Social return on investments in smoking cessation policy in The Netherlands

Master Thesis

Lina Lukoseviciute

ANR: 248693

MSc Economics

Faculty of Economics and Business Administration

Tilburg University

Supervised by prof. dr. Johan J. Polder

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Abstract

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Introduction. Smoking is one of the most addictive behavioural risks, causing serious health problems for individuals and imposing costs to the whole society. Nearly every country has adopted more or less stringent smoking policies, leading to increased smoking cessation. The question is whether it is economically worthwhile to raise the magnitude of various anti-smoking campaigns and cessation aids.

Research Question. From a viewpoint of society, does smoking cessation policy in The Netherlands pay off in the long run?

Methods. A method of social return on investment was applied. Smokers of three different age groups (20 – 44, 45 – 64, 65+) were targeted and work productivity and health outcomes were analyzed as a consequence of successful smoking cessation.

Results. Returns on investment appeared to be substantially positive, ranging from approximately 110% to 220%. It is an exceptionally high return if we compare it to any other regular investment. Therefore, smoking cessation could be a contributor to welfare, and every euro invested might potentially bring a € 1.1 to € 2.2 net return.

Conclusions. *S*moking cessation does pay off to the Dutch society in the long run, and employers, individuals, governments, health insurers, and care providers can take advantage of anti-smoking policies and get tangible returns on their investment. Yet, the interventions’ financing issue needs to be addressed with private-public partnerships as a potential mechanism to make smoking cessation pay its way to society.

Key words: *smoking cessation, social costs, cost-effectiveness analysis, return on investment, productivity, health care costs.*

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Chapter 1

Introduction

> *"It's easy to quit smoking. I've done it hundreds of times."*
> Mark Twain

Smoking is one of the leading causes of preventable morbidity and mortality in terms of substantially increased risk of death from cancers, particularly lung cancer, heart diseases, and chronic respiratory diseases. Approximately 17.9% of deaths in high income countries could theoretically be avoided if people stopped smoking (Global Health Risks, 2006). In The Netherlands 3.7% of total health care costs is attributable to smoking (Volksgezondheid toekomst verkenning 2006). Tobacco consumption also bears an economic impact for a smoker himself/herself and his/hers dependants in the form of costs of purchasing tobacco, lost income due to disability to continue working, higher health insurance premiums in some countries, and eventually, premature death. As a result, every society is exposed to lower productivity levels (Bunn *et al.*, 2006; Collins & Lapsley, 2008), higher burden of diseases and rising health care costs (Ezzati *et al.*, 2006; van Baal *et al.*, 2007, 2008).

On top of that, tobacco is a highly addictive substance. It may seem to be a solely personal decision to start smoking and eventually to quit after having encountered health problems or any other discomfort caused by smoking. However, many smokers find it difficult to stop. Statistically, just 3 – 5% of smokers, who are trying to quit on their own will power, are still on track after one year (Feenstra *et al.*, 2005). In addition to that, tobacco industry is a powerful lobbyist investing large amounts of money every year to maintain and increase tobacco consumption (MPower, 2008).

Presumably, interventions aimed at reducing smoking prevalence may be a solution to this comprehensive problem. However, smoking cessation itself can be costly. Not only the implementation of interventions requires financial resources, but successful smoking prevention does increase life expectancy and smoking-related inexpensive lethal diseases (see Appendix A for major smoking-related diseases) are substituted by more expensive and less lethal unrelated diseases (Van Baal *et al.*, 2007). From the perspective of a health care provider, a non-smoking society may turn to be more expensive. On the other hand, smoking has been found to increase sickness absence from work (Bunn *et al.*; Lundborg, 2006; Robroek *et al.*, 2010), to reduce efficiency while being present at work, and to increase the probability of early retirement (Collins & Lapsley, 2008; Neubauer *et al.*, 2006; The Price of Smoking, 2004), suggesting that gains of smoking reduction may after all be larger than imposed costs. Bearing in mind that a modern society has to constantly seek for ways to induce growth, raise the standard of living, and meet ever emerging socio-demographic challenges, smoking cessation support can as well become the means to contribute to that. Once we have strong economic arguments to support a case of smoking cessation, it may find its way to policy makers, be implemented on a larger scale, and yield potentially high social returns on such investment.

Therefore, my **research question** is:

- "From a viewpoint of society, does smoking cessation policy pay off in the long run?"

I will be trying to quantify the answer in a form of ***social return on investment*** in smoking cessation interventions in The Netherlands. A positive ratio will indicate that a particular set of interventions is beneficial to implement from the social perspective.

A current state of art in the field cannot provide us with a sound link between specific interventions, their costs, and social benefits that they yield, given their efficacy.

There is a large array of literature on cost-effectiveness of separate interventions or different combinations of them; however, in most cases researchers focus on health care effects. Others analyze overall social costs or individual effects of quitting. The purpose of this thesis is to start bridging the gap with a return on investment approach and build up a starting point for a more explicit and broader research.

In my thesis I am going to develop a model to calculate a social return on investment in smoking cessation, combining literature evidence on cost-effectiveness of interventions and my own estimations of individual costs or benefits, resulting from quitting. I will concentrate on productivity and health care costs differences between smokers and quitters of different age groups in The Netherlands. First of all, I will present a literature review on social costs of smoking, methodological issues, and cost-effectiveness of smoking interventions. Afterwards, I will describe the model constructed of different scenarios (low, moderate, and high reach of interventions) and perform a sensitivity analysis. I will also throw some light on distribution issues of cessation benefits. And finally, I will conclude by answering my research question, discuss limitations of the model, and provide suggestions for future researchers.

Chapter 2

Social costs of smoking

"Social, or external, costs are costs that fall on society, including a part of it which is users of tobacco products who are not freely choosing to use tobacco in full knowledge of consequences." (Scollo & Winstanley, 2008: Ch. 17.2.1)

Smoking is a behavioural risk which not only has an addiction factor but is also subject to bounded rationality, a lack of awareness, and other external factors. All these circumstances together imply that individuals do not borne all related costs themselves, and there are negative spillovers to other members of society. This can be compared to the market failure in a market economy, where governments need to step in to correct for it.

In most sources of literature social costs of smoking are divided into two main categories: direct and indirect (see Figure 1).

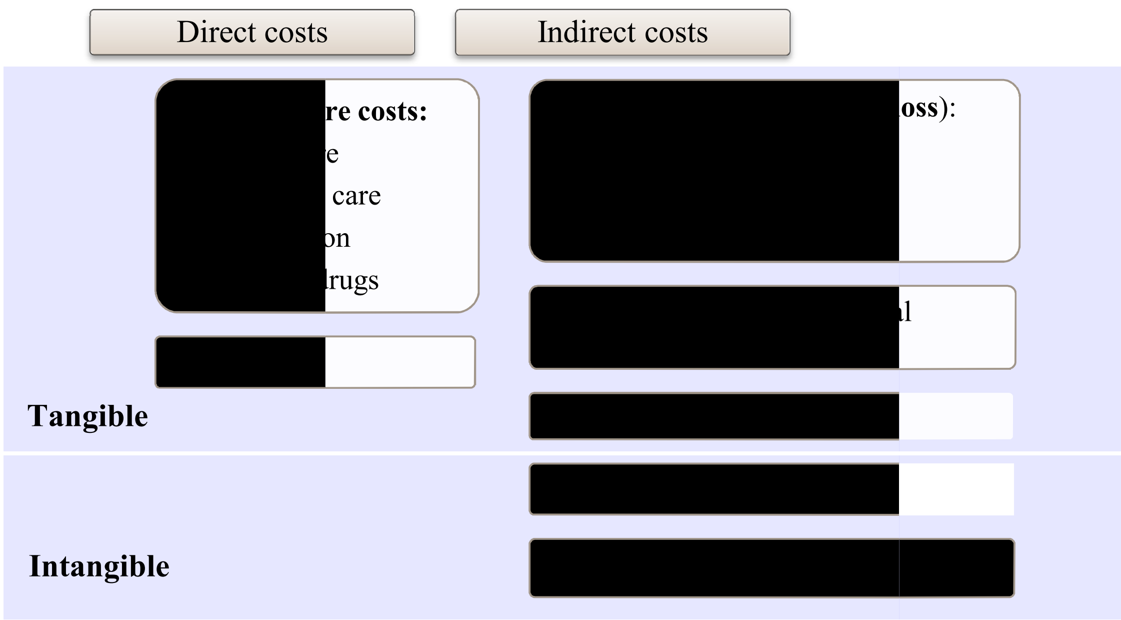

Figure 1. The division of social costs of smoking.

Direct costs are largely composed of expenditure on curing smoking-related diseases. Some researchers also consider costs due to fire caused by cigarettes as direct costs. For instance, Collins & Lapsley (2008) estimated the cost incurred by smoking related fires in Australia (2.7% of all fires in the country were caused by smoker's materials) to be equal to € 105 mln. in 2004/2005, i.e. 0.02% of GDP.

Indirect costs are a social loss triggered by increased absenteeism at work, inefficiency, low self-esteem, early retirement, and premature death. There are some attempts to evaluate damage done by environmental tobacco smoke as well. However, the latter requires several assumptions to be made, one of them is which part of smoking-attributable conditions reflect passive or involuntary smoking. One could also classify financial resources spent on tobacco as indirect social costs since it could alternatively be used for other consumption or investments, which might have positive externalities instead.

Similarly, social costs can be split into tangible and intangible (see Figure 1). Tangible costs are costs whose reduction releases resources for other uses. Whereas, in case of intangible costs, there is no release of resources. Consequently, it makes it difficult to value them because there is no market in intangibles (Collins & Lapsley). And one needs to derive an estimate of the psychological value of the loss of one year's living. There is little objectivity, not to mention the evaluation of low self-esteem or suffering, where it is barely possible to assign a monetary value in the area of smoking (Collins & Lapsley) .

As for the total size of a social burden of smoking, literature evidence is rather diverse and varies from country to country. Collins & Lapsley provide a following split of social costs among communities in Australia: households bear a burden of 50.3% of total tangible costs, businesses – 42.1%, and finally, the government is paying 7.6%. Thus, approximately a half of total costs are borne by society. Total social costs amounted to approximately 31.5 billion dollars in 2004/2005. Out of them, 38% were tangible costs, 62% were intangible. Their calculations of productivity costs relied heavily upon a finding from a research prior to theirs (Bush & Wooden, 1994) that smokers are 1.4 times more likely to be absent, and ex-smokers are 1.3 times more likely to be absent than those who have never smoked. Similarly, Neubauer *et al.* (2006) assessed costs of cigarette smoking in Germany in 2003. They divided total costs into direct and indirect. Total costs of smoking for the German society reached 21 million euros in 2003, 36% of which were direct and the rest 64% were indirect costs. Besides, 56% of the morbidity (productivity) costs occurred due to early retirement and the remaining 44% – due to work days lost. A strong point of their research is that they used primary national statistics for absenteeism figures, as opposed to Collins & Lapsley. All in all, it seems that a burden of smoking falls rather heavily on a wide society. However, an American illustration in The Price of Smoking (2004) states that for a smoker aged 24 a real price of each pack of cigarettes was US$ 40, taking the effect of smoking on mortality, health care spending, social security, private pensions, insurance programs, and the health of family members into account. Of this hypothetical price the smoker pays US$ 33 (i.e. 83%), which means there is a considerably lower social burden of smoking than the one in two previously mentioned studies.

Apparently, the results of social cost of smoking calculations can be mixed but an important underlying reason is different methods and data availability. Unfortunately, a lack of information prevents economists to attach sharp values to every cluster of social costs listed in Figure 1. In my analysis I will leave out intangible costs of smoking due to discussed limitations, as well as ETS impact, since probably the only feasible way to capture this effect is by assuming that all smoking-attributable conditions suffered by people younger than, for example, 15 years old (when people are most likely still non-smokers) will reflect involuntary smoking, and this age group is out of the scope of my thesis. Further in this chapter I will discuss two main categories of costs, i.e. health care and productivity, providing existing literature evidence on their quantifications in order to make reasonable choices for my own analysis.

Impact of smoking on health care costs

A continuous acceleration of health care costs is one of the central issues of an ongoing debate in both medical and wide societies. Some parties claim that prevention could possibly become a remedy, balancing health care budgets. Van Baal *et al.* (2008) suggest that in the short run "at all ages, smokers <…> incur more costs than do healthy-living[1] people". Intuitively, smoking cessation seems to be one of the agents to cut down these expenses. Whether this is really the case is a question I will answer in this section.

It is important to note that health care costs are sensitive to the definition of it (what is included and what is not), a country of reference, and existing treatment practice (Polder & Achterberg, 2004). According to the broad definition by the Dutch Government, these costs include a necessary medical care and residential facilities for the elderly and/or disabled, while international standards exclude some major parts of long term care (Polder *et al.*, 2006). This is an important aspect for economic analysis, if we acknowledge gained life years as one of the consequences of smoking cessation.

An extensive strand of literature affirms that if we take lifetime costs into consideration, they happen to be noticeably higher for never smokers in comparison to

[1] Non-smokers with a body mass index between 18.5 and 25.

their smoking counterparts. For instance, van Baal *et al.* (2008) estimated expected lifetime health care costs for healthy-living and smoking cohorts in Dutch population. At the age of 20, a non-smoker can expect to incur costs equal to € 281,000[2] over his/her lifetime, whereas, a smoker is most likely to experience costs of € 220,000[3], i.e. approximately 22% less. Sensitivity analysis unveiled that this difference might even get larger (28%), in case a broader definition of costs is applied, or, on the contrary, narrow down to 20%, assuming a yearly decrease in all relative risks due to preventive efforts. All in all, van Baal *et al.* expected smoking cessation to contribute to higher lifetime health care utilization.

Health care costs of quitters

If smoking cessation indeed raises lifetime medical costs, the question is what the size of this effect is, or in other words, how large health care costs of quitters become compared to those of never smokers and smokers. One might expect them to be somewhat intermediate. To investigate the effect of quitting, Fishman *et al.* (2003) studied enrollees in one American HMO[4] and tested an impact of cessation on costs for seven years after successful quitting. They used a generalized linear model multivariate regression to address the issue of the skewed distribution of costs. Besides, total health care costs were assumed to be a function of age, sex, smoking status, and an overall health condition. They discovered that health care costs had significantly escalated in the first year after cessation but had dropped in the following periods, and cumulative seven years expenses turned out to be lower. The authors indicate that their "evidence suggests that smoking cessation does <u>not</u> increase long-term health care costs". Yet, the study is

[2] 2003 price level, not discounted
[3] 2003 price level, not discounted
[4] Health Maintenance Organizations– a form of health insurance combining a range of coverage in a group basis; health care is offered for a flat monthly rate with no deductibles within the HMO network only. [definition by www.investorwords.com]

known to have some limitations, such as a single HMO examined, a lack of consistent data, and a short follow up period without a knowledge of the trend in the following years to come. A later study by Kahende *et al.* (2009) used nationally representative survey data to assess health care utilization differences of smokers, never smokers, and quitters. They found cigarette smoking, whether current or former, to be associated with higher consumption of health care in terms of outpatient visits and inpatient hospital admissions, translating into higher health care costs. In addition to that, former smokers tend to pay more outpatient and inpatient visits immediately after quitting (coinciding with Fishman *et al.* findings). A reasonable explanation is that patients might have quitted after experiencing severe health problems. In fact, this was a missing link in the study – the absence of data on respondents' past health care utilization. Furthermore, both studies, by Fishman *et al.* and Kahende *et al.*, did not take life expectancy changes into account, and this turns out to be an influential element, while comparing outcomes to the ones obtained by studies, which did include additional life years into consideration.

Rasmussen *et al.* (2005) estimated lifetime savings of smoking cessation in the Danish society. For health care costs calculation, the researchers used a stationarity assumption[5] and combined the cost of illness with life expectancy (i.e. modeled population attributable risk percentages and relative mortality risks, depending on a status of smoking, intensity of tobacco consumption: light, moderate or heavy, and gender differences). They found substantial lifetime health care cost savings for moderate smokers quitting at the age of 35 – € 7,600 for men and € 12,200 for women, or 30% to 43% relative savings. Yet, they only dealt with smoking related illness and a narrow definition of medical costs, which explains the contradicting conclusions to the study by van Baal *et al.* (2008).

[5] Parameters, such as mean and variance, do not change over time or position.

Accounting for future health care costs

The issue of accounting for future health care costs has long been in the centre of debates among health researchers (Meltzer, 1997; Garber & Phelps, 1997; van Baal *et al.*, 2007). It has been a long-term practice to only look at health care spending contraction related to prevented diseases or conditions. But the fact is that the more years of life we gain, the higher chances to suffer from various unrelated diseases, which are more expensive. Another issue, yet a technical one, is distinguishing between related and unrelated costs. If we prevent a single disease, e.g. any type of cancer by regular screening, it is easier to categorize costs. However, if we are dealing with primary prevention – smoking cessation, physical activity promotion, etc. – we are largely exposed to uncertainty because lifestyle tends to have an impact on a large variety of health conditions (Meltzer). Nonetheless, researchers have developed necessary techniques. According to van Baal *et al.* (2007), a disease is related if it has a relative risk greater than one. However, while estimating future medical costs after quitting, researchers are confronted with another issue – relative risks of different disease groups are known to be distinctively effected by the time since cessation, some positive effects occurring faster, while others – later in life (Rasmussen *et al.*). Consequently, it brings some uncertainty, yet only for the scope of cost reduction and not for the final outcome as such.

Connecting health care costs with quality-adjusted life, the latter study states that "the gain in QALYs during life years that would also have been lived without interventions, cannot be attributed to medical care for unrelated diseases". This implies that differences of health care costs of unrelated diseases are present if and only if life prolonging interventions are enforced. This conclusion is somewhat contradictory to the previous work by Meltzer. He claims that the resulting QALYs are a product of both – interventions and unrelated medical care at the same time, or at least, one cannot tell whether a QALY did result from a related or unrelated medical care. Smoking cessation interventions, if successful, all seem to add more life years to one's life. Thus, as it was also concluded in van Baal *et al.* (2007), unrelated costs should be included into analysis to compose a meaningful decision problem.

To sum it up, in a short run smoking cessation seems to be cost saving from a health care provider perspective. However, once we take a lifetime point of view and account for all future health care spending, outcomes are reversed and former smokers are gradually approaching health status and costs similar to those of never smokers. Not to mention the fact, that methodology-wise it seems to be a more correct way to deal with this category of costs.

Impact of a smoking status on workplace absenteeism and productivity loss at work

Not only are smokers bound to experience various health problems over their lifetime but they are also considered to be less efficient at work, be it through taking numerous smoke breaks or absenteeism from work due to sickness or disability. It generates indirect smoking losses for both employers and society as a whole. The questions are whether this adverse effect can be measured objectively, if so, how large it is, and what evidence literature can provide us with. I will attempt to answer them hereafter.

Smoking-related sick leave

Generally, researchers tend to encounter various methodological difficulties while trying to measure absenteeism rates of smokers and former smokers, such as sample selection bias, sick leave reporting bias, health-related behaviours reporting bias, health-related selection (smoking cessation might be more common among those, who already have health problems[6]), and industry-specific or even country-specific factors. For example, workers from countries, where sick leave is being fully reimbursed by employers or a state itself, are more likely to report higher absenteeism rates as opposed to countries, where it is only partially covered by social security funds.

One thread of literature analyzes sick leave patterns of two population groups – smokers and non-smokers. Lundborg (2007) examined the effect of smoking on sick leave days. He found smoking to increase the length of sick absence by 54% compared to never smokers in Sweden at the time this research was carried out. The author expected quitting to contribute to improved labour performance substantially. A similar comparison was made in a Dutch study by Robroek *et al.* (2010). They conducted a cross-sectional study on the role of lifestyle behaviours in a productive workforce, using a sample of 49 Dutch companies in 2005-2009. Smoking, together with obesity, appeared to be most detrimental in terms of sick leave prevalence and its duration. The population attributable fraction (PAF)[7] for sick leave related to smoking was 4.1% (multivariate OR 1.14, 95% CI: 1.06-1.28). This means that 4.1% of sickness cases can be avoided if all employees would change their unhealthy behaviours and quit smoking, all other factors remaining fixed. Smokers were most likely to go on sick leave of 10 to 24 days a year.

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[6] Laaksonen *et al.*, 2010

[7] PAF = Pe(OR-1)/((1+Pe)(OR-1)), where Pe is the prevalence of study population, OR is odd ratio.

Yet, this study has a few drawbacks, such as a short period of investigation (one year) and self-reported sick leave frequency.

Other studies included quitters as a separate group. Halpern *et al.* (2001) studied workers of one US airline company. They found that the difference of sick leave days between smokers and former smokers was significant. Ex-smokers had 40% less absenteeism than current smokers (comparing mean values). Another emphasis of the study was a finding that "former smokers experienced a decrease of 0.1 absenteeism days <…> for every year of smoking cessation" and this amounts to a relative 2.5% annual reduction in sick leave. The latter impact of time since cessation on absenteeism also proved to be significant. However, study population (small, younger than average, and female-dominated) might have greatly influenced the outcomes, thus, any generalization of the results has to be cautious. Laaksonen *et al.* (2010), similarly to Robroek *et al.,* came to a conclusion that smoking and relative weight are most strongly associated with workplace absenteeism. Contrary to Robroek *et al.,* the authors investigated medically confirmed sickness absence spells per 100 person-years (an alternative outcome measure), and used a follow-up period (3.9 years). They also distinguished between men and women, heavy and moderate smokers, and adjusted with psychosocial/physical working conditions and occupational classes. Heavy smoking almost doubled the risk for sickness absence. Whereas, former smoking only slightly increased sick leave, reaching statistical significance solely for women (PAF of ex-smoking was 2.9%). As for psychosocial and physical working conditions as well as social classes, these factors only slightly explained the size of the relationship. The results are admitted to have a potential bias due to the assessment of health-related behaviours, which was only done at a baseline.

To sum it up, a vast majority of articles, to a lesser or greater extent, come to the same conclusion that smokers are exposed to higher sickness rates, whilst, former smokers improve their productivity by reducing a number of sick leave days. Therefore, smoking cessation or smoking initiation prevention may be a remarkable contribution to keeping productive workforce and providing substantial gains in work ability. A previously discussed Danish research by Rasmussen *et al.* measured productivity savings (gains) related to smoking cessation, which, as expected, greatly depended on quitting age. Smokers, who successfully quitted between 35 and 55 years old, demonstrated the most sizeable effects. In relative measures, productivity savings varied from 25% to 38%, depending on previous tobacco consumption intensity (whether it was light, moderate, or heavy) and gender (women produced higher benefits). Nonetheless, researchers are still being cautious about the causality relationship of those effects.

Presenteeism losses

Academic society tends to agree that smoking habits lead to increased absenteeism. However, productivity at work is a less clear issue and the results are rather diverse. American study by Bunn *et al.* (2006) demonstrated that current smokers had experienced more unproductive time at work than former or never smokers. This contributed to more than a half of average annual loss of labour productivity due to smoking, with the rest part being caused by sick leave. On the other hand, there is a contradicting strand of literature. For instance, Alavinia *et al.* (2009) conducted a survey-based research about self-reported productivity loss at work due to various conditions, either individual or external, among employees from 24 different companies in The Netherlands in the period of 2005-2006. They indeed did find a positive relationship of health problems with reduced perceived productivity. However, smokers reported less productivity loss (odds ratio fell below 1 – OR 0.78, 95% confidence interval: 0.64 – 0.95). Authors suggest a reporting bias to have had a large effect on this outcome. A stringent smoke-free policy was adopted in all workplaces in The Netherlands, the main reason being productivity loss incurred by smokers, who might have felt a need to prove that nonetheless, they are as productive as non-smokers. Yet, another previously mentioned recent Dutch study by Robroek *et al.* confirmed the same finding. They found no association between smoking and the presence of productivity loss at work (OR 0.98, 95% CI: 0.89 – 1.07). And only for higher levels of loss, i.e. 20% and ≥ 30%, odd ratios were above 1 – 1.25 and 1.45, respectively. Due to the lack of supportive evidence (particularly in the Dutch study), I will therefore exclude presenteeism costs from the SROI model.

To conclude, I have demonstrated various effects of smoking status on health care expenditure and workplace productivity in different research settings. Apparently, these two categories are the main drivers in CBA of smoking cessation – the difference of medical costs being most likely positive (thus, a cost to society) and productivity levels increasing (thus, a social benefit) after cessation. Therefore, my subsequent choice is to quantify absenteeism reduction and health care consumption levels as a consequence of quitting, leaving intangible costs as well as presenteeism losses out of a scope of the model.

Chapter 3

Methodological issues in economic evaluations of interventions

Due to the scarcity of resources, economic analysis of alternative programs and services in order to determine what to fund is necessary. Amongst them, cost-effectiveness analysis (CEA) has been the most widely used in health sector so far (Claxton *et al.*, 2010). Interventions are evaluated by their costliness for every unit of health gain, e.g. a quality-adjusted life year. An undertaken perspective plays the biggest role in determining those costs. It can either be the one of a health care provider, which implies accounting only for intervention costs and corresponding health care expenditure as a result of quitting, or a broad social perspective, which includes all short and long term costs and benefits, irrespective of a concerned party, paying the costs and/or getting the benefits.

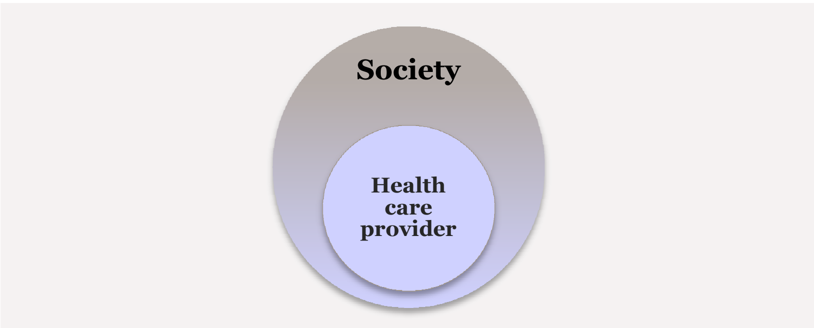

Figure 2. Different perspectives towards economic evaluation of interventions.

Economists generally prefer the social perspective, particularly if positive or negative externalities are involved. However, health care interventions are still being evaluated under a variety of instruments and methodological approaches, causing comparability problems. Consistency and reliability of cost-effectiveness ratios have long been a subject of discussions as well. And even if we came up with a good ratio, another concern would be a selection of criteria to determine which interventions are socially acceptable, given their costs, efficacy, and social considerations beyond monetary arguments. Hence, the aim of this chapter is to give an overview of major methodological issues, so that to learn the lessons and apply those findings to my own estimations.

A search of a consistent cost-effectiveness ratio

I have already briefly discussed the matter of related and unrelated health care costs and whether to account for them or not in Chapter 2. I will now specify an importance of this issue for estimating cost-effectiveness ratios (CERs) and evaluating different interventions. Van Baal *et al.* (2007) studied four different cost-utility (-effectiveness) ratios in order to examine which one is the most consistent. Researchers used internal consistency[8] criterion, described in an earlier study by Nyman (2004).

The inclusion of only incremental intervention costs or incremental intervention costs together with health care costs due to smoking-related diseases were concluded to produce internally inconsistent CERs, since QALYs might be the result of both – related and unrelated – medical care. This problem can be solved by subtracting QALYs gained by unrelated medical care from total QALYs and taking intervention costs with related health care costs on the cost side. Yet, it is hard to get reliable data and make a use of this ratio. All health effects (ΔQALYs) and all medical ($\Delta c_{\text{related}} + \Delta c_{\text{unrelated}}$) and intervention costs (Δc_i), necessary to achieve them, were included into the fourth ratio and produced an internally consistent cost-effectiveness ratio:

$$\text{CER} = \frac{\Delta c_i + \Delta c_r + \Delta c_u}{\Delta \text{QALYs}} \quad (1)$$

[8] All costs that directly produce the outcome of interest (i.e. QALYs) should be included.

Empirical research done in the same study by van Baal *et al.* confirmed the notion that in this case, decision makers might favour interventions for younger population to the ones, targeting the elderly, due to the fact that unrelated costs for the elderly go up substantially as health gains occur in a relatively short term. This can be viewed as a conflict with social objectives (for instance, of health care systems), such as equal rights to treatment or service no matter what the recipient's age is (Claxton *et al.*). Alan Williams, the famous British health economist, suggested to introduce an additional ethical tool (in particular age-weighting) to a current CER formula in order to reduce social disparities. He is known for an exploration of a "fair innings" argument (Williams, 1997), which, as opposed to the previously expressed egalitarian argument, states that the young should be preferred over the elderly, looking at the whole lifetime experience. The reason is that older people have already lived long (and healthy) lives and also have a lower capacity to benefit from a given health intervention (Williams & Cookson, 2000). Overall, both – economic and equity – arguments do suggest to invest in younger generation.

What is more, a study by van Baal *et al.* only partially agreed with a preceding work by Meltzer, which concluded that all costs have to be taken into account to get consistent results for lifetime utility maximization problem. Meltzer suggested that not only total health care costs had to be accounted for but also external effects, such as non-medical consumption and productivity, which generally fall outside health care budget planning. For this reason, Claxton *et al.* argued that it is doubtful whether this social perspective helps for policy makers, above all, if transfers between sectors, which would internalize costs and benefits external to health care system, are not feasible. Nevertheless, Claxton *et al.* adopted this social perspective to demonstrate how decision making works under different approaches and what kind of biases a different concept may create. Similarly to Meltzer, the authors employed future consumption as a cost to society and derived a parameter called net consumption costs (individual consumption net of individual production). They examined three different responses to the resource allocation problem:

1. Ignoring costs/benefits outside health care sector;
2. Taking external costs/benefits into budget constraint;
3. Ignoring any budget constraint.

Illustrating the first case, the authors suggest to assume that health benefits are higher than incremental costs necessary to achieve them, and positive consumption costs are neglected. Consequently, a decision in favour of an intervention would be made when in fact, it should be rejected. Thus, we have a positive bias. However, similarly to Garber & Phelps (1997)[9], it is claimed that an inclusion of all costs and benefits is not always necessary. To be precise, if we assume that net consumption benefits (individual productivity gain is higher than additional consumption) are closely related to improvements of health, then those interventions or technologies, which were regarded as cost-effective and provided net health benefits, would also tend to offer net consumption benefits.

By and large, there is little consensus as for a construction of a reliable cost-effectiveness ratio. Yet, we can already notice a move towards a social perspective, even though, there are several pitfalls for employing those ratios for the health care budget allocation problem. I will make a reference to the used methodology, while providing literature evidence on cost-effectiveness of particular interventions in Chapter 4, in order to explain diverging results of different papers.

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[9] They argued that "if future costs were truly unrelated, it did not matter whether such costs were included or excluded, as long as the cutoff CER, above which the costs of health expenditure would exceed the value of the resulting benefits, were properly adjusted".

The Dutch value of a quality-adjusted life year

A decision on a choice of interventions can either be based on net health or monetary benefits (Stinnett *et al.*, 1998, as cited in Claxton *et al.*) or by comparing CERs to a cost-effectiveness threshold (Johannesson *et al.*, 1993, as cited in Claxton *et al.*). The former instrument seems to be more consistent with the notion of Welfare Economics and indicates a verge of costliness, above which society is no longer better off. For this purpose, a decision maker needs to know a perceived value of a QALY. However, as discussed in Bobinac *et al.* (2010), this seems to be a weak point in health economics, due to a lot of limiting factors, such as individual versus social approach, ex-ante versus ex-post valuation problem, income dependency (the wealthier you are, the more you are willing to pay for a gain in quality of life), the importance of a health problem to be avoided (the more severe it is, the higher one's willingness to pay for a QALY). The existing thresholds used for the decision making so far are commonly broad and lack empirical evidence (Eichler *et al.*, 2004, as cited in Bobinac *et al.*). Therefore, the same study by Bobinac *et al.* aimed at "eliciting the first empirical estimate of the monetary value of a QALY in The Netherlands". Up until now Dutch researchers have been using the upper threshold of € 80,000 proposed by RVZ[10]. Bobinac *et al.* conducted an individual valuation exercise of respondents' willingness to pay (WTP) for avoiding the move from the better to the worse health state, and divided it by QALYs difference of those two states. A general finding was a maximum WTP per QALY equal to € 24,500. It might as well be an underestimation since a sample population were in a relative good health, possibly less willing to pay more for avoidance of health problems. As foreseen, WTP was positively related to income level and a size of a health gain. The largest

[10] Council for public health and health care in the Netherlands.

income group (> € 3,499 per month) were willing to pay the amount of € 55,900 per additional QALY – a significantly higher value than the average estimate.

The authors found a considerable fluctuation of valuations. This weakens a case of generalization of WTP per QALY and may also have policy implications, when a provision of a more expensive intervention might be restricted for wealthier people, whose perceived benefits are actually higher than costs incurred. Or on the other hand, it may be granted to those who value it less. Some sort of equity weights need to be introduced in order to solve this problem. Besides, findings are normally sensitive to elicitation techniques (be it a formulation of questions, a range of values suggested, or a proposed method of payment for the health improvement). The authors of the paper do agree that this has only been the first contribution to the creation of a sound methodology.

An in depth look at cost-effectiveness analysis of health care interventions provided a better picture of different approaches and their advantages and disadvantages. An idea of a social perspective seems to be more and more accepted, elaborated, and applied by researchers. And considering various flaws in QALYs approach and a lack of well established monetary value for a single QALY, it seems to me that smoking cessation interventions should be analyzed by the means of social CBA (or a social return on investment analysis), which, in fact, would not be too far away from cost-effectiveness analysis including external effects (i.e. Meltzer's suggested approach). In addition to that, including the value of a QALY in estimations always results in a positive outcome, thus, providing no clear answer to the question of resource allocation and distribution. Therefore, I am convinced that an examination of only tangible effects is more informative for policy makers.

Chapter 4

Estimated cost-effectiveness of smoking cessation interventions

Tobacco control strategies, namely cigarette taxes, smoking and advertising bans or mass media campaigns, can be insufficient to overcome the addiction factor of tobacco (MPower, 2008). Whereas, individual cessation aids, counselling and pharmacological therapies, are known to be highly effective, yet of limited availability. Therefore, it is recommended to apply both type of instruments at the same time to reinforce the effectiveness; a selection of an economic policy package is equally important. In this chapter I will discuss cost-effectiveness figures of individual and population level interventions, estimated in various Dutch and international studies, in order to provide an idea which interventions work better than others and to build up a background for a choice of an optimal set of interventions.

Cost-effectiveness of individual level interventions

Individual cessation support interventions include brief physician advice, (telephone) counselling, or any of those two combined with nicotine replacement therapy (NRT)[11] or bupropian[12]. Since bupropian is known to have adverse effects for quitters' health (Woolacott *et al.*, 2002), I will only focus on NRT. Contrary to population level interventions, which are hardly evaluated due to various uncertainties, most of individually-tailored cessation aids can be examined in clinical trials. Therefore, effectiveness indicators could be considered to be more reliable.

[11] NRT is a pharmacological assistance to abstain from smoking by replacing nicotine previously obtained by consuming tobacco products.
[12] Bupropian is an atypical antidepressant drug that reduces withdrawal symptoms.

World Health Organization is aiming to achieve that identification of tobacco users and a provision of brief advice would be integrated into primary health care systems and would also include follow-ups and reinforcement of quitting efforts. The Dutch Health Ministry has approved a similar policy, including smoking cessation aids into the national health insurance package, which is due to come into force from the 1st January, 2011. The annual limit of reimbursement is expected to be up to € 250 per year (ITC National Report: Netherlands 2010). Vemer *et al.* (2009) attempted to evaluate long-term effects of smoking cessation support reimbursement for medical expenditure by using a randomized clinical trial (a trial of 6 months of reimbursement). The authors of the study came to a conclusion that this policy would lead to more successful quitters (0.2% increase) and improved quality of life at relatively low expenses and, what is also important, it can even be considered to be cost-effective from the perspective of a health care provider. Depending on a time horizon considered, be it 20 or 100 years, total costs per QALY gained were estimated to be € 3,930 and € 4,450, respectively; the main cost driver being unrelated health care costs (see Figure 3).

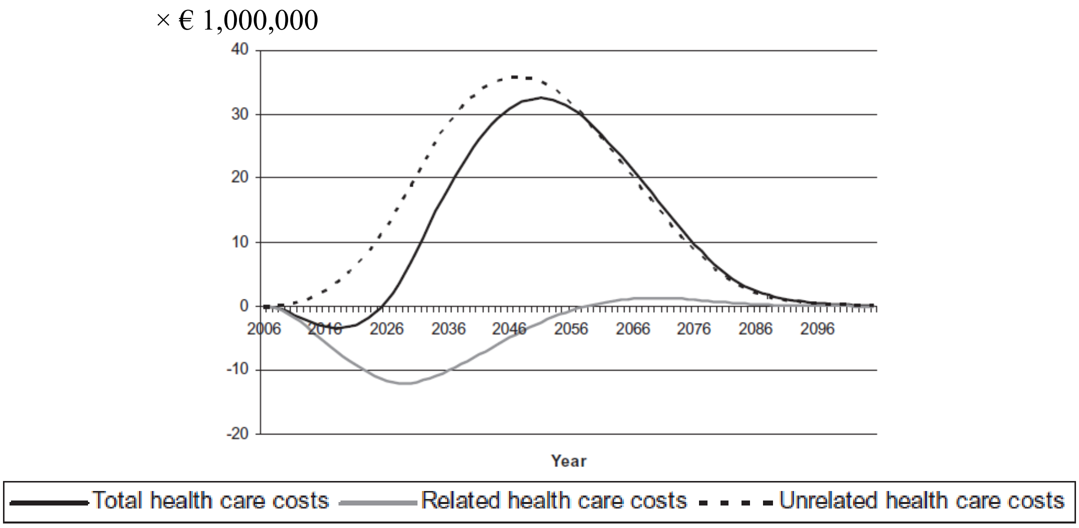


Figure 3. Difference between reference case and trial-based NRT reimbursement scenario in The Netherlands in costs (× € 1,000,000). Vemer *et al.* 2009: 1093.

Nicotine replacement therapy (NRT) is a medication which can substantially raise natural quit rates by increasing the likelihood of abstinence after six months from 70%, achieved by nicotine gum, to 130%, achieved by nasal spray (MPower, 2008). Woolacott *et al.* performed a systematic review of the cost-effectiveness of NRT in UK. Their study revealed that average intervention (advice only) costs per quality-adjusted life year had varied from € 76 to € 229 (2001 price level), depending on the number of QALYs gained per person. Cost-effectiveness of intensive counselling ranged from € 255 to € 383. Nicotine replacement therapy combined with either brief advice or intensive counselling produced cost-effectiveness ratios between € 459 and € 2,682, again depending on the quantity of QALYs gained per quitter. In WHO Europe report "Which are the most effective and cost-effective interventions for tobacco control?" (2003) it was concluded that nicotine replacement therapies in high income countries cost from € 788 to € 1,226 per QALY (2001 price level). In Eastern Europe and Central Asia costs were significantly lower, varying from € 240 to € 261 per QALY (2001 price level).

A similar study by Feenstra *et al.* (2005) showed that the cost-effectiveness figures were higher in The Netherlands, compared to Woolacott *et al*. findings or WHO report. However, methodological differences of calculating effectiveness ratios are most likely to explain the higher costs in The Netherlands. For instance, Feenstra *et al.* took relapse rates into account, which substantially increased costs per QALY. Brief advice intervention costs per QALY gained were estimated to be € 3,900 (or rose to € 9,100, including the difference in total health care costs). Cost-effectiveness of intensive counselling with NRT or GP brief counselling with NRT ranged from € 8,200 to € 11,400 (taking total health care cost differences as a consequence of quitting smoking into account, the corresponding cost rose up to € 13,400 – € 16,600).

Given the efficacy of all described interventions, a reasonable suggestion is to increase access to cessation therapies, particularly brief advice or intensive counselling.

Cost-effectiveness of population level interventions

A variety of policy tools targeting the whole population is a little broader. The most common are the following:

1. Taxes on cigarettes;
2. Advertising and promotional bans;
3. Legislation for a smoke-free environment;
4. Mass media campaigns, educating consumers.

According to ITC National Report, The Netherlands has included all these measures into the national anti-smoking policy package. A key advantage of these instruments is that they are relatively cost-free, except for anti-smoking campaigns in mass media, where one has to pay for the coverage. I will now analyze the main interventions and their effectiveness in more detail.

Increases in cigarette taxes tend to result in a significant reduction of smoking prevalence. Chaloupka *et al.* (as cited in Disease Control Priorities in Developing Countries, 2006) estimated that a 10% rise of cigarette retail price would on average trigger a 2.5 to 5.0 percent drop in smoking, which in turn means that the government will collect more tax revenues, implying a ‘win-win’ situation – less smoking and additional income for the national budget.

Van Baal *et al.* (2007) in their research paper "Increasing tobacco taxes: A cheap tool to increase public health" distinguished three approaches to cost-effectiveness of tax increase:

1. Intervention costs per QALY gained;
2. Intervention costs and health care cost difference due to smoking-related diseases per QALY gained;
3. Intervention costs and total health care differences per QALY gained.

The authors of the article dissociated from any tax implementation or law enforcement costs and tax revenues, since they "normally fall outside the health care sector". As a result, it was costless to gain a QALY by the means of taxation. The second case was cost saving, since the incidence of smoking-related disease had fallen. And only the third method led to positive cost-effectiveness ratios, which, depending on a time horizon and an assumption of a 10% cigarette price increase, ranged from € 2,000 to € 2,500 per QALY gained. However, according to the same study, only 3% of accumulated tax revenues would theoretically be enough to cover additional health care costs if they were to finance health care budget. RIVM[13] reported the costs to be € 5,200 per QALY gained, yet they used an assumption of a 20% price increase.

It is commonly agreed that the youth are more sensitive to price increases. Another study by DeCicca & McLeod (2007) focused on the responsiveness of older (45+) smokers and smokers of different demographical and social characteristics. Contrary to a common belief, they found a significant smoking prevalence reduction among older adults due to tobacco tax ($ 1 increase in tax led to 1.4% pt reduction of smoking participation). The intuition behind is that the youth will react to additional taxes by less initiation; whereas, older adults will demonstrate larger cessation elasticity.

[13] National Institute for Public Health and the Environment in The Netherlands

In addition to that, smokers of lower income and education, as well as smokers with poorer health, tend to be more price sensitive, as we might expect them to be.

DeCicca *et al.* (2008) went even further and carried out a longitudinal empirical study, decomposing smoking participation into smoking initiation and cessation. They showed that the price elasticity of smoking initiation tends to drive the price elasticity of youth smoking participation, while the price elasticity of smoking cessation plays a more important role in the price elasticity of adult smoking participation. Thus, their conclusion was also opposite to a conventional wisdom that cigarette price increase had a larger effect on younger smokers. According to authors, tax made no impact for smoking initiation rates but positively affected smoking cessation, meaning that adults may after all be more tax-responsive than adolescent.

Smoking ban is another instrument in comprehensive legislation regarding smoking. A primary purpose of introducing bans was a protection of people who suffer from a secondhand smoke. This is also a supportive environment for smokers who are attempting to quit. Callinan *et al.* (2010) reviewed 50 studies on effectiveness of smoking bans. It appeared that “an introduction of a legislative smoking ban does lead to a reduction in exposure to passive smoking”. However, the evidence of effectiveness to reduce active smoking was scarce. There was also some evidence of improved health status. However, to date there are no cost-effectiveness studies written on this legislative intervention. And only cost-benefit analyses have been carried out. Spreen & Mot (2008) performed a CBA of a smoking ban in the Dutch hospitality industry in 2008. They estimated a significantly positive balance: benefits exceeded costs by 75 mln. euros. Costs mainly comprised of pension benefits and health care expenditure related to more life years. Whereas, benefits were induced by decreased health damage of active and passive smokers, increased productivity of hospitality workers, and less fire damage. The basis for their estimations was a 30% reduction of exposure to ETS after the ban had been introduced.

One more important population level intervention is mass media campaigns (MMC). They are also difficult to objectively evaluate because "tobacco policies and media campaigns often co-occur, complicating assessment of the relative contribution of each" (Wakefield *et al.*, 2008). The same study performed a time-series analysis with Australian data on anti-tobacco campaigns. The model demonstrated that the effects of tobacco control advertising on smoking participation occurred very fast, yet the decline in smoking was temporary unless MMC was continued. Thus, it seems to be important to communicate the message regularly. Fishman *et al.* (2005) also proved that mass media campaigns are a powerful tool to reduce adolescent and young adults smoking prevalence particularly combined with the increase of cigarette costliness. Intervention cost-effectiveness ratios ranged from $ 2,000 to $ 9,000 (€ 1,588 to € 7,147, respectively), depending on the choice of discount rate, using a $ 1 costs per capita media program (2004 price level). Feenstra *et al.* claimed intervention and additional healthcare costs per QALY gained to vary from € 5,200 to € 6,100 (2004 price level), based on US data, adjusted to the magnitude of the Dutch mass media campaign.

According to Feenstra *et al.*, the most cost-effective interventions, either individual or population level, appeared to be minimal and GP counselling, intensive counselling provided by a general practitioner (with NRT), taxes, and mass media campaigns. The summary graph is presented in Figure 4.

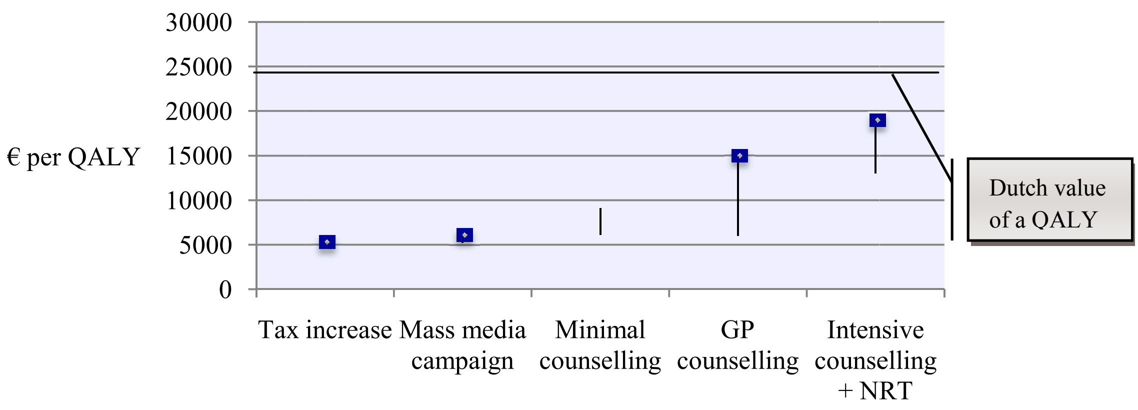


Figure 4. Cost-effectiveness of interventions in the Netherlands.

To conclude, a vast majority of cost-effectiveness figures are estimated from a health care provider perspective. In spite of that, the estimates in literature are very diverse due to different techniques and assumptions, and any comparisons should be carefully made. Nevertheless, it does support the argument that the QALY value threshold does seem to be a weak condition for CEA because it is nearly always satisfied (see Figure 4). Besides, due to a specific perspective undertaken, none of interventions were cost saving since all external benefits were neglected. In my opinion, a social perspective might even compliment CEA, and an optimal set of interventions should be selected, providing the best ratio of cost-effectiveness and external (productivity) benefits. In addition to previous remarks, tax experience suggests that different people react to interventions differently. Thus, it might be a good idea to investigate an age-dependent effectiveness of other interventions as well.

In the next chapter I will introduce the model, which helps to evaluate different interventions in a Dutch situation by attaching social ROI ratios to the combination of tobacco control policies, cessation aids, and interventions. Due to comparability issues with other countries, I will rely on the Dutch study about cost-effectiveness of smoking cessation interventions (Feenstra *et al.*).

Chapter 5

Methods and data of an SROI model

My model will be based on a social cost – benefit analysis (CBA), which will eventually be turned into return on investment ratio. However, my purpose is not to compare return on investment ratios of different interventions in order to recommend the most lucrative one, as it is a common practice with CBA, but rather to prove that there is a positive ROI in a comprehensive smoking policy for the whole society and it should be of a social interest of a benevolent government or, once transfers between sectors become viable, of a public-private partnership to adopt it. In this chapter I will describe the underlying ideas, methods, and approaches of the model, as well as data and its sources.

A design of the model and approaches

I assume that there are two polar policy options available (see Figure 5). A country, i.e. The Netherlands in our case, can either chose to enforce a tobacco policy package, composed of various interventions, depending on cost-effectiveness preferences, or it can take no additional effort to reduce smoking prevalence and rely on natural quitting rates.

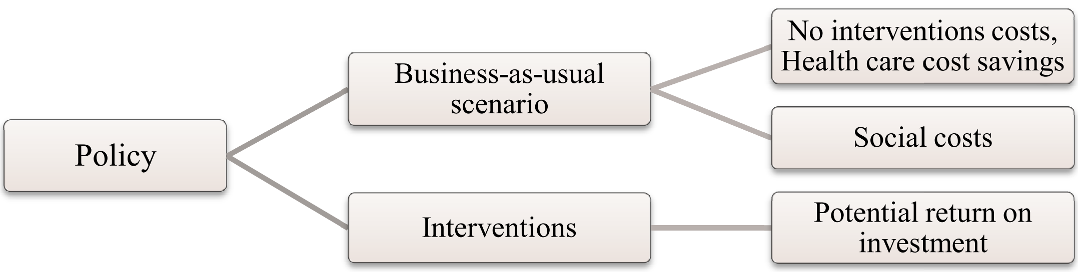


Figure 5. Two scenarios for smoking policy.

One may refer to the latter policy option as a "business-as-usual" scenario. As a result of it, a society is exposed to larger social costs than it would otherwise be if interventions were implemented. On the other hand, we have cost savings in a form of lower lifetime health expenditure for continuous smokers and spare financial resources not spent on interventions.

A general scheme of effects and their directions, which I will investigate, is presented in Figure 6.

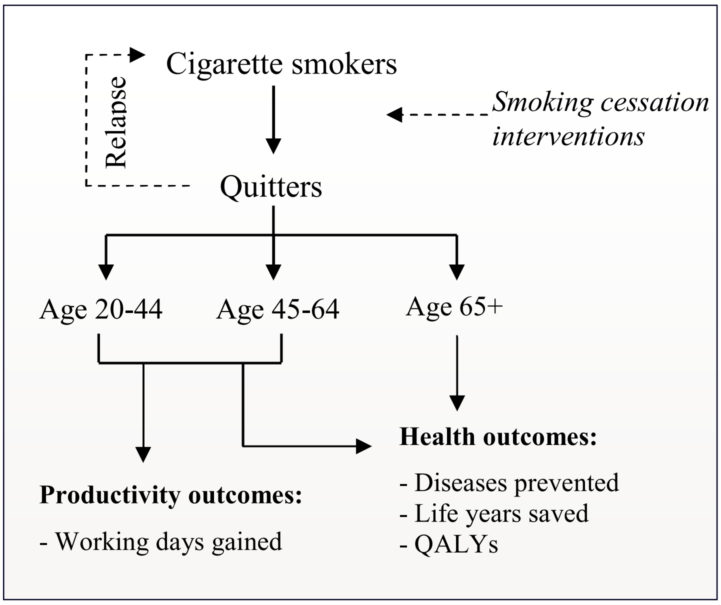


Figure 6. A design of a SROI model for smoking cessation.

Under the influence of smoking cessation interventions, current smokers were found to attempt quitting more frequently compared to the business-as-usual scenario. Nonetheless, a part of new quitters relapse after some time. The rest become successful quitters. This cohort of population will be of my interest further on. In addition, the age of quitting is crucially important for benefits and costs accrued since the time of cessation. Therefore, I will take this aspect into account by forming three age groups: 20 – 44 years old, 45 – 64 years old, and 65 and older. The first two cohorts are known to experience both, productivity and health, effects. Whereas, smokers who quit after the age of retirement will no longer be contributing to labour force productive capabilities and will only be subject to health effects.

The central question will be what the return on investment in smoking cessation interventions is. ROI is calculated in the following way:

$$\text{ROI} = \frac{(\text{Benefits of investment} - \Delta\text{Health care costs}) - \text{Costs of investment}}{\text{Costs of investment}} \quad (2),$$

where: $\Delta\text{Health care costs} = \Delta\text{HC costs (unrelated)} + \Delta\text{HC costs (related)} \quad (3).$

A specification of costs and benefits included into the estimation of ROI is presented in Table 1. In my analysis benefits of investment in the expression (2) are limited to productivity gains by reduced sick leave alone. If a result in (3) is positive, it comes as a net loss for society.

In order to compare future streams of costs and benefits for each group of quitters, I will discount future values with a discount rate of 4%[14]. This approach towards productivity costs/benefits is known as a human capital approach – worker's future production is brought back to present values by the use of an appropriate discount rate (Collins & Lapsley; Oostenbrink *et al.*). Alternatively, a friction cost approach[15] can be adopted. Yet, it is more relevant for early retirement loss and dropping out of labour force evaluation. Human capital approach is agreed to be more applicable to CBA (Collins & Lapsley). Besides, as I already mentioned in Chapter 2, I am going to neglect early retirement factor because of a friction cost argument and a limited access to data.

[14] Recommended by Oostenbrink *et al.* (2004).
[15] The productivity loss is measured by the time it takes companies to restore initial production level. This includes lost production (human capital approach) and recruitment and training costs. Usually these costs appear to be significantly smaller than calculated with human capital approach (Claxton *et al.*).

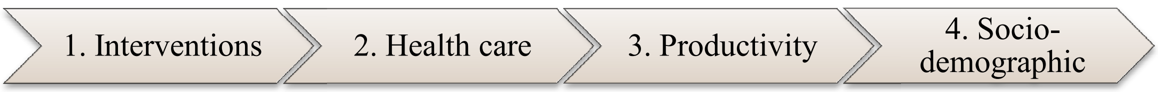
Table 1. Tangible costs and benefits of smoking cessation.

Smoking cessation costs for welfare	***Smoking cessation benefits for welfare***
Intervention costs	Higher productivity of the workforce
Health care costs due to unrelated diseases	- Less sick leave
	Reduction of health care costs due to related diseases

Productivity levels of smokers and quitters will be determined by different absenteeism rates (sick leave from work). I have also decided to leave out presenteeism due to conflicting findings in literature and a lack of evidence in the Dutch situation. What is more, I will also assume that productivity levels and health care costs are fixed over time (no technological or economic progress). The reason is to provide a consistent outcome, since estimates of health care costs taken from an RIVM report were derived in this manner. As far as non-financial benefits are concerned, I will not include them into ROI calculation, since the value of a QALY has appeared to be arguable (see Chapter 3). This indicator will serve as a descriptive outcome of smoking policy to illustrate the benefits enjoyed by individuals.

Data description

The model will be based on four data categories:



I will briefly describe each cluster by either providing the data straightaway or referring to information sources. Due to the lack of recent data, I will operate with costs and benefits in 2004 – 2005 price level and demographical data of 2005. Technically, it does not have any impact on the final outcomes, since ROI is a ratio, and inflation would have effected both – a numerator and a denominator – equally.

Interventions

The main source of data on interventions and their parameters is two RIVM reports: "Cost-effectiveness of interventions to reduce tobacco smoking in The Netherlands. An application of the RIVM Chronic Disease Model" (2005) by Feenstra *et al.* and "Kosten en effecten van tabaksontmoediging" (2007) by Vijgen *et al*. The latter was only available in Dutch.

A list of selected interventions is presented in the following Table 2. The choice was based on cost-effectiveness levels and a relative easiness of implementation in The Netherlands.

Table 2. Description of interventions.

Intervention	Abbreviation	Description
Individual level		
Minimal counselling	MC	A short (1 to 12 minutes) counselling by general practitioner (GP) or assistant
GP counselling	H-MIS	1 or 2 consultations by GP and/or assistant
Intensive counselling + nicotine replacement therapy	IC+NRT	40 –110 minutes of intensive counselling by a trained counselor combined with NRT for an average period of 12 weeks
Population level		
Mass media campaign	MMC	Publicity via TV, radio and newspapers, provision of leaflets, billboards, and educational messages
Tax increase	TI	Cigarette price increase of € 0.25/ € 0.5

Source: Feenstra et al.: 23.

The costs of interventions were evaluated from the health care perspective (except for the costs of mass media, which were based on previous anti-smoking campaigns in

The Netherlands and their incurred costs to achieve a planned coverage) and adjusted to a 2004 price level (see Appendix C).

Effectiveness was measured in terms of increased cessation compared to the reference scenario (no interventions or a placebo instead of medication). Naturally, estimates were related to the reach of interventions and were derived from international and, when available, Dutch literature or scientific trials (see Appendix C).

Health care data

Lifetime health care cost changes due to smoking cessation were derived from RIVM Chronic Disease Model (CDM) and computed in euros per additional quitter:

Table 3. Results per additional quitter in different age groups.

Age group	**20-44**	**45-64**	**65+**
Difference in health care costs of smoking related diseases [a]	– € 1,000	– € 1,100	– € 200
Difference in health care costs of all other diseases [a]	+ € 1,700	+ € 3,200	+ € 1,700
Differences in total health care costs [a]	**+ € 700**	**+ € 2,100**	**+ € 1,500**
€ per QALY gained [a b]	€ 2,900	€ 6,300	€ 16,900

[a] Discounted at 4%, [b] Difference in total health care costs divided by gain in discounted health adjusted life expectancy

Source: Feenstra et al.: 32.

Given estimates of health care costs resulted from an annually changing demographical situation (in terms of age, gender, and smoking prevalence). Researchers also took into account relapse rates, which were a function of time since cessation. In addition to that, risks of smoking related diseases diminished gradually. Last but not the least, cost levels were kept fixed, in this way assuming there is no technological or economic progress.

Productivity data

Productivity level will be measured by annual labour costs[16] (see Table 4), which was € 47,700 per worker in 2005. I will assume that costs are equal in all age groups, i.e. an employee of 25 incurs the same costs as an employee of 40 years old or any other age.

Table 4. Structure of annual labour costs in The Netherlands, 2005.

Year		Structure, % total structure			
	×1000 EUR	Wages	Direct wages and special payments	Social premiums	Other costs
2005	47.7	76.9	66.6	21.0	2.1

Source: CBS Statistics Netherlands.

Another important figure is the number of employed labour force. In 2005 there were 7.33 mln. workers in The Netherlands aged 20 to 65, and 16.2% of them worked part-time, i.e. ≤ 19 hours per week *(source: CBS Statistics Netherlands).*

Average work absenteeism in The Netherlands is measured by yearly absence rate, which is the number of days an employee is absent due to sickness as a rate of the total number of calendar days available in the period under review (258 days in 2005). The total sickness absence rate includes absence up to a maximum of two years, and is exclusive of pregnancy and maternity leave. In 2005 (latest available data) a yearly absence rate was 4% or 10.32 days on average (4% × 258). *(Source: CBS Statistics Netherlands)*

Productivity loss will be measured by the difference of sickness absence between a non-smoker and a smoker, which will be assumed to be caused by smoking. Similarly, the difference of sick leave days between a quitter and a never smoker is also due to former smoking. I have decided to use a previously discussed Swedish study by

[16] Recommended by Oostenbrink *et al.*

Lundborg (see Appendix D for empirical results), even though, a recent Dutch study by Robroek *et al.* has been conducted. The reason is that the latter work is dealing with odd's ratios that give no insight into the amount of sickness days. Whereas, Sweden and The Netherlands have similar smoking prevalence figures and both had historically high absenteeism. Therefore, the findings in Lundborg's paper are a good approximation for my model. What is more, the Swedish study relied on national data, which makes it superior over other papers examining samples of selected companies (also Robroek *et al.*). I will adjust Swedish sick leave data and the findings to the Dutch situation by assuming that effects are proportional.

Lundborg concluded that the mean value of sick absence in Sweden had been 25.22 days (in the years under review) and never smokers had been absent for 19.93 days, i.e. 21% below average. Assuming that this proportion is the same in The Netherlands, Dutch never smokers are absent for 8.15 days a year ((100% – 21%) × 10.32 days average sick leave). For corresponding sick leave of former smokers, I am going to use the results of OLS regression (see Appendix D). Smoking was found to increase the annual number of days of absence by 10.7, compared with never smoking. Former smoking resulted in 3 more days of absence, again compared with a reference category of never smokers. Common knowledge says that this difference can occur due to bad health condition caused by tobacco smoking, or it can be the case that smokers are people with different, possibly riskier occupations, which leads to a more frequent absenteeism. Once controlled for the latter effect, sick leave of smokers and former smokers slightly dropped to 9.7 and 2.5 days, respectively. I would suspect that the rest is mainly triggered by worse health condition. Yet, the results revealed 7.7 and 0.6 days still unexplained by health factors.

Taking into account the fact that health status was self-reported and agreeing with the author himself that “inadequate controls” might have been chosen for health status evaluation, I will still assume a number of sick leave days attributable to smoking to be 9.7 for current smokers (48.7% of average sick leave of never smokers) and 2.5 for former smokers (12.5 % of average sick leave of never smokers) in the Swedish case[17]. I applied the proportions of sick leave of smokers and quitters to never smokers in Sweden in order to come up with the Dutch figures. The summary of the results is shown in the table below.

Table 5. Average annual costs of lost productivity related to smoking status.

	Never smoker	**Smoker**	**Quitter**
Annual sick leave days	8.15	12.1 (8.15 × 148.7%)	9.17 (8.15 × 112.5%)
Lost productivity due to sick leave, €	1,507	2,237	1,695
Productivity loss (PL), % of annual labour costs	3.2%	4,7%	3.6%

Lost productivity in absolute values was calculated according to the following formula:

$$(\text{Sick leave days}/\ 258) \times € \ 47{,}700. \qquad (4)$$

e.g. Lost productivity of a smoker: (12.1/ 258) × € 47,700 = € 2,237.

Socio-demographic data

A final group of data is a general socio-demographic situation in the country. Population figures, decomposed by different age cohorts, are presented in Table 6. In 2005 there were over 12.3 million people older than 20, among them approximately 50% were 20 – 44 years old, 34.5% were 45 to 64 years old, and finally, 19% were retired

[17] After controlling for occupational factors only

people. 2009 figures are also displayed in order to demonstrate that a composition has not changed much over four years.

Table 6. Dutch population by age group.

	2005	% of 20+ population*	2009	% of 20+ population*
Total	16,305,526		16,592,206	
20+	12,317,569	100%	12,552,202	100%
20 – 44 years old	5,775,548	46.9%	5,529,430	44.1%
45 – 64 years old	4,253,351	34.5%	4,550,957	36.3%
65+ year old	2,288,670	18.6%	2,471,815	19.7%

*Source: CBS Statistics Netherlands; *Author's calculation*

Last but not the least, my target group, i.e. smokers, was 29.5% of total population in 2005. It is one of the largest prevalence among all OECD countries.

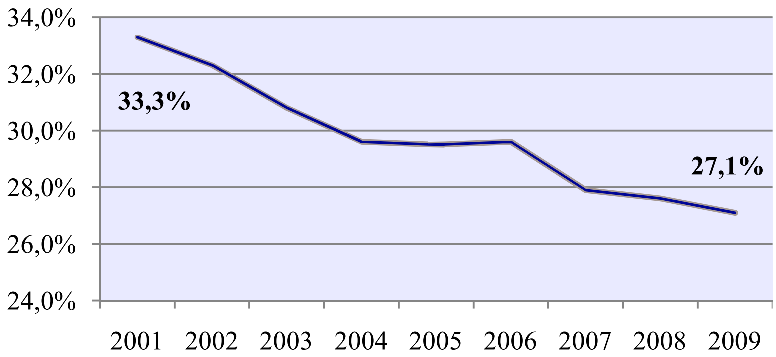


Figure 7. Smoking trends in The Netherlands.
Source: CBS Statistics Netherlands.

Fortunately, the trend in smoking prevalence is downwards, indicating ongoing lifestyle improvements in Dutch society.

Chapter 6

SROI in smoking cessation interventions

In this chapter I will calculate individual (micro level) and population (macro level) costs and benefits of smoking cessation. I will also perform a sensitivity analysis and discuss the importance of key parameters and data for the final outcomes.

Economics of quitting (micro approach)

First of all, I will compare a present value of a lifetime accumulated productivity differences of a never smoker, a smoker and a quitter of different age groups and join these findings with existing estimates of health care costs. The calculation basis for lifetime productivity is the average annual labour costs in The Netherlands, i.e. € 47,700, and a reference age of 20, meaning that a person is participating in the workforce for another 46 years until the age of 65. A smoker is assumed to have started smoking at the age of 20 or younger, since statistically this is the most common age when people take up the habit (Feenstra *et al.*).

The next thing to do is to estimate lifetime productivity differences in absolute values. A complete valuation of discounted flows of labour costs is presented in Appendix B, where sick leave-adjusted actual individual productivity for each year is calculated in a following way:

Annual labour costs (€) × (100% – PL, %). (5)

Present value of a lifetime productivity:

$$PV = \sum_{t=1}^{46} \frac{K_t}{(1+i)^t} \quad (6),$$

where:

t = year of participation in labour force

K_t = annual productivity (labour costs)

i = discount rate.

Combining information of total health care costs changes from Table 3 with productivity figures, I can estimate gains (or losses) of quitting for each age category (see Table 7) by using this formula:

$$\Delta \text{ } Productivity \text{ } (€) - \Delta \text{ } Health \text{ } care \text{ } costs \text{ } (€). \quad (7)$$

Table 7. Economic impact of quitting over a lifetime.

	Smoker	Quitter A (20–44)	Quitter B (45–64)	Quitter C (65+)
Δ Health care costs (€)		+ 700	+ 2,100	+ 1,500
Discounted lifetime productivity (€) at age 20	949,477	955,706	950,817	949,477
Δ Productivity (€)		+ 6,229	+ 1,340	0
Gain/loss per quitter (€)		**5,529**	– **760**	– **1,500**

We can see that early quitting is the only situation generating benefits – there is a surplus of approximately € 5,500. Whereas, smoking cessation encouraged in older smoking population leads to increased total health care costs which offset productivity gains (relevant for quitters between 45 to 64).

Interventions: five scenarios (macro approach)

In order to induce smoking cessation, five different interventions (described in Table 2) are jointly implemented for a period of four years with individual interventions being active every year and population level interventions being enforced every two years. See the table below for an explicit definition of each scenario.

Table 8. Smoking policy scenarios.

	Interventions included	***Reach (% of smokers)***	***Assumptions***	***Smoking reduction (%pt)***
Scenario 1	+ € 0.25	100	Moderate price elasticity (-0.4); Basic effectiveness of MC, H-MIS, IC+NRT; Low effectiveness of MMC	2.4
	MC	25		
	H-MIS	5		
	IC+NRT	7		
	MMC	100		
Scenario 2	+ € 0.25	100	Moderate price elasticity (-0.4); Basic effectiveness MC, H-MIS, IC+NRT; High effectiveness of MMC	3.3
	MC	25		
	H-MIS	5		
	IC+NRT	7		
	MMC	100		
Scenario 3	+ € 0.5	100	Moderate price elasticity (-0.4); Basic effectiveness of MC, H-MIS, IC+NRT; Low effectiveness of MMC	2.8
	MC	25		
	H-MIS	5		
	IC+NRT	7		
	MMC	100		
Scenario 4	+ € 0.25	100	Low price elasticity (-0.3); Pessimistic effectiveness of MC, H-MIS, IC+NRT; Low effectiveness of MMC	1.9
	MC	8		
	H-MIS	2		
	IC+NRT	4		
	MMC	100		
Scenario 5	+ € 0.5	100	High price elasticity (-0.5); Optimistic effectiveness of MC, H-MIS, IC+NRT; High effectiveness of MMC	6.4
	MC	30		
	H-MIS	12		
	IC+NRT	15		
	MMC	100		

Source: Vijgen et al.(2007).

The reach of interventions is claimed to be realistic and is based on expert opinions. Smoker's desire to quit was also taken into account (25% of smokers in 2005 wanted to quit). It is an important aspect, determining total policy costs and effectiveness of combined interventions. The estimates of effectiveness are provided in Appendix C.

To the existing analysis at Vijgen *et al.* I will add another ratio – intervention costs per quitter:

$$\frac{\text{Total intervention costs}}{\#\text{Quitters}} \qquad (8),$$

where #Quitters is calculated in this way:

$$\frac{\%\text{ pt decrease in smoking prevalence}}{100} \times \text{ Population.} \qquad (9)$$

---

e.g. Scenario 1: $\frac{€\ 383{,}000{,}000}{{}^{2.4}/_{100} \times 16{,}305{,}526} = \frac{€\ 383{,}000{,}000}{391{,}333} = €\ 979.$

Once we know a total amount of money spent on smoking cessation aids and the level of success in terms of smoking prevalence reduced, we can also measure total benefits (TB). While computing benefits for the whole population (10), I will assume that age composition of successful quitters remains the same as in the whole 20+ population in 2005 (see Table 6).

TB = (46.9% × #Quitters)× Gain/loss per quitter A + (34.5% × #Quitters) × Gain/loss per quitter B + (18.6% × #Quitters) × Gain/loss per quitter C (10),

where a gain/loss per quitter is taken from Table 7.

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e.g. Scenario 1: TB = (46.9% × 391,333) × € 5,529 + (34.5% × 391,333) × (– € 760) + (18.6% × 391,333) × (– € 1,500) = € 803,040,295.

The results for each scenario are presented in the Table 9.

Table 9. Total intervention costs and total benefits of smoking cessation (2005 price level).

	Total interventions costs (€ mln)[1]	***% pt decrease in smoking prevalence***[2]	***Cost per quitter (€)***	***Total benefits (€ mln)***
Scenario 1	383	2.4	979	803.0
Scenario 2	380	3.3	706	1,104.2
Scenario 3	381	2.8	835	936.9
Scenario 4	220	1.9	710	635.7
Scenario 5	670	6.4	642	2,141.4

[1] [2] source: Appendix E.

The only difference between Scenario 1 and 2 is the effectiveness of mass media campaign. A successful MMC leads to 37.5% increase of total benefits, if all other variables remain unchanged. This is more than twice than an increase of price by € 0.5 instead of € 0.25 would result into (from Scenario 1 to Scenario 3), indicating that an effective and well planned mass media campaign is a powerful tool to reinforce smoking cessation efforts.

Calculation of SROI

SROI is a different concept from a regular return on investment. The latter evaluates the efficiency of an investment, given financial flows induced by it. Whereas, SROI has a form of a social loss reduction, and in most cases it is not directly creating financial flows but rather saving resources and at the same time contributing to enhancement of social welfare (as in the case of smoking cessation). However, few policies can be built on social welfare arguments. Therefore, in my analysis I am using financial (tangible) variables. As for the type of SROI, I am applying a forecast social return on investment, which is predicting how much social value will be eventually created if the intended outcomes do happen, as opposed to evaluative SROI (Nicholls *et al.,* 2009).

I will now use formula (2) to calculate the return for each case.

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e.g. Scenario 1:

The results are presented below.

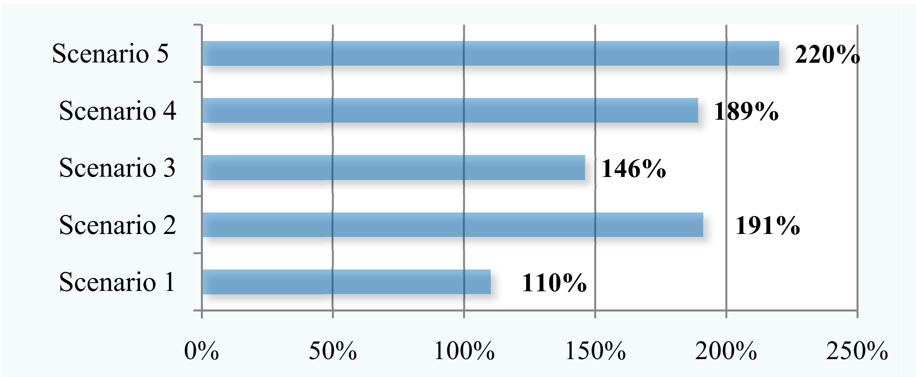

Figure 8. SROI in smoking cessation in The Netherlands under five scenarios (see Table 8 for the description of each scenario).

Returns on investment appeared to be substantially positive, ranging from approximately 110% to 220%. It means that smoking cessation could be a contributor to social welfare, and every euro invested might potentially bring a € 1.1 to € 2.2 net return. It is an exceptionally high return if we compare it to any other regular investment.

However, investment is recovered within a long time span and a payback period is even less clear. Then, this situation raises a question of financing, since the ones who pay are most likely not the ones who reap the rewards of this investment. I will briefly go back to this issue in Chapter 7.

Sensitivity analysis

The results have showed that a return on investment was well above zero in all the simulated scenarios. Another step is to see whether these positive outcomes hold if we alter the main parameters with values which are either higher or lower than a baseline estimates. I will firstly examine the impact of changing a number of smoking status related sick leave days (see Table 10). The lower and upper thresholds are 95% confidence intervals from OLS regression output in Lundborg's paper.

Table 10. Sensitivity analysis by a varied number of sick leave days and productivity elasticity correction.

	ROI_1	ROI_2	ROI_3	ROI_4	ROI_5
Sick leave days (Smoker – Quitter)					
12.10– 9.17 (baseline)	110%	191%	146%	189%	220%
11.09 – 8.21 (min)	104%	182%	139%	181%	210%
13.12 – 10.15 (max)	114%	196%	151%	195%	226%
Difference between sick leave of smokers and quitters					
2.93 days (baseline)	110%	191%	146%	189%	220%
2.5 days	59%	120%	86%	119%	142%
2.1 days	12%	55%	31%	54%	70%
2 days	0%	38%	17%	38%	52%
1.9 days	-12%	22%	3%	21%	34%
1.8 days	-24%	6%	-10%	5%	16%
1.7 days	-35%	-11%	-24%	-11%	-2%
0.8 elasticity correction	41%	95%	65%	94%	114%

The variation of days gives no significant disparity in returns on investment. Yet, further simulation revealed that under **all** scenarios the investment is paying off in the long run ***only if*** absenteeism difference between smokers and quitters is at least 2 days per year; a 1.9 days difference maintains social profitability all but the first scenario. The smaller the difference, the more losses smoking policy incurs, all other factors fixed.

What is more, Oostenbrink *et al.* argued that a relationship between working time and productivity may not be perfectly elastic. A Dutch study (Koopmanschap *et al.*, 1995, as cited in Oostenbrink *et al.*) found this elasticity to have a value of 0.8, meaning that a working decrease by 10% reduced production output by only 8%. An application of this finding reduced ROI by approximately a half, still leaving investments significantly valuable (see Table 10).

For the sake of simplicity, in the basic model I assumed a target population to work full-time. Whereas, statistically 16.2% of employed labour force aged 20 to 65 were working part-time, accordingly, being approximately half productive. Correcting for this gives lower ROI ratios, yet a reduction is not significant. Newly estimated ratios are the following: ROI_1 = 82% (↓ 28% pt), ROI_2 = 152% (↓ 39% pt), ROI_3 = 113% (↓ 33% pt), ROI_4 = 150% (↓ 39% pt), and ROI_5 = 177% (↓ 43% pt).

Another equally important variable in the model is effectiveness of policy in terms of reduced smoking prevalence. Clearly, more effective interventions would lead to even higher returns on investment. However, it is more important to see where a bottom line is. In order to check it, I reduced current effectiveness levels proportionally in each scenario until all ROI became negative (see Table 11 below).

Table 11. Sensitivity analysis by varied effectiveness level.

Effectiveness reduction	ROI_1	ROI_2	ROI_3	ROI_4	ROI_5
0% (baseline)	110%	191%	146%	189%	220%
-20%	68%	132%	97%	131%	156%
-30%	47%	103%	72%	102%	124%

Table 11 continued

Effectiveness reduction	ROI_1	ROI_2	ROI_3	ROI_4	ROI_5
-40%	26%	74%	48%	73%	92%
-50%	5%	45%	23%	44%	60%
-55%	-6%	31%	11%	30%	44%
-60%	-16%	16%	-2%	16%	28%
-65%	-73%	-63%	-69%	-69%	-59%

As we can notice, society may still be better off introducing a set of interventions, even if effectiveness goes down by at least 50% compared to its current rate. This gives a lot of room for uncertainty, as far as cessation rates are concerned.

Finally, I will investigate the effect of a discount rate. Contrary to previous analyses, I will use productivity gains per quitter instead of ROI as a dependent variable in the simulation. The reason behind is that ROI is an outcome of both intervention and health care costs, which are also discounted. However, these parameters are from secondary sources and a changed discount rate cannot have any influence on them.

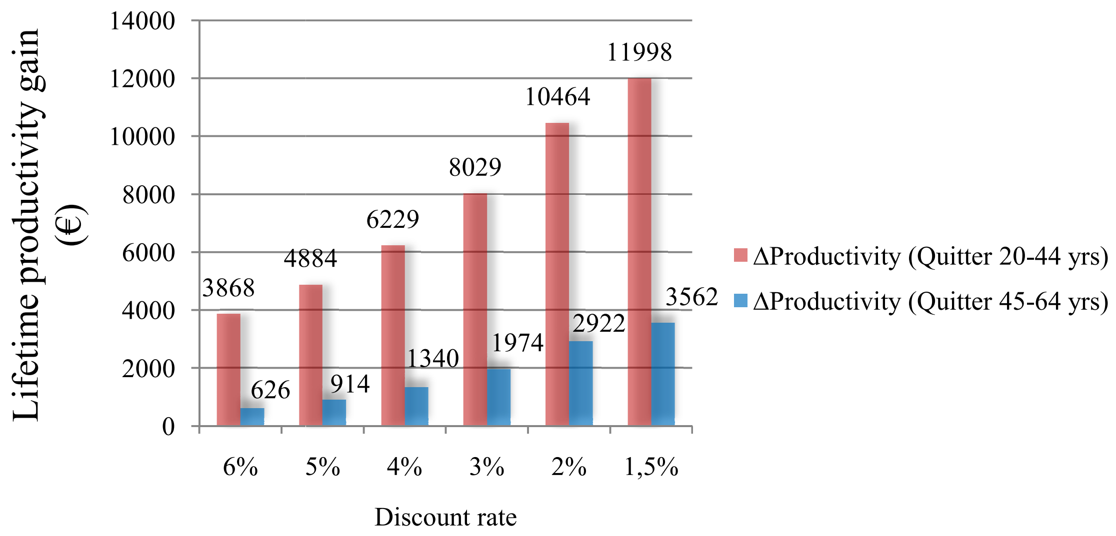

Figure 9. Sensitivity analyses by a varied discount rate.

Figure 9 demonstrates that a discount rate indeed has a big impact on lifetime productivity estimates. The lower it is, the higher an estimated gain of reduced sick leave. This would most likely imply that a social return on investment would increase, in spite of the fact that total health care costs and intervention costs would go up as well. Intervention costs occur at the very beginning and a monetary value of health care costs is far outweighed by productivity gains.

To sum it up, discount rate and sickness absence appears to be the most influential parameters in the model, whose variance may largely determine the main outcome. Thus, the conclusions drawn need to be cautiously received, bearing in mind specific assumptions undertaken. It also turned out that it is very important to analyze a direct impact of specific interventions (and combinations of interventions) on sick leave, and to calculate robust quantitative estimates of it.

Chapter 7

Distribution of smoking cessation benefits

Smoking cessation gains (and costs) are widely spread in time and are commonly shared among governments (local and central), health insurers, providers, employers, and individual former smokers themselves. Societal macro perspective towards smoking cessation summarizes overall effects, yet it does not give the answer of distribution of the returns for a separate stakeholder within time frame nor does it explain what the share of each party is.

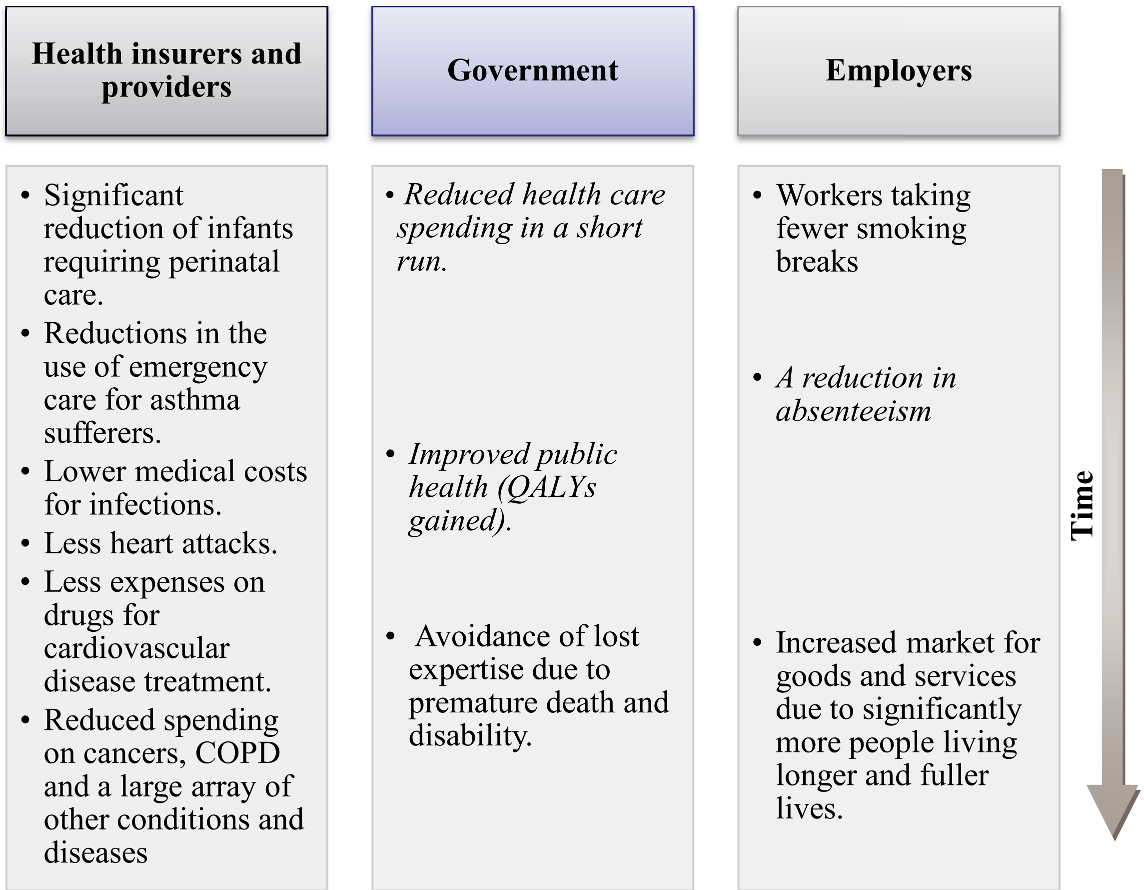

Figure 10. Benefits of investment in tobacco control for each major stakeholder and potential investor into smoking cessation spread in time.

Source: Scollo & Winstanley: 33-35; combined with author's contribution.

Health and productivity effects come as benefits for health insurers, health care providers, employers, and certainly, quitters (I exclude this group from further considerations, since it is an object of the discussion) either directly or indirectly. Benefits vary from early to mature ones (see Figure 10). Although, it has been concluded that total health care costs would rise (see Appendix E for quantifications), each smoking policy scenario shows a significant drop in medical spending within a period of about 25 years since the start up of cessation aids' provision and the enforcement of new regulations (see Figure 11). Short-term health care cost savings would free up valuable capacity and providers could alternatively use the resources for research and development to come up with efficient solutions to confront future challenges of rising costs. Therefore, it is important to split up total benefits into short and long term in order to notice hidden opportunities.

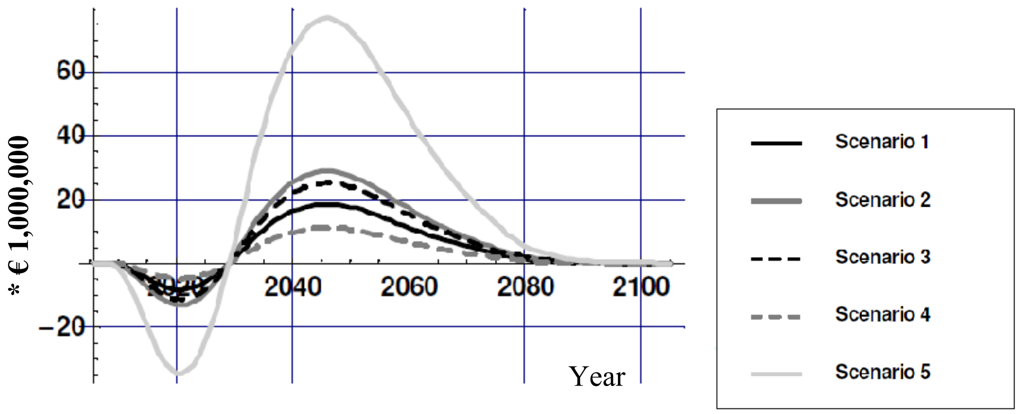

Figure 11. Dynamics of total health care changes compared to a reference scenario.

Source: Vijgen et al.: 26.

Another concern is a practical application of a ROI tool. For instance, if the government is to finance smoking cessation aids, then cost-benefit analysis would only take into account costs and benefits which are relevant to the government itself, thus, forgoing a part of social benefits and undervaluing smoking cessation or perhaps even suspending some programmes from implementation, which might be of a high value for society. This implies that there is a room for Pareto improvement. As an option to take advantage of this economical phenomenon, researchers had advised for public and private sectors to cooperate and introduce periodic transfers among them (from a beneficiary to decrement experiencing sector) in order to reap the rewards of social returns.

Claxton *et al.* examined transfers in the context of health care consumption benefits or costs. They claimed that transfers would be necessary if a new health technology (i.e. smoking cessation intervention in our case) would offer benefits for health care sector, whereas, costs would fall on a wider economy or vice versa. In other cases, we would in theory have a “win-win” situation requiring no financial cooperation unless the gains of a particular stakeholder are lower than its investments.

As for the size of a transfer, it should at least be equal to the resources required within the health care system to generate enough health elsewhere to just offset the net health benefits that will be forgone as a consequence of adopting technology. In case consumption costs fall on a wide society and benefits are concentrated in health care sector, a similar transfer of opposite direction should take place, leaving health sector at least not worse off and compensating other sectors for the costs imposed on them. However, according to Claxton *et al.*, this type of transfer would reduce overall net consumption value because transferred resources are generally more valuable in health care sector than elsewhere. Thus, it would be socially undesirable.

Even though, transfers might solve a problem of a mismatch between an investor in smoking cessation programmes and an actual beneficiary, it might be equally hard to implement this system due to transaction costs and alternative costs of transferred resources. Hence, there is a huge potential for researchers to come up with effective schemes to implement public-private partnerships in practice.

Chapter 8

Discussion

Potential weaknesses

Assumptions always play a key role in every economic analysis, and it is important that they are realistic. I also relied heavily on a few assumptions. In the first place, a relationship between smoking status and absenteeism at work may not be that direct, as assumed. It could be the case that smokers are low skilled or less educated workers and they are bound to be less conscious of their health conditions or simply cannot afford a proper health care, thus, having higher sickness absence rates. In addition, we cannot reject a possibility that the improvement of health and a significant reduction of smoking-related diseases even in a relatively short-term may not have an equal impact on absenteeism from work. A similar idea was expressed in Halpern *et al.*, when researcher found absenteeism to decrease gradually.

Another issue is an implication of fixed labour and health care costs. Obviously, inflation or future technological progress would make a correction to the estimates that I got. However, nominal costs in the analysis ultimately produce conservative estimates of ROI because both – labour costs and medical expenses – tend to increase over time.

Omitted factors

Smoking is interconnected with different sorts of socio-economic factors and to perform a CBA of entire social costs and benefits would require to include estimates, which are hardly obtainable at this point in time or it could be the case that the actual net impact is not clear. I will shortly discuss what impact those factors would potentially have for my current outcomes if they were to be of expected size and effect.

To begin with, productivity gains may be underestimated because of the omitted early retirement factor. If there is unemployment in a country, workers can be relatively easily replaced by people who would otherwise be unemployed. However, friction costs method seems to suggest a solution, yet again, some important generalizations need to be made as for the time of searching for new employees, training costs of newly employed people, which are in turn pretty diverse in every sector or even a type of a company. It is also necessary to account for the lost expertise due to early retirement or premature death.

Some researchers (Scollo & Winstanley) suggest to take the loss of tobacco industries into account. Falling consumption of tobacco products would mean less production in this industry, which in turn affects total output of the economy and leads to job losses in the industry. From this point of view, it is clearly a cost to society. Yet, we can equally argue that there are opportunity costs of resources that are at the moment concentrated in tobacco industry and they can be shifted to other (even more productive) industries as well. The real loss in that case would only be resources and time spent on transferring and tailoring them to a new economical activity.

Another potentially important factor to consider is the impact of environmental tobacco smoke (ETS). A previously mentioned Dutch study by Spreen & Mot proved that the net benefits are substantial if we successfully reduce exposure to a so called passive smoking. Therefore, we can assume that the real social benefits of quitting smoking may be larger due to indirect effects through reduction of ETS. However, involuntary smoking effects are hard to capture (Collins & Lapsley).

As far as productivity was concerned, individuals beyond workforce were net consumers, generating losses for society. However, life years beyond work force are still of value. Meltzer suggested to include non-market time by allowing utility to depend on leisure time. However, this parameter only evaluated benefits for an individual and did not give any estimates as for the benefits derived by others from this non-market activity, for instance, informal child care at home, which is undoubtedly valuable for society and should not be neglected. Nonetheless, researchers do agree that identifying and quantifying this value is far too complicated (Claxton *et al.*). Thus, this again confirms an idea that I derived conservative estimates of SROI and the underlying social value of smoking cessation is most likely to be even higher.

Consumption is yet another essential subject of debates. As it has been discussed, some researchers neglect the necessity to include additional consumption which results from extended lifetime into analysis (e.g. Garber & Phelps), while others (e.g. Meltzer) argue it is crucially important to account for future non-medical expenditure and treat it as a burden (cost) to society. However, on the opposite side we have a consumption as an individual benefit due to increased lifetime utility (Claxton *et al.*). Therefore, if we added consumption as a benefit to a recipient of a smoking cessation intervention and as a cost to society, those two effects cancel each other out and we only have productivity gains as a positive benefit. What is more, additional consumption by individuals who live longer is a benefit for businesses because it triggers economic activity to produce the necessary goods and services and may contribute to a higher employment. Thus, we can see that a consumption increase is a double-sided effect and it may have either a positive or a negative form, depending on an undertaken perspective.

Going back to health care costs, medical expenses decrease due to unrelated diseases were perceived as benefits of smoking cessation. However, Claxton *et al.* draws attention to displaced consumption effects. What he means is that if we adopt a new technology which displaces another one, we have to think of not only forgone health elsewhere, but also forgone benefits to patients, health care providers, and a wide economy. To apply this idea for smoking cessation would mean that quitting will reduce health care consumption in a short to medium period and those displaced visits at general practitioners or regular screening may have prevented spotting other unrelated diseases in their early phases while they are still easily cured. As a result, we may have lower SROI ratios. However, I believe it should not reverse the positive sign of it.

One more point of discussion is taxes. I assumed that taxes were a costless intervention. However, according to the neoclassical economic theory, there is a dead-weight loss in every tax raise because consumer or producer surplus is forgone. I dissociated from this possible effect in my analysis. And the reason is additional tax revenue generated, since cigarette demand is not perfectly elastic. One of the views in support of this statement is expressed in Collins & Lapsley. They say that “tobacco tax revenue does in fact exceed by a considerable margin the tobacco-attributable costs borne by the government”.

Last but not least, some researchers argue that quitting smoking increases obesity, which in turn has its own implications and social costs. For example, a Canadian study by Sen *et al.* (2010) concludes that health benefits from higher cigarette taxes might be at least partially offset by an increase in obesity levels. However, there are contradicting findings as well. For instance, US study by Gruber & Frakes (2006) came to a conclusion that there is no positive effect between quitting smoking and gained weight. This issue clearly needs some further attention.

Measurement issues

Not only assumptions and chosen effects are important but also a measurement of those effects. Productivity estimation base, i.e. average labour costs in the country, may indeed be questionable. A higher concentration of smokers is among low skilled, manual workers with lower wages (productivity). Therefore, it would also make sense to take average labour costs of smokers. However, there is no nationally representative data available in The Netherlands. As a consequence, the benefits of quitting in absolute terms might be overestimated from this point of view.

Chapter 9

Conclusions

My model proposes that smoking cessation does pay off to the Dutch society in the long run and every considered stakeholder can take advantage of anti-smoking policies and get tangible returns on their investment. Yet, the financing issue needs to be addressed with private-public partnerships as a potential mechanism to make smoking cessation pay its way to society.

If we are only focusing on the net individual financial gains of quitting smoking, assuming intervention costs are equal for all recipients of it, it is clearly visible that we should target smokers between 20 to 45 years old. An aggregate social ROI allows for excess benefits in younger population to compensate losses which occur in other age cohorts so that the overall result is still positive. Thus, depending on a scope of SROI, we may have different policy implications, i.e. a decision to channel resources to younger population might be made, if we look at SROI that is decomposed and tailored to different age categories, or alternatively, there could be no age specified intervention policies, if aggregated SROI ratios were compared.

My personal contribution to existing knowledge includes:

- An application of economic analysis, widely used in all sorts of investment projects, for evaluation of a healthier lifestyle;
- A combination of micro and macro approach in order to provide a comprehensive view on this issue;
- A first attempt to calculate the return on investment in smoking cessation in The Netherlands, given an established smoking cessation policy.

Nonetheless, this is just a start up of a complex socio-economic analysis in this area and it can undoubtedly be refined, and other social parameters can certainly be added once additional data becomes available or better techniques are being proposed. One of the key future research areas should be to study the effectiveness of interventions in terms of sick leave and not only health status and other health related parameters. Another suggestions for researchers is to apply the same approach of SROI for the investigation of effects of smoking initiation prevention, i.e. discouraging people to start smoking in the first place with a large amount of resources being channeled to school education. I would expect these gains to be even higher. Furthermore, avoiding social costs of smoking altogether would save up a lot of resources for employers and health care providers. Also, a similar type of analysis can be carried out for prevention of other unhealthy behaviours such as excessive alcohol consumption, bad eating habits, or physical inactivity, allowing for an even more integrated approach of the underlying determinants.

It can be concluded that social return on investment in smoking cessation policy clearly demonstrates the economic and societal importance of prevention in The Netherlands and possibly in other developed countries.

References

Alavinia, S. M., Molenaar, D., Burdof, A. (2009). Productivity Loss in the Workforce: Associations With Health, Work Demands, and Individual Characteristics. American *Journal of Industrial Medicine, 52,* 49-56. doi:10.1002/ajim.20648

Bobinac, A., van Exel, N. J. A., Rutten, F. F. H., Brouwer, W. B. F. (2010). Willingness to Pay for a Quality-Adjusted Life-Year: The Individual Perspective. *Value in Health, no.* doi: 10.1111/j.1524-4733.2010.00781.x

Bunn, W. B., Stave, G. M., Downs, K. E., Alvir, J., Dirani, R. (2006). Effect of Smoking Status on Productivity Loss. *Journal of Occupational and Environmental Medicine, 48,* 1099-1101. doi: 10.1097/01.jom.0000243406.08419.74

Callinan, J.E., Clarke, A., Doherty, K., Kelleher, C. (2010). Legislative smoking bans for reducing secondhand smoke exposure, smoking prevalence and tobacco consumption. *Cochrane Database of Systematic Reviews, 4*, 1-15. doi:10.1002/14651858.CD005992.pub2

Claxton, K., Walker, S., Palmer, S., Schulpher, M. (2010). Appropriate Perspectives for Health Care Decisions. CHE Research Paper 54. Retrieved from http://www.york.ac.uk/che/pdf/rp54.pdf

Collins, D. J., Lapsley, H. M. (2008). *The Costs of Tobacco, Alcohol and Illicit Drug Abuse to Australian Society in 2004/05.* Canberra: Department of Health and Ageing.

DeCicca, Ph., Kenkel, D., Mathios, A. (2008). Cigarette tax and the transition from youth to adult smoking: Smoking initiation, cessation, and participation. *Journal of Health Economics, 27,* 904-917. doi:10.1016/j.jhealeco.2008.02.008

DeCicca, Ph., McLeod, L. (2008). Cigarette taxes and older adult smoking: Evidence from recent large tax increases. *Journal of Health Economics, 27,* 918-929. doi:10.1016/j.jhealeco.2007.11.005

Ezzati, M., Hoorn, S. V., Lopez, A. D., Danaei, G., Rodgers, A., Mathers, C. D., Murray, Ch., J. L. (2006). Comparative Quantification of Mortality and Burden of Disease Attributable to Selected Risk Factors. In Lopez, A. D., Mathers, C. D., Ezzati, M., Jamison, D. T., Murray, Ch., J. L. (Ed.), *Global Burden of Disease and Risk Factors*. Washington (DC): World Bank.

Feenstra, T. L., van Baal, P. H. M., Hoogenveen, R. T., Vijgen, S. M. C., Stolk, E., Bemelmans, W. J. E. (2005). *Cost-effectiveness of interventions to reduce tobacco smoking in The Netherlands. An application of the RIVM Chronic Disease Model*. RIVM report 260601003. Retrieved from http://www.rivm.nl/bibliotheek/rapporten/260601003.pdf

Fishman, P. A., Ebel, B. E., Garrison, M. M., Christakis, D. A., Wiehe, S. E., Rivara, F. P. (2005). Cigarette Tax Increase and Media Campaign: Cost of Reducing Smoking-Related Deaths. *American Journal of Preventive Medicine, 29,* 19-26. doi:10.1016/j.amepre.2005.03.004

Fishman, P. A., Khan, Z. M., Thompson, E. E., Curry, S. J. (2003). Health Care Costs among Smokers, Former Smokers, and Never Smokers in an HMO. *Health Services Research, 38,* 733-749. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1360912/pdf/hesr_142.pdf

Garber, A. M., Phelps, C. E. (1997). Economic foundations of cost-effectiveness analysis. *Journal of Health Economics, 16,* 1-31. doi:10.1016/S0167-6296(96)00506-1

Garber, A. M., Phelps, Ch., E. (2008). Future costs and the future of cost-effectiveness analysis. *Journal of Health Economics, 27,* 819-821. doi:10.1016/j.jhealeco.2008.05.002

Gilbert, A., Cornuz, J. (2003). *Which are the most effective and cost-effective interventions for tobacco control?* Copenhagen, WHO Regional Office for Europe. Retrieved from http://www.euro.who.int/document/e82993.pdf

Global health risks: mortality and burden of disease attributable to selected major risks (2006). Geneva: WHO Press. Retrieved from http://www.who.int/healthinfo/global_burden_disease/GlobalHealthRisks_report_full.pdf

Gruber, J., Frakes, M. (2006). Does falling smoking lead to rising obesity? *Journal of Health Economics, 25,* 183-197. doi:10.1016/j.healeco.2005.07.005

Halpern, M. T., Shikiar, R., Rentz, A. M., Khan, Z. M. (2001). Impact of smoking status on workplace absenteeism and productivity. *Tobacco Control, 10,* 233-238. doi:10.1136/tc.10.3.233

ITC Netherlands National Report (2010). Retrieved from http://www.stivoro.nl/Upload/_publdocs/Netherlands%20National%20Report-Single%20Web.pdf

Jamison, D. T., Breman, J. G., Measham, A. R., Alleyne, G., Claeson, M., Evans, D. B., … Musgrove, Ph. (2006). *Disease Control Priorities in Developing Countries* (2nd ed.). New York, NY: Oxford University Press.

Kahende, J. W., Adhikari, B., Maurice, E., Rock, V., Malarcher, A. (2009). Disparities in Health Care Utilization by Smoking Status – NHANES 1999-2004. *International Journal of Environmental Research and Public Health, 6,* 1095-1106. doi:10.3390/ijerph6031095

Laaksonen, M., Piha, K., Martikainen, P., Rahkonen, O., Lahelma, E. (2009). Health-related behaviours and sickness absence from work. *Journal of Occupational and Environmental Medicine, 66,* 840-847. doi: 10.1136/oem.2008.039248

Lundborg, P. (2007). Does smoking increase sick leave? Evidence using register data on Swedish workers. *Tobacco Control, 16,* 114-118. doi: 10.1136/tc.2006.017798

Meltzer, D. (1997). Accounting for future costs in medical cost-effectiveness analysis. *Journal of Health Economics, 16,* 33-64. Retrieved from http://ideas.repec.org/p/nbr/nberwo/5946.html

MPOWER: A Policy Package to Reverse the Tobacco Epidemic (2008). Geneva: WHO Press. Retrieved from http://www.who.int/tobacco/mpower/mpower_english.pdf

Neubauer, S., Welte, R., Beiche, A., Koenig, H. H., Buesch, K., Leidl, R. (2006). Mortality, morbidity and costs attributable to smoking in Germany: update and a 10-year comparison. *Tobacco Control, 15,* 464-471. doi:10.1136/tc.2006.016030

Nicholls, J., Lawlor, E., Neitzert, E., Goodspeed, T., Cupitt, S. (2009). A guide to social return on investment. London: Society Media. Retrieved from http://www.sroi-uk.org/component/option,com_docman/task,cat_view/gid,29/Itemid,38/

Oostenbrink, J. B., Bouwmans, C. A. M., Koopmanschap, M. A., Rutten, F. F. H. (2004). *Handleiding voor kostenonderzoek: Methoden en standaard kostprijzen voor economische evaluaties in de gezondheidszorg*. Diemen: College voor zorgverzekeringen.

Polder, J. J., Achterberg, P. W. (2004). *Cost of illness in The Netherlands*. RIVM report 270751006. Retrieved from http://www.rivm.nl/bibliotheek/rapporten/270751006.pdf

Polder, J. J., Barendregt, J. J., van Oers, H. (2006). Health care costs in the last year of life – The Dutch experience. *Social Science & Medicine, 63,* 1720-1731. doi:10.1016/j.socscimed.2006.04.018

Proper, K. I., van der Beek, A. J., Hildebrandt, V. H., Twisk, J. W. R., van Mechelen, W. (2004). Worksite health promotion using individual counselling and the effectiveness on sick leave; results of a randomized controlled trial. *Occupational and Environmental Medicine, 61,* 275-279. doi:10.1136/oem.2002.005769

Rasmussen, S. R., Prescott, E., Sorensen, T. I. A., Sogaard, J. (2005). The total lifetime health cost savings of smoking cessation to society. *European Journal of Public Health, 15,* 601-606. doi:10.1093./eurpub/cki024

Rasmussen, S. R., Prescott, E., Sørensen, T. I., Søgaard, J. (2005). The total lifetime health cost savings of smoking cessation to society. *European Journal of Public Health, 15,* 601-606. doi:10.1093/eurpub/cki024

Robroek, S. J. W., van den Berg, T. I. J., Plat, J. F., Burdof, A. (2010). The role of obesity and lifestyle behaviours in a productive workforce. *Journal of Occupational and Environmental Medicine, no.* doi:10.1136/oem.2010.055962

Scollo, M. M., Winstanley, H. M. (2008). *Tobacco in Australia: Facts and Issues* (3rd ed.). Melbourne: Cancer Council Victoria.

Sen, A., Entezarkheir, M., Wilson, A. (2010). Obesity, smoking, and cigarette taxes: Evidence from the Canadian Community Health Surveys. *Health Policy.* doi:10.1016/j.healthpol.2010.04.003

Sloan, F. A., Ostermann, J., Picone, G., Conover, Ch., Taylor, D. H. Jr. (2004). *The Price of Smoking.* Cambridge, MA: The MIT Press.

Spreen, M., Mot, E. (2008). *Een rookverbod in de Nederlandse horeca: Een kosten - baten analyse.* CPB document 159. Retrieved from http://www.cpb.nl/nl/pub/cpbreeksen/document/159/

Van Baal, P. H. M., Brouwer, W. B. F., Hoogenveen, R. T., Feenstra, T. L. (2007). Increasing tobacco taxes: A cheap tool to increase public health. *Health Policy, 82,* 142-152. doi:10.1016/j.healthpol.2006.09.004

Van Baal, P. H. M., Feenstra, T. L., Hoogenveen, R. T., de Wit, G. A., Brouwer, W. B. F. (2007). Unrelated medical care in life years gained and the cost utility of primary prevention: in search of a "perfect" cost-utility ratio. *Journal of Health Economics, 16,* 421-433. doi:10.1002/hec.1181

Van Baal, P. H. M., Polder, J. J., de Wit, G. A., Hoogenveen, R. T., Feenstra, T. L., Boshuizen, H. C., Engelfriet, P. M., Brouwer, W. B. F. (2008). Lifetime Medical Costs of Obesity: Prevention No Cure for Increasing Health Expenditure. *PLoS Medicine, 5,* 242-249. doi:10.1371/journal.pmed.0050029

Vemer, P., Rutten-van Mölken R. M., Kaper, J., Hoogenveen, R. T., Schayck, C. P., Feenstra, T. L. (2009). If you try to stop smoking, should we pay for it? The cost-utility of reimbursing smoking cessation support in The Netherlands. *Addiction, 105,* 1088-1097. doi: 10.1111/j.1360-0443.2010.02901.x

Vijgen, S. M. C., van Gelder, B. M., van Baal, P. H. M., van Zutphen, M., Hoogenveen, R. T., Feenstra, T. L. (2007). *Kosten en effecten van tabaksontmoediging*. RIVM report 260601004. Retrieved from http://www.rivm.nl/bibliotheek/rapporten/260601004.html

Wakefield, M. A., Durkin, S., Spittal, M. J., Siahpush, M., Scollo, M., Simpson, J. A., … Hill, D. (2008). Impact of Tobacco Control Policies and Mass Media Campaigns on Monthly Adult Smoking Prevalence. *American Journal of Public Health, 98*, 1-8. doi:10.2105/AJPH.2007.128991

Welke factoren bepalen onze gezondheid? (2006). *Volksgezondheid toekomst verkenning*. Bilthoven: RIVM. Retrieved from http://www.rivm.nl/vtv/object_document/o5437n30048.html

Williams, A. (1997). Intergenerational equity: an exploration of the "fair innings" argument. *Health Economics, 6,* 117-132. Retrieved from http://onlinelibrary.wiley.com/doi/10.1002/(SICI)1099-1050(199703)6:2%3C117::AID-HEC256%3E3.0.CO;2-B/abstract

Williams, A., Cookson, R. (2000). Equity in health. In Culyer, A. J., Newhouse, J. (Ed.), *Handbook of Health Economics*, Volume 1. Retrieved from http://econpapers.repec.org/bookchap/eeehealth/1.htm

Woolacott, N. F., Jones, L., Forbes, C. A., Mather, L. C., Sowden, A. J., Song, F. J., … Barton, P. M. (2002). The clinical effectiveness and cost-effectiveness of bupropian and nicotine replacement therapy for smoking cessation: a systematic review and economic evaluation. *Health Technology Assessment, 6,* 47-67. Retrieved from http://www.hta.ac.uk/execsumm/summ616.shtml

Appendix A.

A list of smoking-related diseases.

Disease
Oropharyngeal cancer
Oesophageal cancer
Stomach cancer
Pancreatic cancer
Laryngeal cancer
Lung cancer
Cervical cancer
Endometrial cancer
Bladder cancer
Kidney cancer
Ischaemic heart disease
Chronic obstructive pulmonary disease (COPD)
Tobacco abuse
Parkinson’s disease
Pulmonary circulation disease
Cardiac dysrhythmias
Heart failure
Stroke
Peripheral vascular disease
Lower respiratory tract infection
Crohn’s disease
Ulcerative colitis
Antepartum haemorrhage
Low birth weight
SIDS
Fire injuries
Asthma (under 15 years)
Macular degeneration
Otitis media
Lung cancer (passive)
Ischaemic heart disease (passive)

Source: Collins & Lapsley (2008): 34.

Appendix B.

Actual labour productivity (€), depending on smoking status.

			Never smoker	Smoker	Quitter[18] (20-44)	Quitter[19] (45-64)
Year	*Annual costs*	*Discounted Value*[20]	*DV*	*DV*	*DV*	*DV*
1	47,700	45,865	44,417	43,714	43,714	43,714
2	47,700	44,101	42,708	42,033	42,033	42,033
3	47,700	42,405	41,066	40,416	40,416	40,416
4	47,700	40,774	39,486	38,862	38,862	38,862
5	47,700	39,206	37,967	37,367	37,367	37,367
6	47,700	37,698	36,507	35,930	35,930	35,930
7	47,700	36,248	35,103	34,548	34,548	34,548
8	47,700	34,854	33,753	33,219	33,219	33,219
9	47,700	33,513	32,455	31,942	31,942	31,942
10	47,700	32,224	31,206	30,713	30,713	30,713
11	47,700	30,985	30,006	29,532	29,532	29,532
12	47,700	29,793	28,852	28,396	28,396	28,396
13	47,700	28,647	27,742	27,304	27,629	27,304
14	47,700	27,546	26,675	26,254	26,567	26,254
15	47,700	26,486	25,649	25,244	25,545	25,244
16	47,700	25,467	24,663	24,273	24,562	24,273
17	47,700	24,488	23,714	23,339	23,618	23,339
18	47,700	23,546	22,802	22,442	22,709	22,442
19	47,700	22,640	21,925	21,579	21,836	21,579
20	47,700	21770	21,082	20,749	20,996	20,749
21	47,700	20,932	20,271	19,951	20,188	19,951
22	47,700	20,127	19,491	19,183	19,412	19,183
23	47,700	19,353	18,742	18,445	18,665	18,445
24	47,700	18,609	18,021	17,736	17,947	17,736
25	47,700	17,893	17,328	17,054	17,257	17,054
26	47,700	17,205	16,661	16,398	16,593	16,398
27	47,700	16,543	16,021	15,767	15,955	15,767
28	47,700	15,907	15,404	15,161	15,342	15,161
29	47,700	15,295	14,812	14,578	14,751	14,578
30	47,700	14,707	14,242	14,017	14,184	14,017

[18] Assume an average quitting age of 32
[19] Assume an average quitting age of 54
[20] Discount rate 4%

Appendix B continued

			Never smoker	**Smoker**	**Quitter (20-44)**	**Quitter (45-64)**
Year	*Annual costs*	*Discounted Value*	*DV*	*DV*	*DV*	*DV*
31	47,700	14,141	13,694	13,478	13,639	13,478
32	47,700	13,597	13,168	12,960	13,114	12,960
33	47,700	13,074	12,661	12,461	12,610	12,461
34	47,700	12,571	12,174	11,982	12,125	11,982
35	47,700	12,088	11,706	11,521	11,658	11,658
36	47,700	11,623	11,256	11,078	11,210	11,210
37	47,700	11,176	10,823	10,652	10,779	10,779
38	47,700	10,746	10,407	10,242	10,364	10,364
39	47,700	10,333	10,006	9,848	9,966	9,966
40	47,700	9,935	9,622	9,469	9,582	9,582
41	47,700	9,553	9,251	9,105	9,214	9,214
42	47,700	9,186	8,896	8,755	8,859	8,859
43	47,700	8,833	8,554	8,418	8,519	8,519
44	47,700	8,493	8,225	8,095	8,191	8,191
45	47,700	8,166	7,908	7,783	7,876	7,876
46	47,700	7,852	7,604	7,484	7,573	7,573
	$\sum_{t=1}^{46} PV$	**996,198**	**964,729**	**949,477**	**955,706**	**950,817**

Appendix C.

Cost structure of interventions and their efficacy.

Resource use, unit costs, and costs per smoker for interventions at individual level/ Total costs of mass media campaign (2004 price level).

Intervention	*Resources needed*	*Units*	*Unit price (€)*	*Costs (€)*
MC	GP time (minutes)	2	2.04	4
	Material (brochures)	1	1.07	1
	Total			**5**
H-MIS	GP time (minutes)	12	2.04	25
	Material (brochures)	1	1.07	1
	Total			**26**
IC+NRT	Physician time (minutes)	2	3.70	7
	Counselor time (minutes)	90	0.81	73
	Medication (DDD)	80	2.42	193
	Material	1	1.07	1
	Overhead consults (per minute)	90	1.26	113
	Total			**388**
MMC (total)				**6,400,000**
TI				**0**

Source: Feenstra et al (2005).: 35.

Effectiveness of interventions for individual smokers.

Intervention	*Difference in cessation rates between intervention and control group (95% CI)*	*Intervention in control group*
Individual cessation support		
MC	0.9% (0.3 – 2.2)	No advice
H-MIS	4.8% (1.1 – 12)	No advice
IC+NRT	6.3% (4.0 – 8.5)	IC + placebo
Interventions at population level		*Net effect (% pt smoking reduction)*
MMC		1.0 – 1.4
TI		0.9 – 2.8

Source: Feenstra et al. (2005): 33-34.

Appendix D.

Ordinary least-squares regression on the annual number of days of sickness among Swedish adults for the period of 1988 – 91.

	Full sample	Males	Females
Current smoker	10.69 (8.17 to 13.20)	10.70 (7.24 to14.15)	10.63 (6.99 to 14.27)
Former smoker	3.09 (0.69 to5.49)	3.48 (0.34 to 6.63)	2.93 (-0.68 to 6.54)
Never smoker (reference)	–	–	–
Observations	14,272	7,020	7,252
Controlling for occupational factors			
Current smoker	9.67 (7.18 to 12.15)	9.67 (6.35 to 12.98)	9.50 (6.03 to 12.96)
Former smoker	2.52 (0.14 to 4.90)	2.83 (-0.42 to 6.08)	2.35 (-1.40 to 6.10)
Never smoker (reference)	–	–	–
Observations	14,272	7,020	7,252
Controlling for health factors			
Current smoker	7.67 (5.43 to 9.90)	7.26 (4.22 to 10.31)	7.55 (4.30 to 10.81)
Former smoker	0.58 (-1.60 to 2.76)	-0.19 (-3.01 to 2.63)	1.05 (-2.27 to 4.37)
Never smoker (reference)	–	–	–
Observations	14,272	7,020	7,252

Source: Lundborg (2007): 3.

Appendix E.

Smoking cessation, health effects, and costs under five scenarios.

Percentage of smokers.

Year	Reference scenario	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
2006	27.7	27.7	27.7	27.7	27.7	27.7
2007	27.3	27.1	27.1	27.1	27.3	26.3
2008	27.1	26.2	25.7	26.0	26.6	23.6
2009	26.8	25.9	25.6	25.7	26.3	23.2
2010	26.5	25.3	24.4	24.9	25.8	21.3
Aggregated effectiveness[1]	27.7-26.5 = 1.2	27.7-25.3 = 2.4	27.7-24.4 = 3.3	27.7-24.9 = 2.8	27.7-25.8 = 1.9	27.7-21.3 = 6.4

[1] Author's calculation

Source: Vijgen et al. (2007): 25.

Total health effects, costs, cost-effectiveness in 5 scenarios.

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Interventions costs[1]	383	380	381	220	677
Gained QALYs[2]	276	428	378	164	1,137
Health care cost difference[1]	440	683	598	259	1,828
€ per QALY[3]	4,900	4,100	4,300	4,800	3,800

[1] discounted with 4% * € 1,000,000
[2] not discounted *1,000
[3] costs discounted with 4% rate, effects discounted with 1.5% rate

Source: Vijgen et al. (2007): 27.