Economic Costs Of Smoking

An Incidence Approach To Estimating The True Cost Of Smoking

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ABSTRACT

Cigarette smoking is a major cause of morbidity and mortality in New Zealand today. Links between smoking and many diseases are well established. Cigarette smoking is, however, still in fashion. Although increasing public awareness of the health risks associated with cigarette smoking has somewhat improved the current smoking patterns in recent years, the evidence regarding health risks alone is still unable to prevent some 4,000 lives from being lost every year due to smoking in New Zealand.

This study focused on the economic implications of smoking from the perspective of an individual. It has produced understandable and meaningful information about the likely lifetime economic costs associated with cigarette smoking. Knowing such costs associated with cigarette smoking may well provide each individual smoker with the incentive needed for smoking cessation.

The results of this study show that the economic costs of cigarette smoking is significant by any measure. The magnitude of the loss varies with gender, age and the type of disease. The greatest concern is for people, both male and female, under 60 years of age, especially for people in their forties who are expected to lose more incomes than any other people in the other age groups due to smoking induced diseases. A male smoker in that group is expected to incur up to 22 months worth of current income. A female smoker, on the other hand, is expected to incur at most 9 months worth of current income. Such costs are by no means insignificant in magnitude.

With the economic costs of cigarette smoking in such an understandable and meaningful format, it is hoped, progress in smoking cessation will be more successful.

ACKNOWLEDGMENTS

This study is based on a similar work conducted by Rolf. D Cremer to whom I owe much gratitude. I am indebted to him for his qualitative suggestion and advice, but especially for his farsightedness in recognising the need for a study of this nature and providing me with the opportunity for the study. Without him, I would have been one of those smokers who is expected to lose a great amount of income.

I am also indebted to staff at New Zealand Health Information Services, especially Sharon Moreham, who has provided me with many piece of information and invaluable advice critical to the successful completion of this study.

I would also like to thank Ian Richards who kindly corrected English in this thesis.

Finally I have attempted to present the results in such a way that would be clear to the lay reader. I hope that many find the study interesting.

CHAPTER 1

INTRODUCTION

1.1 Cigarette Smoking

Smoking is an internationally recognised health problem. More and more people have been aware of the potential hazard of cigarette smoking. Not only individuals but public and private institutions have also been actively combating the potential problems of the smoking habit. Although tobacco consumption and the number of smokers may have declined steadily over the past decade or so in New Zealand, there are many people who still take up cigarettes even though many of them know what would be the likely consequence of their smoking habit.[1] Tobacco contains over fifty toxic and cancer-causing chemicals.[2] It is estimated in 1988 that the smoking of tobacco products accounts for 16 percent of all deaths in New Zealand, which is over 4000 death tolls a year.[3,4,5] It is believed that there are no other drugs, except for alcohol, more widely regarded as hazardous products to humans and at the same time more easily accessible than cigarettes today.[6]

Smoking is also an economic problem. While much is known about the detrimental physical effects of smoking, little is known about the economic implications of smoking. People who smoke are probably aware of the cost that they have paid or that they are going to pay for packs of cigarettes, matches, ash trays and the like. However those are not the only costs that they may have to incur during the course of their smoking lives or even of their entire lives. People who smoke in fact have a much higher probability

of developing certain diseases. For example lung cancer, heart disease and other illnesses relating to respiratory systems are much common among smokers.[7] Once they contract those kinds of diseases, obviously they will have to pay for the treatment until they are recovered - costs of health care. At the same time they will have to sacrifice wages and salaries, and work proficiency and fitness that they could have earned and retained if they had not caught the diseases - lost earnings and productivity. Those valuable resources could be saved and used for other goods, services and occasions if they had not smoked at all in the first place or quit smoking at some stage. Smoking is costing any country thousands of lives and hundreds of thousands of dollars every year.

1.2 Objectives Of The Study

The objective of the study is to estimate, from the perspective of an individual smoker, the life-time costs of smoking which includes lost earnings and health care costs due to smoking-related diseases. Estimates are to be developed on an incidence basis. A pioneering study using this approach was done by Oster, Colditz and Kelly.[8] More work was done by Cremer in Hong Kong.[9] Such studies dictate that the incidence-based approach was designed so as to meet the individual need to provide information to each individual smoker regarding how smoking influences them in economic terms. In other words, the incidence-based approach focuses on the costs of a certain smoking-induced disease if a person contracts it because of smoking, regardless of when those costs will be incurred. The costs of smoking-related diseases are not only the primal concern in this analysis. The evaluation of the marginal probability that a smoker would contract a certain disease is incorporated in the analysis. The analysis, therefore, takes into consideration the increased likelihood of

contracting certain diseases as well as the subsequent costs of diseases once each individual smoker does contract them, to yield a clear picture on how in economic terms smoking affects individuals.

To transform scientific evidence regarding the detrimental effects of smoking into associated economic costs, several steps are to be taken to develop the cost estimate. Namely:

Identifying the risks of illness for the smokers and non-smokers;

Identifying the treatment that would normally be taken to cure the illness in question;

Assessing the long-term impact of the illness on smokers - the extent of disability and the risk of premature death;

Assigning values to the consequences - medical treatment and lost productivity;

Calculating the expected or average costs of smoking for individual smokers.

All these estimates of economic costs of smoking are expected values as the future consequences of what may happen to the health status of a certain smoker is unforeseeable. The estimates are accordingly to be translated as the amount which every smoker should on average expect to lose. It is like playing a lottery. Some people win and some lose. Some smokers may be lucky enough not to contract a serious disease at all in their life-time, in which case they do not have to bear the costs that smokers are expected to incur on average. Some people are just out of luck, so that they incur significant costs far in excess of those that are expected on average. However such estimates are a sufficiently valuable indication of the likely economic consequences of smoking to every individual smoker.

1.3 Organisation Of The Study

The remaining chapters describe empirical facts, methods and findings. Chapter 2 presents the links between smoking and disease. Chapter 3 shows the current situation of the smoking habit in New Zealand. Chapter 4 presents the methods for obtaining the estimates of the lifetime cost of smoking. Chapter 5 shows the lost productivity and income due to cigarette smoking. Chapter 6 shows the health care costs on diagnosis due to cigarette smoking. Finally, chapter 7 reviews the findings acquired in the last two chapters. A concluding remark is also contained in chapter 7.

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CHAPTER 2

LINKS BETWEEN SMOKING AND DISEASE

2.1 History Of Tobacco

Tobacco was first brought back to Europe in the late fifteenth century when Columbus sailed westward from Spain to seek out the riches of India. The natives of the islands, whom Columbus called Indians, though they were actually native Americans, smoked tobacco in Y-shaped pipes, one fork of the pipe being inserted into each nostril, both for ceremonial purposes and as a symbol of goodwill. Moreover the tobacco was believed to have a medicinal value in India. These were the main reasons that the explorers brought them back to Europe, not knowing that it would provoke such social and medical diseases as it is known for today.

In the seventeenth century, tobacco came into general use in quite the same way as it is seen today. Small cigars or cigarettes in a paper-wrapped form originated in Spain, spread both eastwards and westwards and then to more remote regions. With the development of improved production methods and hence the greater availability of better-made cigarettes, the distribution and use of cigarettes became a world-wide phenomenon. Quite surprisingly, it is found that people in even primitive tribes in a very remote isolated area

smoke tobacco.[1] Cigarette smoking is nowadays one of the characteristics of almost every society.

2.2 Links Between Smoking And Disease

It is known today, however, that smoke out of cigarettes has more than fifty toxic and cancer-bearing chemicals. Most of those chemicals are complete carcinogens, substances that tend to cause a cancer, and sufficient alone to generate malignant changes in the cell.[2] The scientific evidence that smoking causes disease is authoritative and continues to accumulate. Smoking shortens the lives of smokers. It is also found to be:[3, 4]

- a cause of increased lifetime risk of chronic bronchitis and emphysema
- a cause of increased lifetime risk of lung cancer
- a cause of shortened life due to heart attacks
- a cause of strokes; a cause of arterial disease causing reduced blood supply to legs and feet; a cause of cancer of the lip, tongue, throat, larynx and gullet
- a contributing factor for cancer of the bladder, pancreas and kidney
- associated with sudden infant death syndrome and aortic aneurysm
- responsible in the United States for 40 to 50 percent of smokers dying prematurely from smoking.

The list could easily be extended with more diseases associated with tobacco smoking. Smoking may be the most preventable cause of premature deaths and excessive life-long morbidity.

2.3 Risks Of Premature Death

It is expected that between 1995 and 2015 some 80,000 people will die

prematurely in New Zealand as a result of the habit of smoking, provided that the death rate due to cigarette smoking stays at the present level of over 4,000 per year. Almost all of these premature deaths will be found amongst the half million regular smokers currently aged between 25 and 75 years of age. If people, however, quit smoking before the age of 45 years, most of those deaths could be avoided.[5,6]

The reduction in life expectancy was previously estimated at three to eight years among British doctors who had been smokers, in comparison to those who had never smoked.[7] A similar result was also yielded from the study conducted in New South Wales in the late eighties.[8] The study showed deferring years of male life expectancy at birth in New South Wales for differing level of smokers. People who had never smoked were expected to live up until 76.2 years of age on average.

On the other hand, people who had smoked but stopped smoking were expected to live up only to 72.1 years of age. Even worse, heavy smokers' life expectancy was only 70.6 years of age on average. Nearly 60,000 New Zealand children and teenagers currently under twenty years of age could be expected to die prematurely because of the smoking habit unless the current uptake of smoking decreases.

2.4 New Evidence

Recent study, however, suggests that one in two lifetime smokers dies as a result of tobacco smoking, on an average, fourteen years earlier than those who had never smoked or had quit smoking along the way.[9,10,11] This is almost twice the risk previously estimated. According to the study, half of premature deaths as a result of smoking occur prior to 70 years of age, losing on average 21 years of life. People who quit smoking before 35 years of age

avoided almost all of the mortality risks of smoking. People who stopped smoking in middle age between 35 and 69 were faced with less risk of premature death in their old age (70 years and over). Smoking-related premature deaths for 1995 are now projected to be 4,500, whilst the previous estimated smoking-related deaths were just 4,000.[12]

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CHAPTER 3

SMOKING IN NEW ZEALAND

3.1 Smoking Prevalence In New Zealand

Despite all the evidence about the links between smoking and disease noted in previous chapter, overall 26.1 percent of people aged 15 and over were regular daily smokers in 1991. 27 percent of all males aged 15 and over and 25.2 percent of all females in the same age-group were reported to smoke some type of cigarette. Of course smoking prevalence and varies not only with gender but also with age, as well as race.

3.2 Smoking By Gender

Although there were some periods of years in which the percentage of female smokers was as high as that of males, smoking among men has been much more common. Proportionately more male than female smokers have been recorded. However if we are to look at the break-down of the smoking prevalence data by age rather than in aggregated form, it is surprising to see that there were more smokers among females aged between 15 and 24 recorded than males of the same age, relatively speaking. Table 3 below reveals the smoking prevalence in New Zealand among different age groups and sexes from the year 1983 to 1991.[1]

Table 3-1 Cigarette Smoking Prevalence In New Zealand

Year	Age	>15	>15		15-24		25-34		35-54		>55	
	Sex	M,F	M	F	M	F	M	F	M	F	M	F
1983		32.8	34.5	31.2	33.5	39.4	37.9	34.6	36.9	31.6	29.1	20.8
1984		32.1	34.0	30.5	35.2	39.5	39.3	34.3	34.7	28.3	26.7	21.6
1985		30.0	30.1	30.0	30.7	40.0	34.9	33.5	30.7	28.5	24.4	19.4
1986		30.0	29.3	30.7	31.4	37.4	31.5	33.7	31.1	32.1	23.6	19.2
1987		29.6	30.9	28.5	32.3	36.2	34.4	34.9	34.1	26.4	22.0	18.8
1988		28.6	28.7	28.5	27.1	38.9	37.4	35.5	31.1	27.5	24.4	19.6
1989		26.8	27.0	26.7	28.7	36.1	30.1	32.7	28.9	24.8	19.8	16.7
1990		27.5	27.3	27.3	30.4	34.5	32.5	32.7	30.3	28.7	17.6	25.7
1991		26.1	27.0	25.2	28.3	33.4	35.3	30.4	26.9	23.9	18.0	15.9

Source:
OTR Spectrum Research Surveys, 1982-91, in Tobacco Statistics 1991, The department of Health, 1992, Wellington.

3.3 Smoking In Different Age Groups

Elderly people, as is expected, tend to smoke less cigarettes than young people do. Yet, 18 percent of males and 15.9 per cent of females aged 55 years and over were still regular smokers. The highest percentages of smoking prevalence appear at the age between 25 and 34 for the males and the age between 15 and 24 for the females. From those age groups onward, the prevalence of smoking tends to decline.

3.4 Smoking Amongst Races

Most notably it is a fact that 49.9 per cent of all Maori aged 15 and over were smokers in 1991. The 1976 and 1981 Census of Population and Dwellings reported that New Zealand Maori women aged between 15 and 34 were the highest percentage of those persons of the same age-group who smoked some type of cigarette. More Maori women in all age-groups were smokers, according to the data tabulated below. In 1989, 61 percent of Maori women aged between 15 and 34 smoked cigarettes compared to 44 percent of Maori

men of the same age. Table 5 lists the percentage of Maori people who regularly take up cigarettes.[2,3,4]

Table 3-2 The percentage of New Zealand Maori Who Regularly Smoke, 1976, 1988-1991

Year	Age	15-35		35 & over		15 & over		15 & over
	Sex	M	F	F	M	M	F	Total
1976		58.0	63.2	53.0	53.0	56.1	59.4	57.8
1981		56.3	63.6	48.7	49.8	53.5	58.5	56.0
1988		50.0	72.0	48.0	45.0	49.0	62.0	56.0
1989		44.0	61.0	46.0	52.0	45.0	57.0	51.0
1990		-	-	-	-	-	-	54.3
1991		-	-	-	-	-	-	49.9

Source:
OTR Spectrum Research Surveys, 1982-91, Tobacco Statistics 1991, The department of Health, 1992, Wellington.

3.5 Smoking In The Past

There were more smokers thirteen years ago, in 1983, than there were in 1991. 32.8 per cent of the total population accounted for daily smokers in 1983. The 6.7 per cent decrease in the cigarette smoking prevalence over that period was perhaps due to price increases, tax hikes, the economic recession, and general health consciousness amongst many other things.

In 1983 around 56 per cent of Maori were regular smokers, almost 6 times as high as the prevalence of Pakeha (European origin) smokers. The reduction in the cigarette smoking prevalence of Maori over the period of 1983 and 1991 was around 7.9 percent point, a little more than the Pakeha counterpart. The above-mentioned factors, price rises, recession, etc., also seem to have hit some of the Maori, but more effectively.

3.6 Effects On Human Health

Exposure to cigarette smoke also exposes the lungs to cancer-bearing chemicals, among which 4 chemicals are known to cause cancer in humans and almost 40 chemicals are known to cause cancer in animals.[5] The addictive nature of nicotine promises prolonged exposure of the lungs to those cancer-causing chemicals over a lifetime.

In New Zealand over 4000 people a year are estimated to die prematurely from cigarette smoking related illness. One in four smokers will die as a result of the practice of smoking.[6] These figures are bound to increase, as the types of disease known to be caused by smoking has increased in recent years. The most frequent cause of deaths in New Zealand is circulatory heart disease with a total of 1807 deaths. Table 6 below shows the broken down of the type of smoking-related deaths by males and females in 1988.[7] Cancer is the second common cause of death, claiming 1339 people's lives. Another major follow-up is bronchitis/emphysema, totalling 836 deaths. The number of deaths due to smoking-related diseases overall is higher for male smokers than for female smokers.

Table 3-3 Estimated Average Number Of Deaths Per Year Due To Smoking In NZ, 1981-85

Type of smoking related death	Men	Women	Total
Circulatory disease	1192	615	1807
Cancer	1049	290	1339
Bronchitis/Emphysema	615	221	836
Fire	3	2	5
Deaths in infancy			86
Total	2859	1128	4073

Source:
Health or Tobacco: An End to Tobacco Advertising and Promotion, Toxic Substances Board, 1989, Wellington

A more specific break-down of the types of smoking related deaths is taken from other research and tabulated in the table below.[8] Major causes of premature death among each of the categories above are Ischaemic Heart Disease - IHD (410-414), Chronic Obstructive Respiratory Disease - CORD (490-492 and 496) and Lung Cancer - LC(162) with the figures in the brackets being the ICD9 codes.

Table 3-4 Mortality And Hospital Utilisation Data

ICD9 codes	Hospital utilisation, 1984				Mortality for 1980-82 The number of deaths				1984-85 Attributed #	
	Admis -sions	Days stay	Attributed #							
			Adm	Days	14-44	45-59	60 +	PYLL*	Death	PYLL
Males										
Malignant neoplasm:										
Lips (140)	64	309	23	112	1	3	15	55	6	24
(141, 143-145)	148	2470	112	1861	7	45	84	441	103	370
Pharnyx (149-149)	156	2156	112	1541	6	52	99	445	118	374
Oesophagus (150)	223	4194	108	1935	8	96	334	715	210	466
Stomach (151)	359	7824	67	1452	36	169	857	1850	185	371
Pancreas (157)	210	3698	100	1762	24	110	545	1230	322	616
Larynx (161)	177	2908	145	2377	3	43	117	302	132	227
Lung (162)	2511	315055	2141	26865	57	836	3549	5653	3822	4530
Bladder (188)	947	8541	501	4515	9	43	408	386	250	144
Kidney (189)	206	2661	51	661	21	92	271	1054	97	212
CIS resp (231)	17	43	15	37	0	0	0	0	0	0
IHD (410-4140	8853	89170	1988	20025	508	3525	17479	31617	4179	7463
PUL (415-417)	272	4472	169	2775	6	14	103	294	73	194
CHF (428-429)	1963	38298	334	6512	20	51	1034	893	176	186
CI S(431-438)	2939	120460	208	8538	51	358	5148	3312	368	293
PVD (440-444)	2172	44997	1497	31011	17	105	1619	940	1165	693
CORD (490-492, 496)	3018	50483	2232	37331	16	269	3931	1678	3074	1286
E890-E899	201	3850	34	64≤	46	12	25	1590	14	265
Females										
Malignant neoplasm:										
Lips (140)	15	70	3	15	1	0	1	0	0	0
(141, 143-145)	102	1531	46	687	4	8	70	137	34	69
Pharnyx (149-149)	60	676	29	322	4	14	33	151	23	76
Oesophagus (150)	142	3040	87	1869	4	26	203	229	128	146
Stomach (151)	237	4953	0	0	38	72	524	1251	0	0
Pancreas (157)	147	2451	18	295	9	70	464	601	65	96
Larynx (161)	36	3470	15	27	0	7	22	40	13	20
Lung (162)	862	8881	585	6026	33	325	1140	2410	994	1749
Bladder (188)	831	11422	208	2860	114	144	236	4007	118	1057
Kidney (189)	100	1976	7	141	11	33	148	443	13	39
IHD (410-4140	4601	68707	552	8243	115	970	13837	8077	1475	1464
PUL (415-417)	258	4604	102	1826	13	28	129	547	59	256
CHF (428-429)	2049	54299	193	5117	29	39	1755	992	157	167
CI S(431-438)	2952	182052	276	17009	49	258	7800	2624	673	425
PVD (440-444)	1142	36427	652	20806	6	39	1310	358	713	253
CORD (490-492, 496)	1565	25143	1108	17809	7	190	1364	1105	1106	783
E890-E899	94	1736	16	289	12	6	36	588	9	98
LBW (764-765)	2492	40981	800	13151	(193)	na	na	na	62	na
SIDS	5	7	2	2	(1157)	na	na	na	370	na

Source:
Gray, A J, Reiken, J A and Laugesen, M. The cost of cigarette smoking in New Zealand. New

Zealand Medical Journal, 101(846), 25 May 1988, pp. 270-73, Table 3.

*	Potential years of life lost
CIS	Carcinoma in situ
IHD	Ischaemic heart disease
CHF	Congestive heart failure
CVA	Cerebrovascular accident
PVD	Peripheral vascular disease
CORD	Chronic obstructive respiratory disease
LBW	Low birth weight
SIDS	Sudden infant death syndrome

Hospital use due to smoking is very high in the three afore-mentioned diseases, (IHD, CORD, LC), as can be seen from the table. For example, for lung cancer treatment a total of 32,891 bed days was attributed to smoking out of 40,386 total bed days. That is, almost 82 per cent of hospital days are estimated to be spent by smokers who developed the disease in question. Likewise the ratio of hospital utilisation for chronic obstructive respiratory disease is also high at 67.1 per cent. Although the ratio of hospital utilisation for ischaemic heart disease is not as high as those two diseases above, this disease produces the largest number of deaths in New Zealand, so that special attention is to be paid to this disease as well. The economic costs of smoking are, therefore, to be extracted sorely from those three diseases in this study. It is a regret that the economic impact of peripheral vascular disease, which is another major cause of smoking-related deaths, is omitted from this study due to lack of data. However, it is believed that the above-mentioned diseases are sufficient to describe the general and economic implications of cigarette smoking.

3.7 The Health Costs

The cost from tobacco use to New Zealand publicly funded personal health care services in 1987 was estimated at $202 million in 1992 dollars. Not included in that figure are costs of passive smoking and costs of cigar and pipe smoking. The figure above included directly estimated hospital costs -

excess medicines and doctor visits.[9]

This cost figure, however, was estimated only from the perspective of the country as a whole. It does not inform any individual regarding how much he or she, the individual smoker, is likely to pay for health care costs if any are to be incurred at all. Nor does it indicate how much wages or salaries of each individual are lost while he or she is admitted to a hospital due to a smoking-related illness.

Contracting diseases due to cigarette smoking does indeed involve substantial human costs as can be found from such a country-wide costs of smoking. These are , however, accompanied by not only the illness care costs regardless of when he or she has to incur them and of whether or not he or she recovers from an illness, but also by productivity loss and hence lost earnings. These losses can be either temporary, if he or she can get back to work, or permanent when his or her life is terminated. These costs are not usually accounted for when we talk about the cost of smoking in general, since it is obviously more difficult to calculate them than the nominal costs of cigarettes. Nor are they included in the usual economic costs estimate of smoking. Therefore by calculating the magnitude of these costs, it is hoped that every individual will be encouraged to make the best decision as to smoke or not to smoke.

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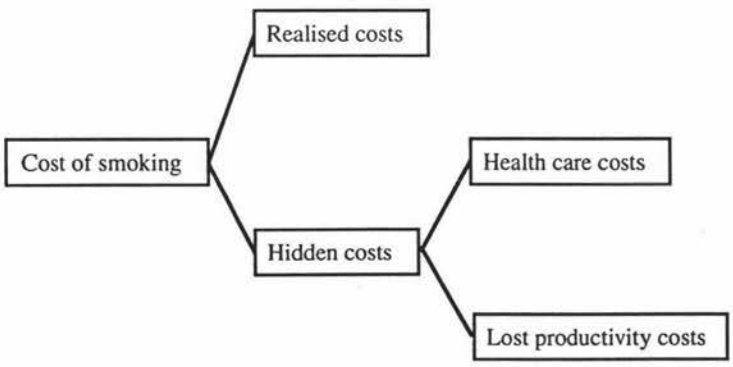
CHAPTER 4

METHODOLOGY

4.1 Types Of Expenditure

In the last chapter, it was pointed out that although individuals may be familiar with the diseases that they may contract as a result of cigarette smoking, they may not completely be aware of the economic costs that have to be borne by those who develop the diseases. They may even be unaware of the very notion of the likely or expected costs of smoking. The objective of this study is to estimate the amount of money that smokers lose, on average, as a result of smoking.

Fig 4-1: Cost Structure Of Smoking



The cost of smoking consists of two components: realised costs and hidden costs, as the diagram above shows. Realised costs are merely the cost of

cigarettes that he or she may have to incur during the course of his or her smoking life. On the other hand, hidden costs are the costs of smoking which are not in the normal sense counted as part of the cost of smoking. Hidden costs are further broken down into health-care costs and lost-productivity costs.

Expenditures on tobacco and tobacco related products such as lighters, ashtrays, etc. are obvious to any individual who smokes. Smokers are fully aware how much they spend on tobacco products and other accessories. Moreover if a smoker is asked how much he or she spends on smoking, he or she will probably give an estimate based on the number of packets he or she smokes and the number of lighters, ashtrays, etc. he or she consumes during a certain period of time. Hence this is termed the realised cost of cigarette smoking. For smokers, those expenditures are worth the benefits that they obtain from cigarette smoking, usually in the form of relaxation, increased concentration, etc.

However, smokers may not be realising at all that they will be incurring the potential hidden costs of cigarette smoking, that is, costs of health care and lost productivity. As noted in an earlier chapter, there are significant risks attached to people who smoke. If a smoker contracts a disease, he or she will have to pay for treatment that he or she will obtain to cure the disease in question. Incomes will also have to be foregone while he or she is in hospital. This could be temporary, if he or she recovers, or a permanent loss if his or her life is terminated. Moreover it is uncertain whether a smoker can get back to the original state of health in which he or she can maintain a maximum level of fitness. Work proficiency may be reduced after treatments because of reduced fitness, so that income may also be reduced because of diminishing work proficiency.

These factors are not usually taken into account when a smoker is asked how expensive smoking is. Smoking is like making a gamble. In gambling, most players will lose on average. The situation is very similar with cigarette smoking. Smokers are running higher risks of contracting certain diseases, compared to non-smokers. Most smokers will develop one kind of disease or another sooner or later, though some do not, so they will lose in the end despite their hope not to. The very difference from gambling is that smokers do not seem to realise that they will lose. Money that will be spent on treatments and that will be lost because of productivity loss which we call the hidden costs of cigarette smoking is not, therefore, realised by typical smokers. The ultimate objective of this study is to estimate these hidden costs of smoking, namely health care costs and lost earnings.

4.2 Prevalence-Based Studies

There are two types of studies which translate the health toll into economic costs. One type of study focuses on the prevalence-based costs of illness. The other focuses on the incidence-based costs of illness. The former approach looks at a particular year and identifies the costs of smoking-related diseases and the lost future income as a result of lost productivity. Such a method is particularly useful in identifying how much loss an economy, in a region or a country as the whole, suffered in a given year. Much of the studies conducted so far are based on this method. For example the cost of tobacco products used in New Zealand in 1988 is estimated at NZ$1.9 billion dollars, without counting the costs of passive smoking. This study was commissioned by the Australian Government. The cost of smoking in Australia in 1988, on the other hand, is estimated at A$6.84 billion, estimating the cost of previous and current tobacco use impacting in that year. Both estimates include all illness-care costs, loss of earnings of the

deceased, and the value of life of the prematurely deceased. No grief and suffering, or the cost of accidental fires are included.[1]

However smoking is not a transient epidemic, nor is it a disease in itself. Unlike some epidemics, for instance influenza, there is no way to compare the two states of a society or an economy, because there simply does not exist a non-smoking society or a smoke-free economy. Smoking reflects the characteristics of a society. It is thought to be a bad habit as many diseases are related to the use of tobacco products. It has been however for a long time one of the characteristics of our society and we have no measurement with which we can make comparisons. Neither can the prevalence approach analyse the likely long-term impact of a wide-spread adverse health practice like tobacco smoking, because it is simply not designed to do so. It is probably less than meaningful to say that a society lost a certain amount of money in a certain year because a certain smoking-related disease swept through the country. Comparing that amount with another possible year's estimate would give no clear picture of what is really happening.

4.3 Incident-Based Studies

The incidence-based approach, on the other hand, focuses on the costs of illness which a person incurs during a particular time period regardless of when those costs will be incurred. It also focuses on lost productivity due to a smoking-related illness. While taking into account both the realised and hidden costs of smoking, illness care, lost productivity, etc., as does the prevalence-based approach, the incidence-based study also takes a different approach from the prevalence-based study. The incidence-based approach estimates the costs of illness for the life-time of an individual instead of annually for a cross section of such individuals.

The incidence-based approach recognises that a smoker is participating in a deadly health gamble. There is a certain chance, or to put it another way, a certain risk of contracting a serious, if not fatal, disease. Like any gamble, this game has an expected outcome which in turn means the expected costs of cigarette smoking are involved. Of course not every smoker will incur these costs. Those who will lose will have much higher costs than the expected costs and those who will stay as healthy as non-smokers may incur no extra costs at all. However the expected outcome, and hence the expected costs, as in any other economic decision making process, will be a useful piece of information for any individual. Once a person is well informed regarding the potential economic consequences of cigarette smoking he or she, be they a smoker or non-smoker, may well be persuaded to give up smoking or not even to start taking up cigarettes in the first place, while a mere general knowledge of the national costs of smoking and of the potential health consequences will have little meaning for an individual.

4.4 Expected Costs Of Illness

Expected costs of illness consist of two flows of cost streams in the future, the health care costs and the foregone income and productivity costs. Although the lost productivity is not really a cost in an usual sense, as it involves no expenditure, it is definitely a cost to people as they have to forego a part of their wages and salary. Such flows of cost streams are calculated separately for the lost earnings and for the health care costs .

4.5 Lost Earnings And Productivity

The current full-time employment income of 5-year intervals by gender and current age is taken as a first step to estimate the expected lifetime income of

a healthy person. It is expressed in a mathematical form as shown in Equation 4-1 below.

Equation 4-1: 5-Year Employment Income

$$Inc_{s,n} = Y_{s,n}$$

where

$Inc_{s,n}$	5-year income of a person of sex s and current age n
$Y_{s,n}$	Actual income of a person of sex s and current age n taken from the Incomes 1992[2]
s	Sex
n	Current age

However this 5-year employment income cannot obviously be taken as future flows of incomes as some people may die along the way. Therefore it needs some adjustment. Such an adjustment will take into consideration the probability that a person of current age n of both sex will actually survive through some higher age n+x. Equation 2 below shows this adjustment to derive the expected 5-year employment income of a person of sex s and age n. The data on survival rates are taken from Demographic Trends for New Zealand.[3]

Equation 4-2: Expected 5-Year Employment Income

$$ExpInc_{s,n} = Inc_{s,n} \frac{S_{s,n}(l) + S_{s,n}(l+5)}{2 \times S_{s,n}(n)}$$

where

$ExpInc_{s,n}$	Expected 5-year income of a person of sex s and current age n
$Inc_{s,n}$	5-year income of a person of sex s and current age n
S	Survival rate: Percentage of persons of sex s and current age n who survive to some age l
s	Sex
n	Current age
l	Future age

This expected income can be treated as expected lifetime incomes of healthy persons where the average productivity of a healthy person at any age can be taken as 100 per cent. Since lost productivity cost is that employment income which a person diagnosed ill loses because of lower work proficiency or premature death, they can then be obtained by multiplying the expected employment incomes of healthy persons by a relative productivity for persons diagnosed ill. We expect to see that the expected employment income of a diagnosed person decreases relative to how young the person is and how high the expected income would have been without the disease. At time of writing, relative productivity figures for New Zealand are not available, so such statistics are taken from United States data reviewed and compiled in 1984.[4] The following equation is then used to estimate the relative productivity for 5-year intervals.

Equation 4-3: Relative Productivity

$$RelProd^{d}_{s,i} = Act^{d}_{s,i} \frac{S^{d}_{s,m}(n) + S^{d}_{s,m}(n+l)}{2 \times 100}$$

where

RelProd	Relative productivity of a person of sex s, diagnosed of d at year i past onset of the disease
Act	Activity level of a person of sex s, diagnosed of d at year i past onset of the disease
S	Percentage of survivors of sex s to age n, who were diagnosed of disease d at age m
i	Year past onset of the disease
s	Sex
n	Current age
m	Year of diagnosis
d	Type of disease

Equation 4-4 is the final step to obtain the expected employment income in any future 5-year intervals for a person diagnosed ill. Lost productivity costs are just the difference between the expected employment income of a healthy person and that of a diagnosed person.

Equation 4-4: Expected Income Of A Diagnosed Person

$$ExpInc_{s,n}^{d,m} = ExpInc_{s,n} \times RelProd_{s,i}^{d}$$

where

ExpInc	Expected 5 year income of a person of sex s, current age n, who was diagnosed of disease d at age m
RelProd	Relative productivity of a person of sex s, diagnosed disease d at year i past onset of the disease
i	Year past onset of the disease

s	Sex
n	Current age
m	Year of diagnosis
d	Type of disease

4.6 The Health Care Costs

Health care costs are comprised of two components. One is the average cost of treating a patient with a smoking-related disease per day. Another is the average bed day spent by a patient with the disease in question. These data are obtained from two sources, the first from a study done by Phillips, et al[5] and the second from Hospital and Selected Morbidity data.[6] Expected 5-year health care costs are then the product of the average cost per day and the average length of stay in hospital, which is shown in equation 5 below.

The treatment costs for each disease are also estimated with data directly obtained from the Ministry of Health's publication, Core Services for 1995/96, and through personal communications where needed, which are thought to give a more adequate estimate of the health care costs than the average disease costs would do.[7]

Equation 4-5: Health Care Costs

$$ExpHCC_{s,n}^{d,m} = ALS_{s,n}^{d,m} \times AC_{s,n}^{d,m}$$

where

ExpHCC	Expected 5-year health care costs of a person of sex s, current age n, who was diagnosed with disease d at age m

s	Sex
n	Current age
m	Year of diagnosis
d	Type of disease

4.7 The Present Value

When a decision involves income and/or cost streams in a future period, we usually net the costs of each year against the revenues of each year to find the discounted present value of the net revenues and/or net costs. This study is no exception. Since both the expected lost earnings and health care costs are to be incurred over a period of time, it is necessary to discount expected future flows of costs at an appropriate discount rate in order to be able to compare costs which fall at different periods. In this study the discount rate is chosen to be at 5 per cent, rather than simulating whatever the current discount rate is, in order for the study to remain conservative.

Also taken into account is the increasing productivity, which results in a general increase of expected incomes, and the growing medical expenses. The increasing productivity is assumed to be at 2 per cent and the growing medical care costs to be at 4 per cent, which bring down the net discount rate for the expected lost earnings to 3 per cent and for the expected health care costs to 1 per cent.

The following equations, Equation 4-6 and 4-7, which can be found in the next page, show the net present value of the lost earnings and health care costs respectively, calculated and discounted at the respective net discount rates chosen above.

Note that an adjustment of $(1+r)^{2.5}$ is made in both equations in order to obtain the mid period estimates. This is to comply with the earlier adjustments made to 5-year employment income.

Equation 4-6: NPV Of Lost Earnings

$$NPVLoss^{d}_{s,m} = \left(\sum_{i} \frac{1}{(1+r)^{5i}} ExpInc_{s,n} \right) x\ (1+r)^{2.5} - \left(\sum_{i} \frac{1}{(1+r)^{5i}} ExpInc^{d,m}_{s,n} \right) x\ (1+r)^{2.5}$$

where

NPVLoss	Net present value of lost earnings of a person of sex s, diagnosed of disease d at age m
ExpInc	Expected 5 year income of a person of sex s, current age n, who was diagnosed of disease d at age m
s	Sex
n	Current age
m	Year of diagnosis
d	Type of disease

Equation 4-7: NPV Of Health Care Costs

$$NPVHCC^{d}_{s,m} = \sum_{i} ExpHCC^{d,m}_{s,n}$$

where

NPVHCC	Net present value of health care costs of a person of sex s, diagnosed of disease d at age m

ExpHCC	Expected 5 year health care costs of a person of sex s, current age n, who was diagnosed of disease d at age m
s	Sex
n	Current age
m	Year of diagnosis
d	Type of disease

4.8 Expected Costs Of Smoking

While we have focused thus far on the costs of lost earnings and productivity and the health care costs of a person who is diagnosed of one of the smoking-induced illnesses, little has been mentioned concerning who is likely to incur these costs. Of course not everyone has to incur such costs dictated in the formulae above. The probability of contracting a certain smoking-related disease comes into the scene. Although the extra risk of smoking has yet to be determined in the following chapter, once obtained, it can be used to calculate the expected costs of smoking. Basically, the expected cost of smoking is the product of the probability of contracting a given disease and the net present value of lost earnings and health care costs on diagnosis of the disease in question. The expected costs of smoking then tell us how much we can expect to pay on average for lost income and productivity, and disease treatment.

4.9 The Marginal Risk Of Smoking

As was discussed in the previous chapter, a smoker bears much higher risks of contracting a number of serious, if not fatal, diseases than people who do not smoke at all or who quit smoking at some stage during his or her

lifetime. The difference between the disease specific-incidence rates of smokers and non-smokers of diagnosis can then serve as an approximation of the estimate of the marginal risk of cigarette smoking. The marginal risk of smoking can be calculated, as equation 4-8 shows below. Some marginal risk of smoking of diseases are quoted from oversees studies due to lack of such statistics for New Zealand.[8,9,10,11] Also note that a small adjustment is made to comply with the 5-year interval of the data structure.

Equation 4-8: Marginal Risk Of Smoking

$$MRS_{s,n}^{d,z} = 5 \times \frac{InRate_{s,n}^{d,z} - InRate_{s,n}^{d}}{100,000}$$

where

MRS	5-year marginal risk of a smoker of sex s, current age n, and level of tobacco consumption z who was diagnosed of disease d
InRate	Incidence rate of disease d for a person of sex s, current age n and level of tobacco consumption z
s	Sex
n	Current age
d	Type of disease
z	Level of tobacco consumption

4.10 Correction Factors

The procedure taken so far to estimate the lifetime costs of smoking implies that a smoker may contract more than one disease more than once in his or her lifetime. It is possible in reality that a person develops more than one

disease in a lifetime, or two or more diseases concurrently. However, since we are estimating the lifetime costs of smoking due to a certain smoking-related illness to the year of onset, double-counting of disease cost would result if individuals could incur one or more diseases more than once in a lifetime. Throughout the analysis in this study, therefore, it is assumed that a smoker can have one and only one disease once in their lifetime. This is to make as conservative an estimate as possible.

The assumption made above implicitly suggests that the likelihood of developing a disease at a certain future age is not equal to the likelihood of developing it once an individual reaches that age. They differ by the probability that an individual will succumb to the disease prior to reaching that age. If an individual dies before reaching a certain future age of possible disease onset, then he or she is no longer at risk of a smoking-related disease. For example, if the marginal risks of smoking-induced illnesses were very high at age of 90, it would not necessarily mean that the expected costs associated with those risks were similarly high. This is because relatively few persons, be they smokers or non-smokers, survive to that age. Thus the expected costs of smoking at each future age were adjusted for the likelihood of survival to that age. Equations 4-9 and 4-10 take the necessary adjustments.

Equation 4-9 provides an estimate of the total probabilities of being diagnosed with an illness for both smokers and non-smokers with each diseases under scrutiny. For the incidence rates to remain constant over a given 5-year interval, however, the sum of the annual incidence rates is multiplied by a factor of 5 to obtain 5-year probabilities. Equation 4-10 combines the total probability of being diagnosed ill and the general survival probabilities.

Equation 4-9: Probability Of Diagnosis

$$PDiag^{z}_{s,n} = 5 \times \sum_{d} \frac{InRate^{d,z}_{s,n}}{100,000}$$

where

PDiag	5-year probability of being diagnosed ill for a person of sex s, current age n, level of tobacco consumption z
InRate	Incidence rate of disease d for a person of sex s, current age n and level of tobacco consumption z
s	Sex
n	Current age
d	Type of disease
z	Level of tobacco consumption

Equation 4-10: Probability Of Diagnosis And Survival

$$SSND^{z}_{s,n}(n+5) = SSND^{z}_{s,n}(n) \times \frac{S^{s,n}(n+5)}{S^{s,n}(n)} \times \left(PDiag^{s,n} - PDiag^{z}_{s,n}\right)$$

where

SSND	Percentage of undiagnosed smokers of sex s, current age n, level of tobacco consumption z, who survive to age n+5
S	Percentage of persons of sex s and current age n who survive to age n+5
PDiag	5-year probability of being diagnosed ill for a person of sex s, current age n, level of tobacco consumption z
s	Sex

n	Current age
z	Level of tobacco consumption

4.11 Expected Costs Of Smoking Revisited

The expected value of lost earnings and health care costs due to smoking can at last be estimated, based on the expected value of lost earnings, the marginal risk of smoking, and the number of smokers still unaffected. Equations 11 and 12 show how expected lost earnings and expected health care costs are calculated. The expected lost earnings are the product of the expected value of lost earnings, the marginal risk of smoking, and the correction factors. Similarly the expected health care costs are the product of the expected health care costs, the marginal risk of smoking, and the correction factors.

Equation 4-11: Expected Lost Earnings

$$\text{ExpLoss}^{z}_{s,n} = \sum_{d} \frac{\text{NPVLoss}^{d}_{s,m} + \text{NPVLoss}^{d}_{s,m+5}}{2} \times \text{MRS}^{d,z}_{s,n} \times \frac{\text{SSND}^{z}_{s,n}(n) + \text{SSND}^{z}_{s,n}(n+5)}{2 \times \text{SSND}^{z}_{s,n}(n)}$$

where

ExpLoss	Expected lost earnings of a smoker of sex s, current age n, and level of tobacco consumption z in future 5-year intervals
NPVLoss	Net present value of lost earnings of a person of sex s on diagnosis of disease d at age m

MRS	5-year marginal risk of a smoker of sex s, current age n, and level of tobacco consumption z who was diagnosed of disease d
SSND	Percentage of undiagnosed smokers of sex s, current age n, level of tobacco consumption z, who survive to age n+5
s	Sex
n	Current age
d	Type of disease
z	Level of tobacco consumption
m	Year of diagnosis

Equation 4-12: Expected Health Care Costs

$$ExpHCC^{z}_{s,n} = \sum_{d} \frac{NPVHCC^{d}_{s,m} + NPVHCC^{d}_{s,m+5}}{2} \times MRS^{d,z}_{s,n} \times \frac{SSND^{z}_{s,n}(n) + SSND^{z}_{s,n}(n+5)}{2 \times SSND^{z}_{s,n}(n)}$$

where

ExpHCC	Expected health care costs of a smoker of sex s, current age n, and level of tobacco consumption z in future 5-year intervals
NPVHCC	Net present value of health care costs of a person of sex s on diagnosis of disease d at age m
MRS	5-year marginal risk of a smoker of sex s, current age n, and level of tobacco consumption z who was diagnosed of disease d

SSND	Percentage of undiagnosed smokers of sex s, current age n, level of tobacco consumption z, who survive to age n+5
s	Sex
n	Current age
d	Type of disease
z	Level of tobacco consumption
m	Year of diagnosis

4.12 Discounting For Future Costs

The expected lost earnings and health care costs which will fall in any future 5-year intervals should then be discounted back and summed up for each of the different age-groups of smokers. The following formulae, Equation 13 and 14, show how it is done. Note that an extra (1+r)2.5 is multiplied in order to get mid point values of 5-year intervals.

Equation 4-13: Net Present Value Of Expected Lost Earnings

$$NPVLoss^{z}_{s,n} = \sum_{i} \frac{1}{(1+r)^{5i}} ExpLoss^{z}_{s,n} \times (1+r)^{2.5}$$

where

NPVLoss	Net present value of lost earnings for a smoker of sex s, current age n, level of tobacco consumption z
ExpLoss	Expected lost earnings for a smoker of sex s, current age n, level of tobacco consumption z in future 5-year intervals
s	Sex

n	Current age
z	Level of tobacco consumption

Equation 4-14: Net Present Value Of Health Care Costs

$$NPVHCC^{z}_{s,n} = \sum_{i} \frac{1}{(1+r)^{5i}} ExpHCC^{z}_{s,n} \times (1+r)^{2.5}$$

where

NPVHCC	Net present value of health care costs for a smoker of sex s, current age n, level of tobacco consumption z
ExpHCC	Expected health care costs for a smoker of sex s, current age n, level of tobacco consumption z in future 5-year intervals
s	Sex
n	Current age
z	Level of tobacco consumption

4.13 Total Costs Of Smoking

The total expected costs of smoking, or in other words the hidden costs of smoking, are simply the sum of the net present values of lost earnings and health care costs which have been calculated so far. The formula is listed in Equation 15 below.

Equation 4-15: Total Costs of Smoking

$$TCS^{z}_{s,n} = NPVLoss^{z}_{s,n} + NPVHCC^{z}_{s,n}$$

where

TCS	Total expected costs of smoking by sex s age n and level of tobacco consumption z
s	Sex
n	Current age
z	Level of tobacco consumption

Reference For Chapter 4

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CHAPTER 5

LOST INCOME

5.1 Lost Productivity And Income

In the previous chapter it was shown that the cost of smoking consists of two cost component: loss in earnings and health care costs. This chapter presents the resulting estimation of the expected value of all disease-related productivity losses which a smoker is bound to incur due to his or her increasing health risks. The result of expected health care costs due to smoking is reserved for next chapter.

Lost earnings result from temporary illness, permanent disability or premature death. A smoker will most likely encounter one of these health conditions if he or she develops any smoking-related diseases. Three smoking-related diseases have been, as discussed in an earlier chapter, selected because of their significance. They are lung cancer, chronic obstructive respiratory disease and ischaemic heart disease. Unlike actual spending on packs of cigarettes, lost earnings resulting from developing any of the illnesses under scrutiny are less obvious to a smoker, since no actual spending is involved and probability issue is involved.

In order to estimate the lost earnings, the following points should be elaborated.

Employment income of a healthy person

Employment income of a diagnosed person

Risk of smoking

Today's money value

These points will be discussed in order and necessary data will be presented as well.

5.2 Productivity And Earnings Of A Healthy Person

The value of productivity of an individual is based on average employment incomes which a typical person is expected to earn, thereby assuming that the average employment income appropriately reflects the economic productivity of a healthy person. Such average employment income figures are taken from Incomes 1992, the annual publication of Statistics New Zealand.[1]

Table 5-1 5-Year Employment Income In New Zealand (NZ$'000)

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male	24.0	26.0	26.2	25.4	23.9	22.4	14.9	10.4	9.4
Female	9.1	10.4	11.3	11.1	9.3	7.9	8.7	8.7	8.9

Source: Incomes 1992, Statistics New Zealand, 1993, Wellington

Table 5-1 presents the employment income flows, in 5-year intervals, which a healthy person is expected to receive every year on average. The figures are for full-time employees, who according to definition are supposed to work 30 or more hours per week for wages and/or salaries, and whose principal source of income is wages and/or salaries. The table shows that male workers earn more income on average than any female workers do in any age group. The table also shows that the income level tops off at the age

of 40 to 45, which in turn suggests that a person in that age group is the most productive of all. This holds true for both men and women. After the retirement age of around 60 to 65, income declines rapidly. This is especially notable for male workers, as they earn the greatest amount of their total income while in the workforce.

Note that these figures are cross-sectional data which are obtained at a specific point in time. However further calculations will involve time-series data of an individual for each of the age groups, which can not be found from any sources. Hence it is assumed that a person of sex s and current age n will continue to earn as much as a person in an other older age group of the same sex is expected to earn. A 30 year-old male person will, for example, earn \$25.8 (={26.2+25.4}/2) thousand when his age is between 40 to 45. Likewise a 40 year-old male person will be earning \$12.7 (={14.9+10.4}/2) thousand when his age is from 60 to 65.

This assumption regarding the steady state of income flow should, however, be subject to the general survival rate. Customarily, not everyone will survive to a certain higher age. There are always some risks of prematurely dying one way or another. Hence the average income flows should be adjusted to reflect the expected life-expectancy of the general population in each age group. As the expected incomes depend upon the probability that a person of current age n will actually survive to age n + i, the expected income of a person of age n can be derived from multiplying the 5-year employment income by the general survival rate.

The following table 5-2 presents the survival rate of the general New Zealand population in 5-year intervals starting from one hundred live births. This table of figures exhibit a typical pattern. That is, women have a higher life expectancy at any age over men. For example, 97.9 per cent of all female live births are still alive at age 35, whereas only 95.6 per cent of all

male live births are alive at the same age. Such a discrepancy becomes more apparent as both sexes get to older ages.

Table 5-2 The Survival Rates Of The General Population

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male	0.962	0.956	0.947	0.937	0.920	0.893	0.847	0.779	0.677
Female	0.981	0.979	0.974	0.966	0.953	0.933	0.903	0.860	0.796

Source: Health Statistical Services, Mortality and Demographic Data 1980-1990, Wellington: Department of Health, 1982-92.

The following table 5-3 shows the resulting figures for the expected annual employment incomes of a person of currently 30 years of age in New Zealand. The figures are derived from multiplying the 5-year employment income by the general survival rate. For example, the expected income of a man of age 30 is $25.66 thousand in his 40 to 44 years. Note that there are a whole series of tables for a person in each of the age group, but they are simply omitted here to save space. Note also that a small adjustment is made to obtain the probability of survival to the middle of the age interval. In this example, it is calculated as follows:

$$\text{Income in ages between 40-44 (Male, 30)}$$

$$= 26.2 \times \{ (94.7 + 93.7)/2 \} / 96.2$$

Table 5-3 The Expected Annual Employment Income Of A Person Of Currently 30 Years Of Age At Age N And By Sex S

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male	23.94	25.68	25.66	24.47	22.51	20.28	12.57	7.84	3.30
Female	9.13	10.31	11.21	10.85	8.91	7.41	7.78	7.31	3.61

Two more adjustments need to be made before arriving at the expected employment income of a healthy person. One adjustment is the long-run growth in workers' productivity, another is the discounting rate.

In the long run, real income tends to increase as productivity grows over time. Merely taking current incomes as future income, as has been done so far, would lead to an underestimation of true future income flows. To make such an adjustment, a productivity growth rate of 2 per cent is arbitrarily chosen, rather than projecting current growth rates of productivity. This is in order to remain as conservative an estimate as possible. The 2 per cent productivity growth means that a person who earns $ X today will earn $X(1+0.02)$ next year, $X(1=0.02)^2$ in two years time, etc.

The adjusted future employment income should, however, be discounted back to its present time horizon to make any meaningful comparisons. While long run productivity growth raises future flows of income, such future income gets worth less and less as time goes by. A dollar in the future does not carry the same value as a dollar today, since a dollar can be invested today at some bank to yield more than a dollar sometime in the future. A dollar in the future is worth somewhat less than a dollar today by the amount of a compounding interest rate. The value of future flows of employment income is reduced according to a discount rate, but only in terms of today's money value. Discounting procedure is usually employed in many project evaluations which involve a stream of income at different periods of time in the future, and such is the case in this study. In this study a discount rate of rather conservative 5 per cent has been selected for the same reason as when choosing the rate for productivity growth.

The discounting procedure works in quite a similar way to an interest rate, but completely the opposite fashion. An interest rate of r per cent means that X dollar invested today will be worth $ $(1+r)$ X next year and $ $(1+r)^2$ in

two years from now. A discount rate of R per cent, on the other hand, implies that X dollar received in a year from now is only worth $ 1/(1+R) X today. By the same token, X dollars received in two years time is worth $ $1/(1+R)^2$ X today. It is obvious by now that discounting is like a negative interest.

Since the discounting procedure also affects the future income stream in the opposite way productivity growth does, they can be combined to obtain a net for the discount rate. With a productivity growth rate and discount rate of 2 and 5 per cent respectively, a resulting net discount rate of 3 per cent is obtained. Such a discount rate is then used to estimate the net present value of future employment income. Table 5-4 presents the results.

Table 5-4 Net Present Value Of Future Employment Incomes Of A Healthy Person By Sex And Current Age ($'000)

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male	710	628	533	431	331	235	143	84	44
Female	326	297	261	218	175	140	111	78	42

A male person of age 40, for example, is expected to earn a future employment income of $533,000, or $331,000 if he was at the age of 50, $143,000 at the age of 60, and so on, all in today's money value. It can also be described that while a female person of age of 30 earns a future income of $326,000 another female person aged 50 earns only $175,000. This is of course true because the younger the person is the more employment income he or she receives, and hence the larger is the net present value of future employment income. The results just obtained serve as a reference with which the magnitude of lost earnings due to smoking can be compared.

5.3 Lost Productivity Due To Smoking

A smoker who develops a smoking-related disease will suffer the consequence of lost income while he or she is hospitalised for treatment. This is, as discussed, one of the two hidden costs of smoking. Such a loss in earnings can be estimated, compared to a healthy person who is supposed to lose no income, based on the reduced survival probability of a diagnosed person and his or her reduced activity rate. One qualification, however, needs to be addressed. It is assumed that a person will remain as active, productive and hence in the same condition as a healthy person in the general population if he or she, the smoker, does not develop any smoking induced diseases at all. Hence a clear comparison regarding incomes he or she earns can be made between a diagnosed and healthy person.

Table 5-5 Survival Rate At Year End By Disease, Sex And Age Of Diagnosis (%)

Year	LC		MI				CI						CORD
	M	F	M	M	M	F	M	M	M	F	F		M&F
	All		All	35-54	55-64	65+	All	35-54	55-64	65+	35-64	65+	All
1	29.6	29.8	92.0	85.1	67.8	80.0	95.3	96.6	92.5	92.3	96.0	92.5	
2	19.9	22.7	90.8	82.4	62.8	76.0	94.6	93.5	85.7	87.7	92.7	79.5	
3	13.3	17.3	89.5	78.0	58.1	71.7	93.2	88.5	79.3	82.7	89.3	67.5	
4	9.0	13.1	86.9	74.3	53.7	67.1	90.5	84.3	73.3	77.4	86.0	59.5	
5	6.0	10.0	81.5	68.6	49.7	63.1	84.9	77.9	67.8	71.6	82.8	54.0	
6	4.0	7.6	78.7	65.5	46.0	59.4	82.0	74.3	62.8	68.5	79.8	48.5	
7	2.7	5.8	72.6	62.2	43.0	53.3	75.6	70.6	59.0	61.5	73.0	43.0	
8	1.8	4.4	67.8	61.0	42.0	46.2	70.6	69.2	57.0	53.3	68.0	33.9	
9	1.2	3.4	65.9	58.4	40.0	40.0	68.6	66.3	54.0	51.0	66.0	28.3	
10	0.8	2.6	60.8	55.5	34.0	34.0	63.3	63.0	52.0	45.0	61.0	23.5	
15	0.1	0.7	50.0	44.0	0.0	30.0	52.0	50.0	0.0	34.0	0.0	12.4	

LC Lung cancer
MI Myocardial infarction
CI Coronary insufficiency
CORD Chronic obstructive respiratory disease

Survival probability and activity rate are all different between a diagnosed and healthy person, and they really are influencing factors in determining the amount of employment income earned.

Table 5-5 above lists the survival rate of smoking related diseases, which in this study are lung cancer, chronic obstructive respiratory disease and ischaemic heart disease (Myocardial infarction and coronary insufficiency). Such statistics for New Zealand are not available at the time of writing, so they are taken from various sources.[2] The life expectancy of a healthy person is of course 100 per cent.

With lung cancer, the most serious disease of all three, most people will not survive to the first year past onset of the disease. Chronic obstructive respiratory disease also reduces the survival rate dramatically comparative to Ischaemic heart diseases which still has a significant impact on the survival probabilities of a diagnosed person.

Table 5-6 Relative Activity of a Diagnosed Person In Years Past Onset Of The Disease By Sex And Age Of Diagnosis

Year	LC	MI				CI					CORD
	M&F	M	M	Male	M	F	F	F	F		M&F
	All	35-44	45-54	55-64	65+	35-44	45-54	55-64	65+		All
1	0.0	60.6	60.0	46.4	45.4	59.5	58.9	47.2	47.2		93.3
2	6.0	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		80.0
3	25.0	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		66.7
4	44.0	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		53.3
5	83.0	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		40.0
6	100	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		26.7
7	100	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		13.3
8	100	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		0.0
9	100	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		0.0
10	100	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		0.0
15	100	95.8	90.3	77.8	75.0	92.3	87	75.5	74.3		0.0

LC	Lung cancer
MI	Myocardial infarction
CI	Coronary insufficiency
CORD	Chronic obstructive respiratory disease

Table 5-6 above shows activity rate, the second factor which affects the expected earnings of a diagnosed people. As can be seen from the table, it is somehow related with survival probabilities, except for chronic obstructive respiratory disease, in a way that has a disproportionate relationship. For those who survive from lung cancer and ischaemic heart disease, a fairly high rate of activity rate is restored after some years. Activity level for lung cancer patients goes back to the original state of health condition which a healthy person enjoys after 5 years past onset of treatment, but this is for only a small handful of lucky people.

Those who survive from ischaemic heart disease also return to a fairly high activity level, as this is not as serious a disease as lung cancer. The survival rates for ischaemic heart disease patients are much higher than those with lung cancer all through the 15 years past onset of the diseases. Chronic obstructive respiratory disease, however, induces a steady decline in people's working ability, which reaches zero per cent after 7 years even though the survival rate is still at 33 per cent. It is rather more serious disease than it is usually perceived to be.

From these two probabilities, of activity and survival, relative productivity of a person once diagnosed ill can be estimated, taking an average for 5-year intervals. Table 5-7 below presents the results.

The relative productivity of lung cancer patients who have recovered is extremely low right from the very early stage. In other words they will start losing almost all the income that a healthy person enjoys earning, right after they develop the disease in question. The same goes for the chronic

obstructive respiratory disease patient's relative productivity. Although for the first 5 years about 53 per cent of productivity still remains, it is reduced to almost none from 5 years past onset of the disease. For the ischaemic heart disease, productivity is steadily reduced over the long term.

Table 5-7 Relative Productivity In 5-Year Intervals After Diagnosis By Disease, Sex And Age (%)

Year	LC	MI	MI	MI	MI	CI	CI	CI	CI	COPD
Sex	All	35-44	45-54	55-64	65+	35-44	45-54	55-64	65+	All
Male										
0-5	3.4	79.5	75.4	57.1	42.6	82.4	78.3	64.1	56.5	52.8
5-10	2.4	68.2	64.3	48.1	32.2	71.1	67.0	54.6	43.8	4.0
10-15	0.6	54.3	51.2	39.3	14.6	56.5	53.3	44.6	19.7	0.0
Female										
0-5	4.6	63.5	60.3	51.7	51.0	72.3	68.7	58.9	62.4	52.8
5-10	5.5	45.6	43.0	37.3	36.7	54.0	50.9	44.2	53.3	4.0
10-15	1.9	30.9	29.1	25.3	24.9	37.8	35.7	31.0	23.6	0.0

LC	Lung cancer
MI	Myocardial infarction
CI	Coronary insufficiency
COPD	Chronic obstructive respiratory disease

Finally the loss in earnings on diagnosis can be determined by multiplying the 5-year employment income of a healthy person with the relative productivity of a diagnosed person. Table 5-8 presents the lost earnings of a diagnosed person against the employment income of a healthy person.

The loss is substantial, as can be seen from the table below. The lost earnings, as expected, are larger the lower the relative productivity is and the younger a person is, if he or she develops the diseases under scrutiny. As commented for the smoker's relative productivity, a smoker who happens to develop lung cancer and chronic obstructive respiratory disease will lose

almost all the employment income that he or she will earn during his or her life-time. The figures are still high for Ischaemic heart disease patients, including myocardial infarction and coronary insufficiency.

Table 5-8 Net Present Value Of The Lost Income On Diagnosis By Sex, Age And Disease

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male									
Income if Healthy	710	628	533	431	331	235	143	84	44
Loss on Diagnosis									
LC	694	614	521	422	324	230	140	82	44
MI	232	205	174	157	120	122	74	59	31
CI	213	188	160	146	112	107	65	50	27
CORD	570	504	428	346	266	189	115	67	36
Female									
Income if Healthy	326	297	261	218	175	140	111	78	42
Loss on Diagnosis									
LC	313	285	250	209	168	135	107	74	40
MI	174	158	139	122	98	87	69	48	26
CI	148	134	118	105	85	78	62	42	23
CORD	225	205	180	151	121	97	77	54	29

LC	Lung cancer
MI	Myocardial infarction
CI	Coronary insufficiency
COPD	Chronic obstructive respiratory disease

5.4 Marginal Health Risk Of Smoking

While so far the expected loss in employment income due to the three smoking related diseases has been estimated, nothing has been said about who is likely to incur such a loss in earnings. Whereas every smoker has a risk of developing such serious, if not fatal, diseases, not all smokers will contract the diseases in question. In fact, a smoker is playing a lottery with

his or her health. Like usual lotteries played elsewhere, only a lucky winner, in this case the unlucky losers, will suffer the consequences. Such unlucky losers, in other words, must bear the economic costs as estimated above.

Therefore the marginal risk of smoking or the probability of getting diagnosed of one of the smoking-related diseases has yet to be determined to estimate the expected loss of productivity. The annual incidence rates are reported in the Ministry of Health's publication, Selected Morbidity and Hospital data.[3] This data does not, however, distinguish between the levels of cigarette consumption. It does not distinguish between smokers' and non-smokers' incidence. Hence the attributable risks of smoking were used to derive smoker's and non-smoker's incidence.[4]

Table 5-9 below shows the relative risks of smoking. Note that some of the statistics about the risks of smoking are obtained directly from other studies, just as many New Zealand studies do, which were felt to be more reliable than estimating from scratch using limited New Zealand information.

Table 5-9 Marginal Risk of Smoking

	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male									
LC	0.23	0.76	2.55	4.28	5.87	9.21	11.42	12.36	9.93
IHD	1.30	1.50	1.50	1.70	1.70	1.90	1.90	1.40	1.40
CORD	0.25	0.81	2.70	4.53	6.21	9.75	12.10	13.09	10.51
Female									
LC	0.11	0.15	0.41	0.86	1.27	2.09	3.49	3.82	3.56
IHD	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64
CORD	0.12	0.16	0.43	0.91	1.35	2.21	3.69	4.04	3.77

LC	Lung cancer
MI	Myocardial infarction
CI	Coronary insufficiency
COPD	Chronic obstructive respiratory disease

The figures in the table show the probability of how a smoker being affected by one of the diseases against non-smokers. The probability of developing lung cancer and chronic obstructive respiratory disease is devastating, much higher among men than among women. The probability of ischaemic heart disease seems very small and is not much different between the sexes, but it is a major cause of death in New Zealand. As described in chapter 3, the amount of hospital use by ischaemic heart disease patients is almost as high as lung cancer patients' usage.

5.5 The Net Present Value Of The Lost Earnings

The marginal risk of smoking provides information required to develop an estimate of the expected loss of productivity and income due to smoking. Smoking, as a health gamble, can then be characterised as the average outcome or expected value, the value equal to the product of the probability of losing in this case and the amount of money that a smoker will earn in his or her lifetime. Of course not all smokers will actually incur such average costs of smoking. A smoker who happens to develop lung cancer may actually pay an even greater amount than is suggested by the figures. A smoker who happens to contract ischaemic heart disease may not incur as high a cost as is suggested. On the whole, however, the average or expected figures on the costs of smoking convey useful information which anyone can digest, to understand how poor the odds of winning are which a smoker is facing with the smoking game.

Such an average or expected figure is subject to a further adjustment. Since this game of smoking involves a future stream of income and expenditure fallen at different periods of time, a discounting procedure with appropriate discount rate applies in order to make meaningful comparisons at the time of analysis.

Table 5-10 shows the net present value of expected loss of income due to each one of the smoking-related diseases. Also shown with it is the percentage figures of future income.

Table 5-10 Net Present Value Of Expected Lost Productivity And Income Due To Smoking ($'000)

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male									
Income if									
Healthy	710	628	533	431	331	235	143	84	44
Lost Income									
LC	31	33	34	33	29	24	16	9	8
IHD	11	10	9	7	6	4	2	1	1
CORD	33	35	36	34	31	26	17	10	8
As Percentage of Future Income									
LC	4.42	5.24	6.35	7.54	8.83	10.39	11.36	11.29	17.26
IHD	1.58	1.64	1.67	1.73	1.74	1.76	1.64	1.40	2.43
CORD	4.68	5.54	6.73	7.98	9.35	11.00	12.03	11.96	18.27
As Months of Future Income									
LC	15.7	15.2	15.5	15.4	14.7	13.0	13.1	11.0	9.8
IHD	5.6	4.8	4.1	3.5	2.9	2.2	1.9	1.4	1.4
CORD	16.6	16.1	16.4	16.3	15.5	13.8	13.8	11.6	10.4
Female									
Income if									
Healthy	326	297	261	218	175	140	111	78	42
Lost Income									
LC	4.5	4.3	4.5	4.5	4.2	4.0	3.6	2.5	2.4
IHD	5.3	4.6	4.0	3.3	2.6	2.1	1.6	1.1	1.1
CORD	4.8	4.5	4.7	4.7	4.5	4.3	3.8	2.6	2.5
As Percentage of Future Income									
LC	1.38	1.44	1.71	2.06	2.42	2.88	3.21	3.20	5.60
IHD	1.64	1.55	1.54	1.53	1.48	1.48	1.45	1.42	2.58
CORD	1.46	1.53	1.81	2.18	2.56	3.04	3.39	3.39	5.94
As Months of Current Income									
LC	5.9	5.0	4.7	4.9	5.5	6.1	5.0	3.4	3.2
IHD	7.0	5.3	4.2	3.6	3.4	3.1	2.2	1.5	1.5
CORD	6.3	5.3	5.0	5.1	5.8	6.5	5.2	3.6	3.4

The loss in productivity and income is significant, as can be seen from the table above. A male smoker of age between 40 and 45 will expect to see the loss of his income by $34,000 due to lung cancer, which is as much as 6 per cent of his entire lifetime income as listed. Although a female smoker will not expect as high an income loss as a male smoker in general, it still costs around $4,500 for the same disease in the same age group.

A smoker, both male and female, will suffer most from chronic obstructive respiratory disease in terms of lost incomes. A smoker in his or her forties can expect the worst, since more income than anyone in any other group will be taken away because of the disease. The lost earnings due to lung cancer are also nearly as high as for chronic obstructive respiratory disease. Ischaemic heart disease has the least impact on the productivity and income of a smoker, but an impact there is.

The percentage loss in future income in today's money terms ranges from 2 to 18 per cent for a male smoker and from 1 to 6 per cent for a female smoker, which means that a smoker's productivity is 2 to 18 per cent lower for men and 1 to 6 per cent lower for women than those of non-smokers in general. Except for Ischaemic heart disease, the share of the loss of productivity and income in life-time income is increasing. The older a person is today, the greater proportion of their entire lifetime income he or she can expect to lose. This is due to the increasing risk of developing the disease and the declining sum of future stream of income as a person gets older.

Moreover, the expected loss in earnings is approximately worth at most 16 months for a male smoker of age 30 to 45 who happens to develop chronic obstructive respiratory disease. It is worth around 6 months of income for a female smoker of a similar age. Having no incomes whatsoever for those

periods is almost equivalent to a period of unemployment with no compensation.

It is also useful to compare the actual expenditures with the expected lost incomes just estimated above. An average smoker consumes about 5,000 cigarettes per year, which is worth approximately $1,500 a year. These are the costs that a smoker realises. Then a healthy survivor will continue spending on tobacco products until he or she develops one of the smoking-related diseases under scrutiny. It is assumed that a smoker at least stops smoking once he or she is diagnosed of any of the diseases in question.

Table 5-11 Net Present Value of Expenditures On Tobacco Products ($'000)

	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male Spending	30.8	28.3	25.4	22.3	18.9	15.2	11.4	7.7	4.1
Female Spending	36.3	34.1	31.6	28.8	25.5	21.7	17.4	12.4	6.7

Table 5-11 above presents the net present value of a lifetime expenditure on tobacco products by healthy persons. As can be seen from the table, the younger a person is the more spending on tobacco products is involved. The expenditure by a healthy male smoker is much the same amount as the loss in productivity and income due to smoking. This directly suggests that cigarette smoking costs around twice as much as what a smoker actually realises it costs.

This is only for male smokers, however. The story is very much different for women. Since the incidence rates are much smaller for females and a person is assumed at least to stop smoking once he or she develops one of the diseases, female smokers are expected to spend more on cigarettes than

male smokers, as the figures in the table show. The actual spending on tobacco products by females of age 30 to 35 is ten times as high as the expected lost income. In other words, though the expected lost income due to smoking is not as high as that of male, it still consists of one tenth of the total cost of smoking. Such a ratio gradually increases as she gets older, approximately to one third of the total cost of smoking. However, the estimates of the total hidden costs of smoking are bound to increase as the health care costs have yet to be determined, which is the centre of focus in the next chapter.

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CHAPTER 6

HEALTH CARE COSTS

6.1 The Costs Of Health Care

In the previous chapter, the loss of productivity and income due to smoking related illness was estimated. Such an estimate was developed so as to reflect an average, expected outcome of what can be termed a smoking gamble. The estimate was also a discounted value, adjusted to incorporate future values of income flows into the framework of the present analysis. With that estimate, a smoker will know how much he or she is likely to lose on average by playing the smoking gamble.

However, that is only one side of the coin. The estimate developed thus far only tells how much income a smoker would lose if he or she developed one of the smoking-related diseases in question. Yet nothing has been said about the cost of treatment if a smoker needs to be hospitalised to receive some health care. Surely this is an expense that a smoker is likely to bear during his or her lifetime and that should be included in the overall costs of smoking.

In this chapter, the costs of health care are to be estimated for each of the smoking-related diseases under scrutiny, lung cancer, ischaemic heart disease and chronic obstructive heart disease. This will be an expected figure and discounted value, for much the same reason as for the estimate of the loss in productivity and income.

6.2 Costs Of Treating Three Illnesses

The total costs of treatment for each of the smoking related diseases, namely, lung cancer, ischaemic heart disease and chronic obstructive respiratory disease can be approximated by multiplying the average acute bed day costs by the mean number of days stay in hospital due to each illness. While the average acute bed day costs are sufficient as a convenient approximation, more accurate profile of disease specific hospital costs can be obtained from the management information systems installed in some area health boards. In this study data from the resource utilisation system (RUS) of the Otago Area Health Board are used to estimate the total costs of each of the health cares needed for each illnesses.[1] Table 6-1 presents the costs per bed day of the three diseases. It also shows in days the mean number of length of stays day in hospital.

Table 6-1 Costs And Length Of Stay

Disease	ICD Code	Cost/Bed day	Length of stay
Male			
Lung cancer	162	377	10.4
Ischaemic heart disease	410-414	669	8.5
Chronic obstructive respiratory disease	490-494, 496	350	6.8
Female			
Lung cancer	162	377	11.3
Ischaemic heart disease	410-414	669	12.7
Chronic obstructive respiratory disease	490-494, 496	350	6.6

As can be seen from the table, while the costs per bed day of lung cancer is similar to those of chronic obstructive respiratory disease at $377 and $350 respectively, the costs per bed day of ischaemic heart disease is the highest of

all at $669, almost twice as much as those of lung cancer and chronic obstructive respiratory disease.

Average length of stays, in the meantime, varies across the three diseases and gender. The length of stay of chronic obstructive respiratory disease patients is the shortest of all three diseases, an average of 6.8 days for males and 6.6 days for females. The longest length of stays spent in hospital are for female patients with ischaemic heart disease and male patients with lung cancer disease. Those figures above in the table are then utilised to obtain the total annual costs of health care for each of the diseases in question.

Table 6-2 Total Costs Of Health Care

Disease	ICD Code	Total costs
Male		
Lung cancer	162	3921
Ischaemic heart disease	410-414	5687
Chronic obstructive respiratory disease	490-494, 496	2380
Female		
Lung cancer	162	4260
Ischaemic heart disease	410-414	8496
Chronic obstructive respiratory disease	490-494, 496	2310

Table 6-2 shows the resulting figures. Because of the high costs per bed day of ischaemic heart disease, and because of the long length of stay during treatment, the total cost for the ischaemic heart disease is the highest of all three diseases both for males and for females. Notably, the total cost of ischaemic heart disease for females is a whopping $8,496, almost twice as much as that of lung cancer and nearly four times as much as that of chronic obstructive respiratory disease. The second highest cost of treatment is for

lung cancer, at $3,921 for males and $4,260 for females. The lowest of all is for chronic obstructive respiratory disease, costing $2,380 and $2310 for males and females respectively.

Since these figures are already average figures they can be treated in such a way as the expected costs of health cares. It is also assumed that those costs are independent of people's age, so that the figures in the table are representative of all age groups. In other words, they represent the net present values of the treatments for all age groups. The cost of lung cancer treatment for a person aged 30 years is assumed to be the same as for a person of 50 years old and so on. Such figures are listed and arranged by gender and age groups in Table 6-3 below. A word of note is that these figures are conservative estimates as they are averaged costs for each of the diseases. There are, however, more treatment specific data on each disease made available by the Ministry of Health, which are to be looked at next.[2]

Table 6-3 Net Present Value Of Expected Health Care Costs

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Disease Group									
Male									
Lung cancer	3921	3921	3921	3921	3921	3921	3921	3921	3921
Ishaemic heart diseases	5687	5687	5687	5687	5687	5687	5687	5687	5687
Chronic obstructive respiratory diseases	2380	2380	2380	2380	2380	2380	2380	2380	2380
Female									
Lung cancer	4260	4260	4260	4260	4260	4260	4260	4260	4260
Ishaemic heart diseases	8496	8496	8496	8496	8496	8496	8496	8496	8496
Chronic obstructive respiratory diseases	2310	2310	2310	2310	2310	2310	2310	2310	2310

6.3 Treatment Specific Costs - Lung Cancer

Lung cancer can be divided physiologically, according to the structure of the cancer cells, into small-cell cancer and non-small-cell cancer through biopsy or bronchoscopy. A lung cancer patient with non-small-cell type, which is the most prevalent type, undergoes surgery if it is still early enough. Surgical operation provides the best chance of survival. If it is too late or a patient is too weak for the operation, radiotherapy or chemotherapy will be given. It is the same with a lung cancer patient with small-cell type cancer which can not be treated surgically because malignant cells have spread over the body tissue very quickly. In terminal cases a patient is usually hospitalised for around two to four weeks. The costs of treatments for lung cancer therefore consists of the following components, in table 6-4 below. Also shown is the probability of getting each treatment and the resulting expected costs of health care for lung cancer.

Table 6-4 Expected Health Care Costs Of Lung Cancer

Cost component	Costs	Probability	Expected Costs
Surgical treatment	13,828	0.15	2,074
Follow-on care			
Radiation therapy	5,230	0.6	3,138
Chemotherapy	2,807	0.25	702
Terminal supportive care	7,917	1	7,917
Total Expected Cost			11,757

Small-cell lung cancer is present in about 25 per cent of all lung cancer patients, and is usually treated with chemotherapy. The non-small-cell type of the disease accounts for the remaining 75 per cent of lung cancers. About 20 per cent of these cases may be treated surgically. The rest of these cases are treated with radiation therapy.[3] About 70 per cent of all patients of this disease will not survive the first year, so that terminal supportive care is

needed. It is the same for a patient who actually survives the first year but not the second year, and so on till eventual death. This immediately means that every patient with this disease must incur this supportive care cost depending upon the survival rate, since the decision is made at time of diagnosis.

As can be seen from the table, the estimate of the health care costs of this disease more than doubled from the previous estimate, a combined estimate of $11,757 from $3,921 for males and $4260 for females. Amongst that cost estimate the terminal supportive care occupies a major portion of the total expected costs of this disease. This signifies the fact that lung cancer is really a devastating disease.

6.4 Treatment Specific Costs - Ischaemic Heart Disease

Ischaemic heart disease occurs when the supply of oxygenated blood to the muscle tissues of the heart is impaired, resulting from a narrowing of the coronary arteries that is due to the accumulation of fibro-fatty material in the lining of the arterial walls. It can be treated with appropriate drugs, or if necessary through a by-pass operation. Furthermore, people who have suffered a first heart attack are more likely to have a second, so that recurrence costs also need to be considered. The costs of treatment thus consists of the following components, listed in the table below. The actual cost figures are based on myocardial infarction, thereby assuming such figures are representative of general ischaemic heart disease.

As shown in the table for lung cancer data above, Table 6-5 presents the actual costs of treatment, the probability of incurring such costs, the expected costs and the total costs of health care for ischaemic heart disease patients.

Table 6-5 Expected Health Care Costs Of Ischaemic Heart Disease

Cost component	Costs	Probability	Expected Costs
Initial admission	8,481	1.00	8,481
Surgical fees	23,302	0.15	3,495
Follow-on Care	1,548	0.12	1,435
Recurrence costs	4,829	0.15	5,444
Total Expected Costs			18,855

Every patient with this disease will incur at first admission fees of $8,401, amongst which the costs of emergency services, intensive care unit, coronary care unit, etc. are included. About 15 per cent of the patients undergo coronary artery by-pass grafts, the expected cost of which is calculated as $3,495. Around 12 per cent of all patients will need drugs and practitioners' visits of $185.76 per year for 10 years at the onset of the diagnosis. The net present value for the follow-on care costs are therefore estimated at $1,435 with a net discount rate of 1 per cent. The recurrence costs are assumed to be incurred from the second year past onset, which are on average $4,829. With a non-fatal recurrence rate of 14.7 per cent, the net present value of the expected recurrence costs are estimated at $5,444. These cost components add up to $18,855.

From the survival rate of a patient with myocardial infarction in Table 5-5 in the previous chapter, the net present value of the expected costs of general ischaemic heart disease can then be finally estimated. The resulting figures are presented in Table 6-6 below. As each of the cost components is independent of age and sex, the only difference comes from the differing survival rate between age and sex.

Because of the limited data on the survival rate of a female patient with ischaemic heart disease, the expected cost of the disease for female remains the same for all ages at $16,172. On the contrary, the expected costs for males

get smaller as a person gets older. The younger a person is the more treatment he or she will obtain, hence the higher is the cost of health care. It is also due to the fact that the survival probability is lower the older a person is, thus incurring less health care costs. A male person of age between 30 to 54 will expect to incur $17,487 for his health care, while an older person of say 70 years of age will expect to pay $15,515 for the treatment. All these figures are in present value terms. Every follow-on cost and recurrence cost within 10 years past onset of the first diagnosis is so discounted that a reasonable comparison can be made at time of analysis.

Table 6-6 The Present Value Of The Expected Health Care Costs Of Ischaemic Heart Disease

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74
Male Costs	17487	17487	17487	17487	17487	16820	16820	15515	15515
Female Costs	16172	16172	16172	16172	16172	16172	16172	16172	16172

6.5 Treatment Specific Costs

- Chronic Obstructive Respiratory Disease

Chronic obstructive respiratory disease is a disorder of irreversible airways obstruction. It is characterised by the progressive limitation of airflow into and out of the lungs. Such a disease results from the destruction of the walls of the smallest air passages, bronchioles, and the walls of the small air sacs, alveoli, that exchange gases in the lungs. This irreversible collapse or narrowing of the small airways and air sacs of the lung produces a loss of lung recoil and results in chronic airflow obstruction.[4]

Since there is no known cure for Chronic obstructive respiratory disease, however, medical intervention is usually directed towards helping the patient keep his or her symptoms under control. As such, data on the progressive need for medical intervention is hard to come by. In this study, a single unit cost of $4,690 is taken and used as expected health care costs of the disease.[5]

6.6 Expected Health Care Costs Of Smoking

The estimates of the expected costs of health care developed thus far disclose the sum of money a smoker will on average expect to pay for the according treatment if he or she actually happens to develop one of the diseases: lung cancer, ischaemic heart disease and chronic obstructive respiratory disease. Table 6-7 and 6-8 summarise the findings so far.

Table 6-7 The Present Value Of Health Care Costs: The First Approximation

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Disease Group									
Male									
Lung cancer	3921	3921	3921	3921	3921	3921	3921	3921	3921
Ishaemic heart diseases	5687	5687	5687	5687	5687	5687	5687	5687	5687
Chronic obstructive respiratory diseases	2380	2380	2380	2380	2380	2380	2380	2380	2380
Female									
Lung cancer	4260	4260	4260	4260	4260	4260	4260	4260	4260
Ishaemic heart diseases	8496	8496	8496	8496	8496	8496	8496	8496	8496
Chronic obstructive respiratory diseases	2310	2310	2310	2310	2310	2310	2310	2310	2310

Table 6-8 The Present Value Of Health Care Costs: The Second Approximation

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Disease Group									
Male									
Lung cancer	11757	11757	11757	11757	11757	11757	11757	11757	11757
Ishaemic heart diseases	17487	17487	17487	17487	17487	16820	16820	15515	15515
Chronic obstructive respiratory diseases	4690	4690	4690	4690	4690	4690	4690	4690	4690
Female									
Lung cancer	11757	11757	11757	11757	11757	11757	11757	11757	11757
Ishaemic heart diseases	16172	16172	16172	16172	16172	16172	16172	16172	16172
Chronic obstructive respiratory diseases	4690	4690	4690	4690	4690	4690	4690	4690	4690

The procedure employed in estimating the costs of health care on the disease in question is much the same as that of estimating the costs of lost productivity and income. The only difference is that it is the health care costs, not the lost incomes, that are estimated in this chapter. However, the estimate developed so far may be an overestimation of health care costs as the element of risk has yet to be incorporated in the analysis, in much the same way as for the lost productivity and income.

In theory, a smoker engages in a lottery with his or her health. Cigarette smoking leads to increased risks of developing a number of serious diseases. However not everyone develops such serious diseases. There are actually many smokers who remain as healthy as non-smokers for their entire lives. Only unlucky winners in this game who happens to contract one of a variety of smoking-related diseases must bear the attendant costs, like any other usual lottery games.

As can be recalled, the basic information about a smoker's health risk can be obtained from a certain source of statistics, namely, incidence rates of smokers and non-smokers. Such information, the probability for being diagnosed with one of the diseases under scrutiny, was then employed to estimate the expected lost productivity and income in the previous chapter. The same information is again used in this chapter to estimate the expected costs of health care for three diseases: lung cancer, ischaemic heart disease and chronic obstructive respiratory disease. The probability of diagnosis of each of the diseases is reproduced down below in Table 6-9 for easy reference.

Table 6-9 Marginal Risk Of Smoking

	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Male									
LC	0.23	0.76	2.55	4.28	5.87	9.21	11.42	12.36	9.93
IHD	1.30	1.50	1.50	1.70	1.70	1.90	1.90	1.40	1.40
CORD	0.25	0.81	2.70	4.53	6.21	9.75	12.10	13.09	10.51
Female									
LC	0.11	0.15	0.41	0.86	1.27	2.09	3.49	3.82	3.56
IHD	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64	1.64
CORD	0.12	0.16	0.43	0.91	1.35	2.21	3.69	4.04	3.77

It was pointed out in the previous chapter that the risk of contracting one of the diseases is higher the older a person is. Male smokers are also faced with a higher risk than female smokers in general. The risk of developing ischaemic heart disease is, however, almost constant throughout a person's life, unlike the other two diseases. This information is then utilised to develop estimates of the expected present value of health care costs of the diseases in question due to smoking.

Table 6-10 and 6-11 present the expected values of the lifetime health care costs due to each of the smoking-induced diseases. Table 6-10 presents a rather conservative estimate based on the first approximation of the health care costs. Table 6-11, on the other hand, shows a more adequate, if not radical, estimate of the health care costs.

Table 6-10 The Present Value Of The Expected Health Care Costs: First Approximation

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Disease Group									
Male									
LC	2,661	3,346	4,106	4,688	5,056	5,181	4,618	3,419	1,686
IHD	1,553	1,574	1,537	1,490	1,368	1,212	950	615	345
CORD	1,711	2,151	2,639	3,013	3,249	3,331	2,968	2,197	1,083
As Percentage of Future Income									
LC	0.4	0.5	0.8	1.1	1.5	2.2	3.2	4.1	3.8
IHD	0.2	0.3	0.3	0.3	0.4	0.5	0.7	0.7	0.8
CORD	0.2	0.3	0.5	0.7	1.0	1.4	2.1	2.6	2.4
As Months of Current Income									
LC	1.3	1.5	1.9	2.2	2.5	2.8	3.7	4.0	2.2
IHD	0.8	0.7	0.7	0.7	0.7	0.6	0.8	0.7	0.4
CORD	0.9	1.0	1.2	1.4	1.6	1.8	2.4	2.5	1.4
Female									
LC	737	914	1,132	1,348	1,518	1,638	1,599	1,219	657
IHD	2,477	2,391	2,281	2,142	1,964	1,736	1,446	1,076	603
CORD	423	525	649	774	871	940	917	699	377
As Percentage of Future Income									
LC	0.2	0.3	0.4	0.6	0.9	1.2	1.4	1.6	1.6
IHD	0.8	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.4
CORD	0.1	0.2	0.2	0.4	0.5	0.7	0.8	0.9	0.9
As Months of Current Income									
LC	1.0	1.1	1.2	1.5	2.0	2.5	2.2	1.7	0.9
IHD	3.3	2.8	2.4	2.3	2.5	2.6	2.0	1.5	0.8
CORD	0.6	0.6	0.7	0.8	1.1	1.4	1.3	1.0	0.5

LC Lung cancer
IHD Ischaemic heart disease
CORD Chronic obstructive respiratory disease

Table 6-11 The Present Value Of The Expected Health Care Costs: Second Approximation

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70+
Disease Group									
Male									
LC	7,979	10,034	12,313	14,058	15,161	15,536	13,846	10,252	5,055
IHD	4,690	4,729	4,586	4,404	3,978	3,497	2,698	1,677	940
CORD	3,372	4,239	5,200	5,937	6,403	6,563	5,850	4,330	2,134
As Percentage of Future Income									
LC	1.1	1.6	2.3	3.3	4.6	6.6	9.7	12.2	11.4
IHD	0.7	0.8	0.9	1.0	1.2	1.5	1.9	2.0	2.1
CORD	0.5	0.7	1.0	1.4	1.9	2.8	4.1	5.2	4.8
As Months of Current Income									
LC	4.0	4.6	5.6	6.7	7.6	8.3	11.2	11.9	6.5
IHD	2.3	2.2	2.1	2.1	2.0	1.9	2.2	1.9	1.2
CORD	1.7	2.0	2.4	2.8	3.2	3.5	4.7	5.0	2.7
Female									
LC	2,033	2,524	3,123	3,720	4,189	4,521	4,412	3,364	1,812
IHD	4,714	4,551	4,343	4,077	3,738	3,305	2,753	2,048	1,148
CORD	859	1,065	1,318	1,571	1,769	1,908	1,862	1,420	766
As Percentage of Future Income									
LC	0.6	0.9	1.2	1.7	2.4	3.2	4.0	4.3	4.3
IHD	1.4	1.5	1.7	1.9	2.1	2.4	2.5	2.6	2.7
CORD	0.3	0.4	0.5	0.7	1.0	1.4	1.7	1.8	1.8
As Months of Current Income									
LC	2.7	2.9	3.3	4.0	5.4	6.8	6.1	4.7	2.4
IHD	6.2	5.3	4.6	4.4	4.8	5.0	3.8	2.8	1.5
CORD	1.1	1.2	1.4	1.7	2.3	2.9	2.6	2.0	1.0

LC Lung cancer
IHD Ischaemic heart disease
CORD Chronic obstructive respiratory disease

In the first approximation of the estimate of health care costs, it can be said that for male smokers lung cancer is the most expensive disease of all three. Lung cancer deprives a smoker of 4.1 per cent of lifetime income at most, which is the equivalent of 4 months worth of current income. Chronic obstructive respiratory disease comes second and ischaemic heart disease is

the least expensive disease of all. For a female middle aged smoker, on the contrary, ischaemic heart disease is more expensive than the other two diseases, depriving about 1.2 per cent of future income. This is because of the relatively high risk of developing the disease at an early age. And of course the treatment itself is the dearest. The next high health care cost is lung cancer, especially for an older female person, costing as much as a patient with ischaemic heart disease at a later age around 1.6 per cent of lifetime income. The least expensive is the treatment cost for chronic obstructive respiratory disease, about an half as much as that of lung cancer.

The second approximation of the health care costs, which is presented in Table 6-11 above, has pretty much a similar story to the first estimate, except that the costs overall become much higher than the ones in the first approximation. This reflects that fact that the disease treatment costs are estimated according to the specific treatment procedure that a person expects to obtain.

The very high costs of treatment, and high risks of diagnosis at the same time, make lung cancer the most expensive disease of all three. A male person of age 55 to 60 is, for example, expected to pay a whopping $15,536 in today's money. This is the equivalent of 6.6 per cent of lifetime income. Not only lung cancer but also the other two diseases are expensive. As for ischaemic heart disease, due to the high costs of treating the disease and also to the nature of the disease, the younger a person is the more health care costs he or she has to incur. The cost of chronic obstructive respiratory disease tops off at about $6,563 for male smokers and $1,908 for female smokers at age between 55 and 60, as in the case for lung cancer. A male smoker in general can expect to see his health care costs at about more than three times as high as a female smoker.

References For Chapter 6

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3 Sarna GP, Holmes EC, Petrovitch Z, "Lung Cancer." In haskell, C.M., ed., Cancer Treatment, 1980, Philadelphia: W.B. Saunders Co.

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5 See 2.

CHAPTER 7

CONCLUSIONS

7.1 Summary And Findings

This study has focused upon the economic impact of cigarette smoking on each individual smoker rather than on a country as a whole. The three diseases that are linked most often to smoking, lung cancer, ischaemic heart diseases and chronic obstructive heart disease were selected to quantify the associated cost which a single smoker would expect to incur on average over his or her lifetime, if he or she has to be hospitalised as a result of smoking.

The resulting estimates of such cost components, in the form of lost income, and foregone productivity and health care costs, are usually less obvious to a smoker or to any individual than the actual or 'realised' expenditures on cigarettes. It is hoped in this study that by estimating such 'hidden' costs of cigarette smoking each individual smoker can better informed of his or her true financial state, which in turn allows every individual smoker to make a rational decision as to whether he or she should smoke.

The previous chapters revealed that the economic consequences of cigarette smoking are significant by any measure. The serious and often fatal nature of each disease is associated with high treatment costs, lost earnings and foregone productivity. A higher risk of contracting one of the smoking-induced diseases under scrutiny makes the associated expected costs much higher than those for a non-smoker.

Although the health care costs for each of the diseases in question were developed separately based on the separate estimates of the treatment costs, none of the estimates were aggregated into a single cost component. However the health care costs, lost productivity and income for each of the diseases can be summed up to obtain the hidden costs of smoking by sex, age group and each of the diseases. The result indicates that the economic costs of cigarette smoking vary depending upon the diseases, and the two treatment cost estimates, and for each disease those costs vary by sex and age group. Table 7-1, 7-2, 7-3 and 7-4 summarise the results, and can be found in later pages. As can be seen from the tables, it is clear that lost income and productivity occupies a major portion of the total costs of smoking in all cases.

Table 7-1 and 7-2 show the net present value of the expected lifetime costs of smoking for males and females respectively, each based on a conservative estimate of the health care costs. The total hidden costs of smoking for male smokers due to lung cancer and chronic obstructive respiratory disease have similar figures ranging from $38.5 thousand to $9.2 thousand. A person in the 40 to 44 age group expects the highest loss of income because of lost productivity and health care costs. The total costs amount to 17.7 for the highest, to 1.8 for the lowest, in months of current income. That is equivalent to being unemployed for those periods with no compensation. The total cost due to ischaemic heart disease remains the least expensive of all, ranging from $12.8 thousand, which is 6.4 months worth of income to $1.4 thousand, which is 1.8 months worth of income.

A female smoker is faced with less income that is taken away by smoking-induced diseases. Unlike the case of a male smoker, none of the diseases can be uniformly categorised as the most or least expensive diseases. For younger age group, ischaemic heart disease is the most expensive one,

whereas for the other age groups starting from 45 years of age, lung cancer and chronic obstructive respiratory disease are the more expensive ones to contract. As for months of current income, a female smoker expects at most 10.3 and at least 2.3 months of lost income, depending on the age groups. This is unquestionably a large sum of income for anyone to sacrifice.

Table 7-3 and 7-4 present the net present value of the expected lifetime costs of smoking for males and females respectively, each based this time on a more adequate or moderate estimate of the health care costs. For a male smoker, as found in Table 7-3, developing lung cancer is the most expensive consequence of cigarette smoking, costing as high as $46.6 thousand, and $12.7 thousand for the lowest, and depriving him of 22 and 16.3 months worth of current income respectively. The hidden cost of chronic obstructive respiratory disease is the second highest among the three, robbing nearly as much prices as the lung cancer. 13.1 to 19.1 months of income are taken away by the disease. The costs of ischaemic heart disease remains the least expensive of all diseases. However it still costs 2.6 to 8 months worth of current income.

A female smoker, in the meantime, expects to incur up to $10.1 thousand for the youngest age group and $2.2 thousand at least for the oldest age group, if she happens to develop ischaemic heart disease. Lung cancer and chronic obstructive respiratory disease have much similar price tags, the highest to be seen in a women's fifties to early sixties.

Because the same algorithm is used in the analysis, a similar characteristic can be recognised between the two final estimates of the hidden costs of smoking obtained using both the conservative and moderate approximation of health care costs. This is also partly because a major proportion of the hidden costs come from the loss in earnings and productivity.

It is interesting to note, however, that the ratio of lost earnings to health care costs are higher the younger the person is. In other words, a younger person usually earning a relatively higher than average income loses comparatively more earnings than he or she loses on health care costs. The ratio declines as a person gets older.

In general, a person in his or her forties today expects to incur the largest cost of smoking, especially if he or she develops lung cancer or chronic obstructive respiratory disease. A younger person can expect a greater cost of smoking than an older person, primarily because of the many years of future income lying ahead of the young person, which are susceptible of being lost due to smoking-related diseases. It is also because of the debilitating impact of the diseases, which takes many years to develop completely. Once past the age of 50, the total cost falls fairly rapidly, due to the fact that the average employment income declines rapidly.

The total hidden costs of smoking due to ischaemic heart disease seem relatively small compared to the other two diseases. Comparatively less risk of developing the disease and fairly high survival and activity rates keep the expected costs of treatment, lost income and productivity smaller than the other two diseases, despite the fact that it is the most expensive disease of all in terms of actual treatment costs.

As can also be seen from the tables, the total cost of smoking is much lower for females than for male smokers. The employment income for women is much lower and decreases very rapidly, making the lifetime income much smaller than that for males of similar age. This is probably one of the reasons why the total cost of smoking is much lower for female than male smokers. Another possible explanation is that the estimated risks of developing the diseases under scrutiny are much smaller for females than for males.

7.2 Implications Of The Findings

This study has demonstrated that there are substantial costs associated with cigarette smoking for smokers in every age group included in this study. Cigarette smoking is a false luxury, results only in the loss of a large sum of money.

This study has identified a group of individuals that is likely to generate the greatest costs if they continue to smoke at current levels. The most concern is for the group of young and middle-aged people up to the age of 60. Smoking cessation programmes can then be targeted at those age groups.

Great proportion of Maori people are regular smokers, as noted in chapter 3. However the lack of data sources made the analysis difficult to carry out. Hence it will be interesting to see the economic impact of cigarette smoking on Maori people once sufficient and appropriate data become available.

Although the total costs of smoking are lower for female than for male smokers, it is likely to increase further since female labour force participation is bound to increase and the incidence of smoking induced diseases is starting to reflect women's recent smoking prevalence. Further improvements in some data, on the risk of developing smoking-related diseases, relative activity rate, etc. are in order.

Finally such estimates as the costs of smoking, not only the actual expenditures but also the hidden costs of smoking, are deemed useful especially for education purposes. The scientific evidence about health risks of smoking alone is not sufficient to advise any individuals on smoking cessation. The availability of easy-to-understand data on expected costs associated with smoking may provide the smoker with a better incentive for smoking cessation.

Table 7-1 The Present Value Of Expected Lifetime Costs Of Smoking - Lower Estimate: Male Smoker ($'000)

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74
Male									
Income if									
Healthy	710	628	533	431	331	235	143	84	44
Lost Income									
LC	31	33	34	33	29	24	16	9	8
IHD	11	10	9	7	6	4	2	1	1
CORD	33	35	36	34	31	26	17	10	8
As Percentage of Future Income									
LC	4.4	5.2	6.4	7.5	8.8	10.4	11.4	11.3	17.3
IHD	1.6	1.6	1.7	1.7	1.7	1.8	1.6	1.4	2.4
CORD	4.7	5.5	6.7	8.0	9.3	11.0	12.0	12.0	18.3
As Months of Current Income									
LC	15.7	15.2	15.5	15.4	14.7	13.0	13.1	11.0	9.8
IHD	5.6	4.8	4.1	3.5	2.9	2.2	1.9	1.4	1.4
CORD	16.6	16.1	16.4	16.3	15.5	13.8	13.8	11.6	10.4
Health Care Costs									
LC	2.7	3.3	4.1	4.7	5.1	5.2	4.6	3.4	1.7
IHD	1.6	1.6	1.5	1.5	1.4	1.2	0.9	0.6	0.3
CORD	1.7	2.2	2.6	3.0	3.2	3.3	3.0	2.2	1.1
As Percentage of Future Income									
LC	0.4	0.5	0.8	1.1	1.5	2.2	3.2	4.1	3.8
IHD	0.2	0.3	0.3	0.3	0.4	0.5	0.7	0.7	0.8
CORD	0.2	0.3	0.5	0.7	1.0	1.4	2.1	2.6	2.4
As Months of Current Income									
LC	1.3	1.5	1.9	2.2	2.5	2.8	3.7	4.0	2.2
IHD	0.8	0.7	0.7	0.7	0.7	0.6	0.8	0.7	0.4
CORD	0.9	1.0	1.2	1.4	1.6	1.8	2.4	2.5	1.4
Total Hidden Costs of Smoking									
LC	34.0	36.2	38.0	37.2	34.3	29.6	20.8	12.9	9.4
IHD	12.8	11.9	10.5	8.9	7.1	5.3	3.3	1.8	1.4
CORD	34.9	36.9	38.5	37.5	34.2	29.2	20.1	12.2	9.2
As Percentage of Future Income									
LC	4.8	5.8	7.1	8.6	10.4	12.6	14.6	15.4	21.0
IHD	1.8	1.9	2.0	2.1	2.2	2.3	2.3	2.1	3.2
CORD	4.9	5.9	7.2	8.7	10.3	12.4	14.1	14.6	20.7
As Months of Current Income									
LC	17.0	16.7	17.4	17.6	17.2	15.8	16.8	14.9	12.0
IHD	6.4	5.5	4.8	4.2	3.6	2.9	2.7	2.1	1.8
CORD	17.4	17.1	17.6	17.7	17.2	15.6	16.2	14.1	11.8

LC Lung cancer

IHD Ischaemic heart disease

CORD Chronic obstructive respiratory disease

Table 7-2 The Present Value Of Expected Lifetime Costs Of Smoking - Lower Estimate: Female Smoker ($'000)

	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74
Female									
Income if									
Healthy	326	297	261	218	175	140	111	78	42
Lost Income									
LC	4.5	4.3	4.5	4.5	4.2	4.0	3.6	2.5	2.4
IHD	5.3	4.6	4.0	3.3	2.6	2.1	1.6	1.1	1.1
CORD	4.8	4.5	4.7	4.7	4.5	4.3	3.8	2.6	2.5
As Percentage of Future Income									
LC	1.4	1.4	1.7	2.1	2.4	2.9	3.2	3.2	5.6
IHD	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.4	2.6
CORD	1.5	1.5	1.8	2.2	2.6	3.0	3.4	3.4	5.9
As Months of Current Income									
LC	5.9	5.0	4.7	4.9	5.5	6.1	5.0	3.4	3.2
IHD	7.0	5.3	4.2	3.6	3.4	3.1	2.2	1.5	1.5
CORD	6.3	5.3	5.0	5.1	5.8	6.5	5.2	3.6	3.4
Health Care Costs									
LC	0.7	0.9	1.1	1.3	1.5	1.6	1.6	1.2	0.7
IHD	2.5	2.4	2.3	2.1	2.0	1.7	1.4	1.1	0.6
CORD	0.4	0.5	0.6	0.8	0.9	0.9	0.9	0.7	0.4
As Percentage of Future Income									
LC	0.2	0.3	0.4	0.6	0.9	1.2	1.4	1.6	1.6
IHD	0.8	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.4
CORD	0.1	0.2	0.2	0.4	0.5	0.7	0.8	0.9	0.9
As Months of Current Income									
LC	1.0	1.1	1.2	1.5	2.0	2.5	2.2	1.7	0.9
IHD	3.3	2.8	2.4	2.3	2.5	2.6	2.0	1.5	0.8
CORD	0.6	0.6	0.7	0.8	1.1	1.4	1.3	1.0	0.5
Total Hidden Costs of Smoking									
LC	5.2	5.2	5.6	5.8	5.8	5.7	5.2	3.7	3.0
IHD	7.8	7.0	6.3	5.5	4.6	3.8	3.1	2.2	1.7
CORD	5.2	5.1	5.4	5.5	5.4	5.2	4.7	3.3	2.9
As Percentage of Future Income									
LC	1.6	1.8	2.1	2.7	3.3	4.0	4.6	4.8	7.2
IHD	2.4	2.4	2.4	2.5	2.6	2.7	2.8	2.8	4.0
CORD	1.6	1.7	2.1	2.5	3.1	3.7	4.2	4.3	6.8
As Months of Current Income									
LC	6.9	6.0	5.9	6.3	7.5	8.6	7.2	5.1	4.1
IHD	10.3	8.1	6.7	5.9	5.9	5.8	4.2	3.0	2.3
CORD	6.8	5.9	5.7	6.0	6.9	7.9	6.5	4.6	3.9

LC Lung cancer

IHD Ischaemic heart disease

CORD Chronic obstructive respiratory disease

Table 7-3 The Present Value Of Expected Lifetime Costs Of Smoking - Upper Estimate: Male Smoker ($'000)

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74
Male									
Income if Healthy	710	628	533	431	331	235	143	84	44
Lost Income									
LC	31	33	34	33	29	24	16	9	8
IHD	11	10	9	7	6	4	2	1	1
CORD	33	35	36	34	31	26	17	10	8
As Percentage of Future Income									
LC	4.4	5.2	6.4	7.5	8.8	10.4	11.4	11.3	17.3
IHD	1.6	1.6	1.7	1.7	1.7	1.8	1.6	1.4	2.4
CORD	4.7	5.5	6.7	8.0	9.3	11.0	12.0	12.0	18.3
As Months of Current Income									
LC	15.7	15.2	15.5	15.4	14.7	13.0	13.1	11.0	9.8
IHD	5.6	4.8	4.1	3.5	2.9	2.2	1.9	1.4	1.4
CORD	16.6	16.1	16.4	16.3	15.5	13.8	13.8	11.6	10.4
Health Care									
LC	8.0	10.0	12.3	14.1	15.2	15.5	13.8	10.3	5.1
IHD	4.7	4.7	4.6	4.4	4.0	3.5	2.7	1.7	0.9
CORD	3.4	4.2	5.2	5.9	6.4	6.6	5.8	4.3	2.1
As Percentage of Future Income									
LC	1.1	1.6	2.3	3.3	4.6	6.6	9.7	12.2	11.4
IHD	0.7	0.8	0.9	1.0	1.2	1.5	1.9	2.0	2.1
CORD	0.5	0.7	1.0	1.4	1.9	2.8	4.1	5.2	4.8
As Months of Current Income									
LC	4.0	4.6	5.6	6.7	7.6	8.3	11.2	11.9	6.5
IHD	2.3	2.2	2.1	2.1	2.0	1.9	2.2	1.9	1.2
CORD	1.7	2.0	2.4	2.8	3.2	3.5	4.7	5.0	2.7
Total Hidden Costs of Smoking									
LC	39.3	42.9	46.2	46.6	44.4	39.9	30.0	19.7	12.7
IHD	15.9	15.0	13.5	11.9	9.7	7.6	5.0	2.9	2.0
CORD	36.6	39.0	41.0	40.4	37.4	32.4	23.0	14.3	10.3
As Percentage of Future Income									
LC	5.5	6.8	8.7	10.8	13.4	17.0	21.1	23.5	28.6
IHD	2.2	2.4	2.5	2.7	2.9	3.2	3.5	3.4	4.5
CORD	5.2	6.2	7.7	9.4	11.3	13.8	16.1	17.1	23.1
As Months of Current Income									
LC	19.6	19.8	21.1	22.0	22.3	21.4	24.2	22.8	16.3
IHD	8.0	6.9	6.2	5.6	4.9	4.1	4.1	3.3	2.6
CORD	18.3	18.0	18.8	19.1	18.8	17.3	18.6	16.6	13.1

LC Lung cancer

IHD Ischaemic heart disease

CORD Chronic obstructive respiratory disease

Table 7-4 The Present Value Of Expected Lifetime Costs Of Smoking - Upper Estimate: Female Smoker ($'000)

Age	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74
Female									
Income if Healthy	326	297	261	218	175	140	111	78	42
Lost Income									
LC	4.5	4.3	4.5	4.5	4.2	4.0	3.6	2.5	2.4
IHD	5.3	4.6	4.0	3.3	2.6	2.1	1.6	1.1	1.1
CORD	4.8	4.5	4.7	4.7	4.5	4.3	3.8	2.6	2.5
As Percentage of Future Income									
LC	1.4	1.4	1.7	2.1	2.4	2.9	3.2	3.2	5.6
IHD	1.6	1.5	1.5	1.5	1.5	1.5	1.5	1.4	2.6
CORD	1.5	1.5	1.8	2.2	2.6	3.0	3.4	3.4	5.9
As Months of Current Income									
LC	5.9	5.0	4.7	4.9	5.5	6.1	5.0	3.4	3.2
IHD	7.0	5.3	4.2	3.6	3.4	3.1	2.2	1.5	1.5
CORD	6.3	5.3	5.0	5.1	5.8	6.5	5.2	3.6	3.4
Health Care									
LC	2.0	2.5	3.1	3.7	4.2	4.5	4.4	3.4	1.8
IHD	4.7	4.6	4.3	4.1	3.7	3.3	2.8	2.0	1.1
CORD	0.9	1.1	1.3	1.6	1.8	1.9	1.9	1.4	0.8
As Percentage of Future Income									
LC	0.6	0.9	1.2	1.7	2.4	3.2	4.0	4.3	4.3
IHD	1.4	1.5	1.7	1.9	2.1	2.4	2.5	2.6	2.7
CORD	0.3	0.4	0.5	0.7	1.0	1.4	1.7	1.8	1.8
As Months of Current Income									
LC	2.7	2.9	3.3	4.0	5.4	6.8	6.1	4.7	2.4
IHD	6.2	5.3	4.6	4.4	4.8	5.0	3.8	2.8	1.5
CORD	1.1	1.2	1.4	1.7	2.3	2.9	2.6	2.0	1.0
Total Hidden Costs of Smoking									
LC	6.5	6.8	7.6	8.2	8.4	8.6	8.0	5.8	4.2
IHD	10.1	9.1	8.4	7.4	6.3	5.4	4.4	3.1	2.2
CORD	5.6	5.6	6.0	6.3	6.3	6.2	5.6	4.0	3.3
As Percentage of Future Income									
LC	2.0	2.3	2.9	3.8	4.8	6.1	7.2	7.5	9.9
IHD	3.1	3.1	3.2	3.4	3.6	3.8	3.9	4.1	5.3
CORD	1.7	1.9	2.3	2.9	3.6	4.4	5.1	5.2	7.8
As Months of Current Income									
LC	8.6	7.9	8.0	8.9	10.9	13.0	11.1	8.1	5.6
IHD	13.2	10.6	8.8	8.0	8.2	8.2	6.1	4.4	3.0
CORD	7.4	6.5	6.4	6.8	8.1	9.4	7.8	5.6	4.4

LC Lung cancer

IHD Ischaemic heart disease

CORD Chronic obstructive respiratory disease

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