Cost-benefit analysis of smoking in Latvia

Anita Kokarevica\textsuperscript{1} and Anastasija Ludzeniece\textsuperscript{2}

\textsuperscript{1}Rīga Stradiņš University, Riga, Latvia
\textsuperscript{2}SIA CETERA, Riga, Latvia

Abstract. One of 3 persons in Latvia is a smoker. Smoking has been proved to be linked to different cancer, cardiovascular and respiratory diseases. The overall purpose of the study addresses smoking as a cost-benefit subject in Latvian state economy. A model to perform evidence-based cost-benefit analysis (CBA) was developed highlighting direct and indirect costs borne by the state, smokers and second-hand smokers. The paper envisages the approach to building the model. As the first study on economic impact of smoking in Latvia, the CBA results demonstrate substantial excess of financial benefits from smoking citizens in Latvia. Authors discuss the smoking attributable fraction (SAF) eligibility and needs in data to discover the full impact of smoking on health and non-health aspects.

Key words: CBA, smoking, costs, benefits, SAF.

1 Introduction

Every 4\textsuperscript{th} person over 15 is a smoker in the European Union \cite{2}. In Latvia, the issue is even bigger – every 3\textsuperscript{rd} person smokes on daily basis \cite{1}. Smoking as a habit of citizens makes a sound impact on Gross Domestic Product in two polar ways: state budget income and expense. While regulating cigarette consumption with excise tax, the income budget grows. Simultaneously state compensates a notable part of healthcare costs to its citizens who experience smoking affected diseases. Is smoking the cost or the benefit? To address the question, a cost-benefit analysis (CBA) should be performed. Historically CBA covered analysis of investment projects and programs in infrastructure. By increasing the social investment portfolio of the European Union, the cost-benefit analysis methodology was enhanced to be applicable to the specifics of healthcare, education and social care sectors. Both, in infrastructure and social domain, CBA implies discounting of the cash flow and comparing intervene investments and operating costs with the benefits of achieved intervention goals.

The aim of the paper is to present the approach and the results of the analysis of Latvian state costs and benefits of cigarette smoking. The paper describes the CBA model, the limitations and assumptions for CBA calculation and discusses the results of the analysis performed.

2 Material and methods

In order to perform the cost-benefit analysis, the model for assessing the impact of tobacco use on the socio-economic development of Latvia has been developed. The structure of the model implies current world practice on methodology applied in other countries and is limited with availability of statistical data. The model construction approach is demonstrated in Fig. 1.
The key principle of the Latvian model is the value of lost lives due to smoking. It is based on WHO proposed Excess Cost Approach [1]. The model analyzes long-term expenses applying Annual Cost Approach. The model addresses four cost factors:

1. Provision of healthcare services to smokers (in terms of smoking related diseases);
2. Consumption of services due to smoking;
3. Morbidity (lost productivity due to smoking);
4. Premature mortality among smokers.

The impact assessment model includes both direct and indirect costs, thus drawing conclusions about the visible and hidden losses of the society from the long-term use of tobacco. The cost directness criterion can be determined by the existence of real expenditures: spending on the purchase of goods and services constitutes direct costs; the source of indirect costs is the potential loss of income. In other words, indirect costs consist of income that a person could have earned if smoking had not affected the person through disability or premature death. To determine the indirect costs authors applied the Human Capital Approach [6].

The socio-economic model focuses on the state income and losses, and it includes some of the smokers’ borne costs as represented in Fig. 2.

Authors carried out an expert survey as well as analysis of public data and approached public administration bodies to gather data about smoking impacts and costs.

Recent epidemiological studies have evidenced that not only numerous forms of cancer diseases appear due to smoking, but also cardiovascular diseases, chronic obstructive pulmonary disease and acute respiratory illnesses [3]. In terms of statistical data availability, the following diseases have been included in the impact assessment in Latvian model (according to International Classification of Diseases, ICD-10 [4]):

1. Neoplasms:
   a. Malignant neoplasms of lip, oral cavity and pharynx (C00–C14)
   b. Malignant neoplasm of oesophagus (C15)
### Socio-Economic Impact of Smoking

#### Fig. 2. Socio-economic assessment model of impact of smoking.

| (+) Revenue | (-) Direct costs | (-) Indirect costs |
|-------------|------------------|--------------------|
| Excise tax, VAT | Purchase of tobacco | Purchase of tobacco |
| **Healthcare costs** | **Healthcare services** | **Healthcare services** |
| | **Medicine, medical devices** | **Medicine, medical devices** |
| **Social care costs** | **Determination of disability** | **Transportation expenses** |
| | **Disability pension and benefits** | **Transportation expenses** |
| | **Social services** | **Social services** |
| **Other costs** | **Fire extinguishing** | **Potentially lost income** |
| | | **Loss from fire** |
| | | **Other costs** |
| | | **Other costs** |

#### State costs/benefits

- Smokers
- 2nd hand smokers

**Socio-Economic Impact of Smoking**

2. Diseases of circulatory system:
   a. Ischaemic heart diseases (I20–I25)
   b. Cerebro-vascular diseases (I60–I69)
   c. Atherosclerosis (I70)
   d. Aortic aneurysm and dissection (I71)
   e. Other peripheral vascular diseases (I73)
   f. Arterial embolism and thrombosis (I74)
3. Diseases of the respiratory system:
   a. Simple and mucus-purulent chronic bronchitis (J41)
   b. Unspecified chronic bronchitis (J42)
   c. Emphysema (J43)
   d. Other chronic obstructive pulmonary disease (J44)

Another important input to calculate smoking impact is SAF calculation. Smoking attributable fraction is a central measure that determines the impact of smoking on any instance. Rosen explains SAF with the following formula:

\[
SAF = \frac{A}{A + B + C},
\]

where
- A – number of smokers within the population with diagnosed X disease due to smoking;
- B – number of smokers within the population with diagnosed X disease due to other reasons (not smoking);
- C – number of non-smokers with diagnosed X disease within the population.

Assuming T is the total number of persons with diagnosed X disease, the formula can be simplified and explained as follows:

\[
AF = \frac{A}{T}
\]

Through this formula, SAF can be defined as the number of persons with diagnosed X disease due to smoking divided by the total number of persons with diagnosed X disease [8].

In practice, SAF determination in a certain country is an extremely time and resource requiring intensive activity. In order to determine the relative risk of smoking, causing a certain disease, comparing it with the illness of non-smokers, authors of numerous epidemiological studies addressed the necessity to collect individual data within a long period. Then it can be empirically and statistically inferred from the degree of illness and smoking relationship between different profiles (age, gender, and other parameters). The 2009 GHK study, commissioned by the EU, summarizing the results of current economic studies, concluded that all previous studies (at least until 2009) were based on the US study CPSII (US Surgeon General) and used standardized SAF indicators from this study [7, 9]. Equivalent scale study in 2010–2014 was carried out in China, where smoking annually kills a significant part of the country’s economically active population [5]. Authors of economic impact calculations for smoking in different countries similarly conclude that in order to empirically and statistically verify the link between smoking and diseases in other geopolitical regions with different social, ecological, and other factors, long-term studies of similar scale should be carried out [3]. Authors applied the SAF measurements determined by Sir Richard Peto and his team, which is also based on US study CPSII.

3 Results

The cost and benefit cash flow for smoking as presented in Appendix 1 depicts gradual rise of excise tax revenues – 166.2 million euro in 2014 and 7% annual growth further. Assuming the dynamics of income rise will drop to 3% annually, within next 15 years state will collect about 2.5 billion euro (discounted value) from the restrictions in tobacco production and trade.

Smoking linked disease costs compound direct costs. These are out- and inpatient service expenses and medicines, other non-healthcare expenses. Consumption of outpatient and inpatient services in Riga and rural areas is very similar. Indirect costs include productivity
loss in case of work ability loss and years lost in case of mortality. In 2014, state budget expenses of 79.3 million euro were assigned to healthcare services for smokers in Latvia. Applying SAF rate of 14.85%, indirect costs related to productivity loss due to work ability loss comprised 41 million euro in 2014. Mortality of smokers reflects the number of years they could have worked if had not smoked. Based on statistical data of 2014, smokers trigger 9.8 million euro in indirect costs.

To summarize the CBA results it is important to point out that the net present value of state costs and benefits within 15-year-period comprises 1.46bln euro. It means that Latvian state gains financial benefits from smoking citizens, if the level of healthcare, social care and other services to smokers remains at the recent mark. The cost-benefit ratio reaches 2.35, i.e. benefits significantly exceed the related costs.

4 Discussion

This paper shortly depicts the initial results of cost-benefit analysis of smoking in Latvia. The methodology and the results gained raise several questions.

Firstly, the SAF applied values were derived from US statistics about smokers’ health. As the economic, social and environmental issues differ in the US and Latvia, the relative risk of certain diseases may differ substantially. Thus, the real economic impact of smokers can both increase and decrease significantly. Nevertheless, the actual CBA numbers trigger a sharp need to start gathering individual data on smokers’ health dynamics in Latvia to draw realistic conclusions about the smokers’ impact on socio-economic development of Latvia.

Secondly, the list of costs related to smokers’ treatment requires certain additional positions like homecare, alternative healthcare services, family expenditures to sustain smoke-free environment, employers’ expenditures to train new employees in case of smokers’ illness. Moreover, the administrative burden of smoking control, tax collection, legislation and monitoring should be estimated and analyzed within the further research on economic impact of smoking.

5 Conclusions

The analysis of state costs and benefits demonstrates substantial excess of state benefits resulting from tobacco smoking, although state regulation and control activities are in force, and state healthcare system provides outpatient and inpatient services to smokers and second-hand smokers. There is a wide opportunity to tighten the state regulation and review state funding to compensate smoking consequences.

References

[1] World Health Organization, Economics of tobacco toolkit: assessment of the economic costs of smoking (2011). Retrieved from www.who.int
[2] Eurostat, Tobacco consumption: 1 in every 4 persons aged 15 or over in the European Union is a smoker (2016). Retrieved from https://ec.europa.eu/eurostat/documents/2995521/7762296/3-07122016-AP-EN.pdf/e6cf7fd2-06a5-45ba-8385-991bcecf54fd
[3] GHK, A study on liability and the health costs of smoking (2012). Retrieved from www.ghkint.com
[4] International Classification of Diseases, ICD-10 (2016). Retrieved from https://icd.who.int/browse10/2016/en/#J40-J47
[5] W. Li, G. Jiang, D. Wang, H. Zhang, Z. Xu, Y. Zhang et al, Smoking and Mortality in Tianjin, China: A Death Registry–Based Case-Control Study,
2010–2014. Preventing Chronic Disease 15, 170577 (2018). Retrieved from https://doi.org/10.5888/pcd15.170577

[6] W. Max, D.P. Rice, H.-Y. Sung, M. Michel, Valuing Human Life: Estimating the Present Value of Lifetime Earnings, 2000 (2004). Retrieved from https://escholarship.org/uc/item/82d0550k#supplemental

[7] R. Peto, A.D. Lopez, H. Pan, J. Boreham, M. Thun, Mortality from smoking in developed countries 1950–2020 (2006). Retrieved from www.deathsfromsmoking.net

[8] L. Rosen, An intuitive approach to understanding the attributable fraction of disease due to a risk factor: the case of smoking, International Journal of Environmental Research and Public Health 10(7), 2932–2943 (2013). Retrieved from https://doi.org/10.3390/ijerph10072932

[9] United States. Public Health Service. Office of the Surgeon General, How tobacco smoke causes disease: the biology and behavioral basis for smoking-attributable disease: a report of the Surgeon General. U.S. Dept. of Health and Human Services, Public Health Service, Office of the Surgeon General (2010)
## Appendix 1. Discounted cash flow for smoking CBA.

| Year | Excise tax revenue for tobacco products | Direct costs | Indirect costs: | Cash flow | Discounting |
|------|----------------------------------------|--------------|----------------|-----------|-------------|
|      |                                        |              |                |           | Discount factor | Discounted income | Discounted costs | Discounted cash flow |
| 2014 | 164 173 822                            | -40 723 949  | -51 486 340    | 74 642 199 | 1.0000       | 166 173 822       | -91 531 623      | 74 642 199          |
| 2015 | 172 844 480                            | -40 723 949  | -51 486 340    | 85 054 292 | 0.9524       | 168 823 314       | -87 819 227      | 81 004 087          |
| 2016 | 181 283 900                            | -40 723 949  | -51 486 340    | 96 757 084 | 0.9070       | 171 875 011       | -84 113 484      | 93 761 627          |
| 2017 | 189 714 900                            | -40 723 949  | -51 486 340    | 105 680 455| 0.8638       | 171 875 011       | -80 584 261      | 97 296 244          |
| 2018 | 201 185 000                            | -40 723 949  | -51 486 340    | 115 049 928| 0.8227       | 171 875 011       | -77 223 151      | 97 626 867          |
| 2019 | 215 183 842                            | -40 723 949  | -51 486 340    | 120 709 500| 0.7835       | 168 601 202       | -74 022 150      | 93 579 050          |
| 2020 | 225 183 842                            | -40 723 949  | -51 486 340    | 126 526 628| 0.7462       | 165 389 750       | -70 973 632      | 92 553 136          |
| 2021 | 235 183 842                            | -40 723 949  | -51 486 340    | 132 505 424| 0.7107       | 162 239 469       | -68 070 338      | 90 165 111          |
| 2022 | 245 183 842                            | -40 723 949  | -51 486 340    | 138 650 096| 0.6768       | 159 149 194       | -65 162 474      | 94 617 622          |

| Year | Excise tax revenue for tobacco products | Direct costs | Indirect costs: | Cash flow | Discounting |
|------|----------------------------------------|--------------|----------------|-----------|-------------|
|      |                                        |              |                |           | Discount factor | Discounted income | Discounted costs | Discounted cash flow |
| 2023 | 242 189 918                            | -65 501 027  | -56 501 027    | 93 445 694 | 0.6446       | 144 967 942       | -62 672 086      | 93 445 694          |
| 2024 | 250 189 918                            | -65 501 027  | -56 501 027    | 102 230 640| 0.6139       | 147 833 255       | -59 685 429      | 93 456 407          |
| 2025 | 258 189 918                            | -65 501 027  | -56 501 027    | 111 058 204| 0.5847       | 151 177 780       | -56 845 829      | 93 381 648          |
| 2026 | 266 189 918                            | -65 501 027  | -56 501 027    | 119 885 204| 0.5568       | 154 558 464       | -54 138 504      | 93 227 105          |
| 2027 | 274 189 918                            | -65 501 027  | -56 501 027    | 128 712 204| 0.5293       | 157 998 289       | -51 189 219      | 92 337 222          |
| 2028 | 282 189 918                            | -65 501 027  | -56 501 027    | 137 639 204| 0.5051       | 161 490 097       | -49 465 873      | 92 034 225          |
| 2029 | 290 189 918                            | -65 501 027  | -56 501 027    | 146 566 204| 0.4810       | 165 981 971       | -47 841 192      | 91 140 780          |
| 2030 | 298 189 918                            | -65 501 027  | -56 501 027    | 155 493 204| 0.4568       | 170 529 849       | -46 217 569      | 90 312 280          |
| 2031 | 306 189 918                            | -65 501 027  | -56 501 027    | 164 420 204| 0.4337       | 175 079 718       | -44 694 126      | 89 785 542          |
| 2032 | 314 189 918                            | -65 501 027  | -56 501 027    | 173 957 204| 0.4116       | 179 639 586       | -43 169 131      | 89 140 455          |

| Total | Excise tax revenue for tobacco products | Direct costs | Indirect costs: | Cash flow | Discounting |
|-------|----------------------------------------|--------------|----------------|-----------|-------------|
|       |                                        |              |                |           | Discount factor | Discounted income | Discounted costs | Discounted cash flow |
| 3 696 827 304 | 651 583 178 | 874 472 261 | 2 170 771 864 | 0.4116 | 179 639 586 | -43 169 131 | 89 140 455 | 89 785 542 | 89 140 455 |