)
Source:
http://www.tcmb.gov.tr/research/parapoli/inflation2011II.php

10) The GDP and the total expenditures on health in Turkey

GDP in 2010 is 1,106,486 million TL (711,521 million USD). The total expenditures on health is 57,740 million TL in 2008, which we inflation-adjusted to 2010 prices as 42,137 USD.
Source: TURKSTAT

11) US inflation between 1981-2011

153,13% (CPI published by US Bureau of Labor Statistics)
Source: www.bls.gov

12) UK inflation between 1998-2011

27,67% (CPI published by UK National Statistics)
Source: www.statistics.gov.uk

13) Cigarette tax rates and tax included average retail prices in the EU

Source: European Commission Directorate General Taxation and Customs Union, Ref 1032, March 2011.
http://ec.europa.eu/taxation_customs/taxation/excise_duties/index_en.htm