

**ECONOMIC IMPACT OF CARDIOVASCULAR DISEASE
ON THE SOUTH AFRICAN ECONOMY, 1991:**

**J.A.X. PESTANA.
ECONOMICS DEPARTMENT
U.C.T.
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J.A.X. PESTANA
B.Sc.(Hons.), B.Soc.Sci., Ph.D.

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ABSTRACT.

Cardiovascular disease (CVD) is a generic medical term which is applied to any malfunctioning of the circulation of blood in the body. Ischaemic heart disease, cerebrovascular disease, cardiac failure and aneurysm are among the specific diseases subsumed under this term. These diseases are diseases of lifestyle, and have a severe impact on first world economies.

CVD is the leading cause of death among the White, Asian and Coloured population in South Africa, and ranks third for Blacks. South Africa is currently experiencing a rapid rate of urbanisation and redistribution of income (and wealth). The rural-urban transition is accompanied by the adoption of western lifestyles. Consequently, the incidence of CVD is expected to increase markedly.

Tightening fiscal constraints have led to serious focus on allocative efficiency in the health care sector. Cost effectiveness requires that all disease categories be examined. A costing study is usually the first step in this procedure.

This thesis estimates the cost of CVD to the South African economy in 1991. Health economics is in its infancy in South Africa and no cost-of-illness study has been carried out in this country before. This study is thus a pioneering work in many ways; an appropriate methodological framework in which to conduct the costing had to be developed.

Types of costing in health economics, the South African health sector, the aetiology of CVD and the value of a human life are reviewed. An exposition of the major methodologies of calculating direct and indirect costs of disease is given, and the advantages and disadvantages of each are discussed. A direct and indirect cost-of-illness method for the purpose of the project is chosen, and arguments are advanced for their suitability in any cost-of-illness study in the South African context.

A simple method of modelling disruptive and re-employment costs due to illness is proposed, and an elementary theoretical analysis of the distortion introduced by discriminatory employment practices in human capital calculations is given.

The cost of CVD to the SA economy amounted to between R4,135 and R5,035 billion (1991), excluding rehabilitation and follow-up costs. Indirect costs comprised between 56,88% and 59,28% of total costs. Indirect costs were calculated following the human capital approach, whereas direct costs were calculated using prevalence-based methods.

INDEX

CHAPTER	TITLE	PAGE NO.
SECTION 1.		
GENERAL OVERVIEW.		
1.	Types of Costing and the Health Economist's Function	1
2.	Medical Background of CVD.	12
3.	The Value of a Human Life.	26
SECTION 2.		
THEORETICAL FOUNDATIONS.		
4.	Human Capital Theory.	33
5.	A Defence of Human Capital Theory and Reasons for its Utilisation in this Study.	42
6.	Expressed and Revealed Preferences Approaches to the Valuation of a Human Life.	49
7.	Societal Valuation of a Human Life.	67
8.	Non-monetary Methods for the Cost of Illness.	70
9.	The Direct Cost of Illness - A Theoretical Preamble.	76
SECTION 3.		
EMPIRICAL STUDIES.		
10.	Introduction to the Practical Aspects of this Study.	84
11.	The Planning of Direct Costs.	86
12.	Transportation Costs.	89
13.	GP and Physicians' Cost.	96
14.	Public Hospitals' Cost.	104
15.	Private Hospitals' Cost.	113
16.	Drug Costs.	121
17.	Minor costs: Research, Building, Re-employment and Pension Costs.	124
18.	Follow-up and Rehabilitation Costs.	128
19.	Mortality Costs.	134
20.	Morbidity Costs.	144
21.	Summary and Conclusion.	153

SECTION I

CHAPTER 1.

COSTING AND THE FUNCTION OF THE HEALTH ECONOMIST.

"The trend today is to produce rough estimates of costing studies and to concentrate more on the cost effectiveness of different interventions of treatment of disease."

Alan Maynard.¹

"In view of the existing quantomania one may be forgiven for asserting that there is more to be said for rough estimates of the precise concept than precise estimates of economically irrelevant concepts."

E.J. Mishan.²

Current thinking in health economics deems that only rough estimates of costing studies be undertaken. The benefit of refining one's methods to attain a slightly narrower range of figures is achieved only at a disproportionate expense of time and computation. After all, the main objective of costing studies is to assist in policy decision making, and it is doubtful whether decisions undertaken in response to a figure of R3,4 billion will differ much from those undertaken where the figure is R3,2 or R3,6 billion. All that should be ensured is that the range given be a true reflection of the situation that obtains. The relative magnitudes of the cost of various illnesses are more important than the absolute cost of each. Health economists can put their efforts to more productive use than to increase the accuracy of costing figures, which is an endeavour giving diminishing marginal returns for their productive time.

1.1. The Changing Cost Environment of Health Establishments.

The economic evaluation of medication and disease is established on well founded techniques, and has become a major focus of attention of late [Williams (1974)³, Drummond *et. al.* (1987)⁴, Maynard (1990)⁵]. What brought this about?

Primarily, medical establishments had been experiencing a dramatically altered cost structure over the past few decades. The triple impact of inflation, low economic growth and increasing resource demand (especially in South Africa which is in a process of rapid urbanisation) forced the hand of health authorities to enquire with earnest into the efficient use of health resources. The ministry of health found itself having to compete with the pressing demands of other ministries (especially education and housing) for its slice of a diminishing national budget. Avenues of action open to health authorities were to investigate cost containment, efficiency and equity. Political instability and demographic change compounded these issues, as did technological advances and new epidemics such as AIDS.

The containment of costs, and the realisation that resources consumed to keep one patient

alive are not available to save the life of another, have been some of the causes that led to a global change in the philosophy of medical practice over the past few decades. Thirty, perhaps even twenty years ago, doctors would use every available resource to save their patients and even keep veritable human vegetables on life-supporting machines for prolonged periods at great cost. But over the past two decades, the mid-20th century view of the doctor as a physician/scientist/technologist has been changing, and there has been a resurgence of philosophical and theological interest in medical ethics and in the doctor-patient relationship.^{6,7}

Today, medical thinking has changed to the extent that euthanasia is being advocated by a broad spectrum of medical associations in cases where all hope is clearly lost.⁸ Admittedly, cost is not the primary consideration which led to this change in thinking. It was the ethical realisation that there is dignity in dying that has been the primary motivation for this change. This has been accompanied by an ascendent realisation in Western medical ethics that patient autonomy is not necessarily the highest good, and that in less affluent times it might be wiser to give greater focus to the common good.⁹ In other words, the sagacity of sustaining a "lost" patient at great expense to others has been challenged in an environment of constrictive health budgets.

Hence, when the halcyon days of a high gold price ended, and economic growth started to slow dramatically after the disinvestment and political turmoil of the mid-eighties, policy makers realised that changes had to be made. Profligate spending had to end. The realisation dawned that the apartheid-inspired bureaucratic maze which had spawned fourteen ministries of health was no longer tenable. Health authorities started to investigate ways to stretch their budget. The reduction of the number of wasteful health ministries presented itself as a solution, and an effort in this regard was made by the promulgation of the National Policy for Health Act of 1990, which centralised all decision making power in the hands of the minister of health of the (racially White) House of Assembly. But as yet, the other unnecessary and wasteful health ministries have not been abolished. Hopefully, a unitary health service with national insurance coverage for all will be created by a new political dispensation.

1.2. Costing Studies and the Efficient uses of Medical Resources.

Apart from the economic efficiencies which are to be gained by the abolition of a misguided political philosophy, other areas have to be identified where savings can be effected. For this to be possible, detailed accounts of the way funds are allocated across departments and institutions must be available. Savings can also be achieved by bringing down the costs of treatment of different disease categories. If the savings that could be made across diseases by comparing different interventions or modes of treatment are to be calculated, then it is imperative that the resources that each disease category consumes, or *cost of disease*, be known.

Such a stratification of costs is not reflected in any of the official figures, and has to be calculated by following an acceptable methodology. Cost of disease studies can therefore be seen as the first step in a chain of events that could ultimately bring down the cost of

health.

Costing studies give a reasonable idea of the resources consumed in each sector of health care. They define the parameters within which efficient and equitable use of health resources can be effected. But they are not without enormous difficulties of their own, especially as there are usually gross limitations on the available data. Aside from the usual methodological problems such as variations in medical practice, price differences of medication used in various interventions for the same disease, etc., there is the question of the reliability of official data. In South Africa, an additional complication is that a large percentage of the black population (which comprised 70.20% of the population in 1991 excluding the TBVC countries¹⁰) is rural (57% in 1991) and uneducated (61% of African males had either no education or had acquired only some primary school education in 1985).¹¹ This, coupled with underreporting and a long history of insufficient interest in their health status, has meant that data on exact expenditure in many areas is simply not reliable.

1.3. The Nature of Economic Evaluation of Disease.

The economic evaluation of disease involves comparing the effects and costs of a treatment with its next best alternative. A scheme sketching the general plan of the economic evaluation of disease and intervention is given in Table 1.1. The nature of the project will determine the type of study to be undertaken. The four types of economic evaluations performed in health economics are summarised in Table 1.2.¹²

As can be seen from Table 1.1., a costing study such as the one undertaken in this thesis is usually the first approach to determine the extent and impact of disease in a community. On the basis of the sum calculated, the authorities then decide whether the problem is grave enough to warrant intervention. The scale of intervention affordable in the light of other competing diseases is then assessed.

A distinction must be made between social cost calculations (eg. costing the impact of cardiovascular disease on the SA economy) and costing analyses (eg. cost-effectiveness studies). The need for social cost calculations has been questioned by some health economists, and their importance has been played down. A common objection is that estimates of cost calculations are not economic evaluations as no alternatives are compared. The results of social cost calculations do not identify the best way of investing scarce resources (Maynard 1992).¹ Social costings also provide no data to assist in determining which therapies produce the greatest health gains at least marginal cost.

It is true that social costing studies provide no guidelines for action. That, however, is not their aim. Their main objective is to highlight the extent of impact of different disease categories. Media focus often distorts the prevalence and gravity of certain types of illnesses. For example, malnutrition and especially tuberculosis are the major scourge of South Africans, whereas AIDS is assumed to be a bigger problem because of the prominence it receives in the media.¹³ This can be understood; AIDS has elicited world-wide concern, and is a potentially devastating disease. But this does not justify the extent

TABLE 1.1. Measuring Performances: the Nature of Economic Evaluation.

INPUTS.	PROCESSES or ACTIVITIES	OUTCOME
RESOURCES CONSUMED (costs)	HEALTH CARE TREATMENTS and ACTIVITIES.	OUTCOME
i) direct cost ii) indirect cost		
ECONOMIC BENEFITS. UTILITY: enhancements in the quality of life (physical, psychological and social well being) and the length of life of patients and their careers. i) direct ii) indirect		

TABLE 1.2. Types of Economic Evaluation.

	Cost Unit	Outcome measurement: What.	Outcome measurement: How value
Costing.	Rand	Assumed identical	None
Cost Benefit analysis.	Rand	All effects produced by the alternative	Rand
Cost effective analysis	Rand	Single common specific variable achieved to varying extents	Common units (eg. life years)
Cost utility analysis	Rand	Effects of the competing therapies and achieved to differing levels	QALYs

of media distortion. Cost of disease studies serve to correct the imbalance, and are a prerequisite for more elaborate costing analyses.

The advantages and disadvantages of the four methods of economic evaluation are presented in Table 1.2. A *costing analysis* evaluates the costs of alternative ways of pursuing a therapeutic goal of a given, identical nature. The technique assumes that alternative treatments have identical outcomes, an assumption that may not be valid.

1.3.1. Cost-benefit Analysis (CBA).

Cost-benefit analysis (CBA) is a technique that estimates the costs and benefits of alternative treatments in monetary terms. Intangible costs (pains and functional disability) and benefits (reduced morbidity) tend to be ignored in these studies because of the difficulties of their evaluation. Bulpitt and Fletcher (1990) give an example of a typical CBA study conducted in health economics.¹⁴

1.3.2. Cost-effectiveness Analysis (CEA).

Cost-effectiveness analyses were designed in response to the difficulties inherent in CBA. Costs of achieving outcomes such as "number of life years gained" are estimated for a number of alternative interventions. The most effective alternative is the one that achieves the same outcome at minimal cost. An example of such a study was carried out by Goldman *et al.* (1991).¹⁵ Cost-effectiveness ratios of administering various doses of the drug lovastatin for the primary and secondary prevention of coronary heart disease were calculated. This permitted the identification of the most efficient dose.

A problem with calculating the cost-effectiveness of competing treatments is that the quality of their therapeutic outcomes may vary, making purchasing choices difficult. The technicalities and difficulties of cost-effectiveness analysis are documented by Evans (1990),¹⁶ and a review of the topic is given by Hurley (1990).¹⁷ Eddy (1991) gives a fine critique of a cost-effectiveness study carried out by the Oregon Health Services Commission, and considers possible amendments to Oregon's methods.¹⁸

1.3.3. Cost-utility Analysis (CUA).

Cost-utility analyses were devised so as to introduce a "quality of life" (QoL) measure into economic evaluation of treatment. Even if the additional years of life gained from alternative therapies for the same medical condition are the same, the quality of those years in terms of the functional status of the patient may vary. [Compare for example the outcome of a renal transplant versus dialysis in terms of quality of life of the patient]. Patients often face the task of ranking various health options; they may have to choose between a longer life of lower quality and a shorter life of enhanced quality.

Health economists have devised a unit for the quality of life, viz. a QALY, or quality-adjusted life year. QALYs measure the output of a health care programme simultaneously in two dimensions - length of life and quality of life. An example of Kawachi *et al.*

illustrates how QALYs are implemented in medical decision making.¹⁹

A 60 year old individual with severe arthritis expects to live for 20 years. However, these years are to be spent in so much pain that each year of life is valued at only half a year of normal health, i.e. the individual's quality-adjusted life expectancy is 10 years (0.5×20 years). It is known that if his hip is replaced, the individual would attain a level of quality of life equivalent to 90% of normal life. Therefore eight QALYs ($[(0.9 - 0.5) \times 20 \text{ years}]$) will be gained as a result of the hip operation. Supposing that a sequence of drugs becomes available that would relieve the pain and increase the mobility of the arthritic to the extent that he subjectively also gains eight QALYs. Then the cheaper of the two interventions should be selected.

Given its highly subjective nature, there is no agreed standard for a QoL measure. Many authors caution against its excessive and untested use (eg. Carr-Hill and Morris (1991)).²⁰ Ethical implications in the use of QoL measures are discussed by La Puma and Lawlor (1990).²¹

A similar measure to the QALY is the healthy year equivalent, or HYE. It also requires that the individual evaluates the trade-off between quality of life and length of life. Mehrez and Gafni (1989) provide a good discussion of the merits and demerits of using either the QALY or the HYE.²²

Nonetheless, there are examples of simple and validated generic measures of QoL which are widely used. Short Form 36 [SF 36] used in the United States Medical Outcomes Study (Stewart and Ware(1992))²³ and the Euroqol²⁴ are two such instruments. QoL and survival data are used to produce QALY "league tables" which rank competing therapies in relation to the cost of producing one year of good quality life. These rankings were established by assessing the public's revealed preferences of health states. Such tables are crude but provide useful assistance to the economist in prioritising information (Maynard (1991)).²⁵ They allow the details of the outcomes of alternative therapies to be compared more accurately.

1.3.4. Choice of Methodology.

The economist must decide on the technique appropriate to the project at hand. The method of choice should comply with guidelines for good practice in economic evaluation. These have been stipulated by various authors. Williams (1974) listed criteria which can be used to analyse the validity and results of any economic evaluation.³ Drummond, Stoddart and Torrance (1987)⁴ and Maynard (1990(a))²⁶ have considered eight questions that illustrate the essence of any economic evaluation.

1.4. The Economics of South African Health Care.

From 1986, health economics has been growing as a discipline in South Africa,^{27,28} and comprehensive studies of trends in the distribution of health care expenditures have been

published since then.^{29,30}

The government budget allocated to health services has steadily increased over the past decade, despite a steadily declining growth in GDP over this period. Between 1990 and 1992, the average quarter-on-quarter South African GDP growth has been - 0.64%, yet the sum of R9,928 billion was allocated to health services in 1992/1993, a considerable increase of 22% over the previous fiscal year.³¹ Clearly, this cannot be sustained for much longer, and the Department of Finance is calling for an urgent review of the structure and nature of health provision. One can safely predict that the health budget will come under increasing pressure in the near future

Investment in health is considered a merit good by South African society. Despite the fall in real per capita GDP through the 1980's, total real per capita expenditure on health care grew by 5% per year from 1979 to 1984, and by nearly 1,4% thereafter.³² Private consumption expenditure on medical services has remained a steady 10% of expenditure on total services between 1978 and 1991.³³ Private consumption expenditure on medical and pharmaceutical products over this period increased from R710,6m to R1 110m at constant 1985 prices.³⁴ The steady devaluation of the rand over this time has had major implications for the purchase of imported medical equipment and drugs, and has been one of the major reasons for the steady increase in total per capita expenditure on health care by South Africans.

1.4.1. Private and Public Sectors.

Fifty-three percent of all expenditure on health care is in the public sector, which employed more than 42% of all doctors, provided 70% of hospital beds and served 80% of the population in 1987. The public sector provides all teaching and training for the entire health care team, undertakes research and development, provides preventative and rehabilitative services, and offers the only round-the-clock service for emergency cases and trauma.³⁵ These services are threatened by the imminent financial cutbacks to this sector.

In the private sector there is a crisis of spiralling costs. Medical aid premiums increased ninefold from 1978 to 1988, whereas the CPI only increased fourfold over this period.^{36,37} Distortions inhere in this market in the form of supplier-induced demand and perverse incentives to providers of health care. There appears to be widespread misuse and even abuse of medical aid reimbursements. This has fueled the cost of premiums and has, not surprisingly, resulted in a decrease in the percentage of whites with medical insurance, which fell from 87% in 1983 to 68,4% in 1988.³⁸ The private health sector risks pricing itself out of the market, and the steady escalation of costs could soon preclude all but the most wealthy from full participation in private health care.

1.4.2. Future Access to Health Care Facilities.

South Africa has been experiencing a decline in per capita GDP, with a negative growth rate in the 1990's and population growth of 2,4% per year. Population growth has outstripped the development of housing, educational, employment and recreational

facilities so necessary for healthy living. The corrective adjustments necessary to provide a universally acceptable political system in South Africa pose a series of crippling medicosocial challenges to the equitable delivery of health care.³⁹

The question as to which health care model to adopt in the new South Africa has been intensely debated, and policy makers have considered models from abroad. The failure of the health care system in Nigeria has been attributed to capitalism, and socialist solutions have been proposed.⁴⁰ There has been a similar criticism of medicine under capitalism in the United States.⁴¹ Although polar value systems are irreconcilable, there appears to be considerable common ground for negotiated solutions to a workable mix of the two systems.⁴²

1.4.3. The Argument for a Unitary Health System.

There appears to be strong support among the medical fraternity for a unitary national health service or health insurance. A vision of how such a system could be implemented was formulated at a summit meeting of the Medical Association of South Africa in May 1990.⁴³ Furthermore, powerful arguments against encouraging the dominance of private health care in South Africa has been put forward on economic, political, moral and sociological grounds.^{44,45,46,47,39} Benatar (1991) views the government's current drive towards privatisation as holding devastating implications for health, health care services and academic medicine in a new South Africa.⁴⁸

Certainly, the policies of political groupings that are likely to rule South Africa in the near future favour widespread government intervention in all spheres of the economy. But the situation remains fluid at present.

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CHAPTER 2.

MEDICAL OVERVIEW OF CARDIOVASCULAR DISEASE.

2.1. Description of Cardiovascular Disease.

Cardiovascular disease (CVD) is a generic medical term that encompasses any malfunctioning of the heart or the blood vessel system. In the case of congenital physical abnormalities, corrective surgery is prescribed in most cases, and meets with mixed success depending on the nature and severity of the complication.¹ But the most common CVD diseases are those that result from the development of atherosclerosis of the arteries.

Atherosclerosis develops gradually over two to three decades as a result of exposure to known risk factors (see Section 2.3). The most prominent physiological dysfunction issuing from advanced atherosclerosis is a reduction in blood supply to organs in the body. This in turn manifests as angina and heart attacks (myocardial infarctions, MI) where the flow of blood to the heart muscle is impeded, and in strokes (cerebral vascular disease) where the blood supply to the brain is interrupted. Other organs can also be similarly affected, although this occurs less frequently than MI's and strokes.

Certain individuals are born with genetic predispositions that enfeeble their resistance and favour their submission to disease. These mechanisms undoubtedly operate on a physiological, biochemical and psychological level. It is well known that two individuals similar in respect of age, sex, race, diet, and exercise habits may have vastly different total cholesterol levels, and different responses to unhealthy diets and exposure to tobacco smoke.

Ischaemic heart disease has a strong genetic element, making a family history of ischaemic heart disease (IHD) a good predictor of premature IHD.² Specific genetic abnormalities which result in premature atherosclerosis and IHD have been identified. One example is familial hypercholesterolaemia, the most common genetic disease found in South Africa (Gevers et.al. 1987).³ In contrast, when the disease first manifests in later life, there is less evidence for such familial aggregation. It then appears that predisposing influences are present. These have been identified as a number of risk factors to which individuals have been exposed for many decades (see Section 2.4).^{4,5,6}

Cardiovascular disease is the leading cause of death and disability in the United States and other westernised countries. More than 40 percent of deaths that occur in the United States each year can be attributed to diseases that fall under the rubric of cardiovascular disease (US. Dept. of Health, 1989).⁷ Diseases in this category amass a health care bill in the USA that exceeds any other category of illness (Hodgson and Kopstein, 1984).⁸

It is realised that in the absence of CVD, people would be susceptible to other diseases so that the money would be spent on medicine in any event. But two major issues need to be assessed. The first is the excess burden that is imposed on the economy due to *premature*

death or disability brought about by CVD. The second is the imposition of expenditure on the state in terms of disability grants to individuals.

[The literature of health economics abounds in medical and technical terms that are not immediately understood by the economist new to the field. A brief glossary of cardiovascular and related terms is included at the end of this chapter.]

2.2. Difficulties Encountered in Cardiovascular Epidemiological Research.

There are many difficulties in the documenting of CVD. The ability to establish a relationship between nutritional factors and cardiovascular disease has been hampered by limitations in the methodology employed. In particular, cardiovascular disease epidemiology is saddled with both imprecise and variable measures of disease endpoints. A major problem is the absence of a single reliable test to ascertain whether a person actually has the underlying disease. Consequently, researchers are obliged to measure the *effects* of the arterial disease and not the arterial disease itself. This raises considerable problems because expression of coronary artery disease can be very variable.⁹

Compounding this difficulty is the fact that extraneous factors affect the mortality of people who develop various forms of CVD. Thus, if deaths are used as a yardstick of the extent of heart disease in a community over a period, they reflect not only the prevalence of disease, but also the quality of medical care and the severity of any primary non-fatal disease that patients have developed.¹⁰

2.3. The Risk Factors of Cardiovascular Disease.

Severe atherosclerosis and IHD are not inevitable consequences of ageing; they seem to occur commonly only when a certain lifestyle prevails. There are certain risk factors that predispose individuals to cardiovascular disease. In particular, certain inherited characteristics of populations and of individuals influenced by their lifestyle have been shown to play a major role in the aetiology of IHD.

CVD risk factors are classified into major and minor groups according to severity (see Section 2.4). In addition, other factors such as age, sex, diabetes and genetic disposition also play a role. The primary physiological effect of the risk factors is to accelerate the development of atherosclerosis and/or coronary thrombosis, which then leads to CVD. Good overviews of CVD risk factors were conducted by Neaton and Wentworth (1992)¹¹, Ragland and Brand (1988)¹² and the Nutrition Committee of the American Heart Association (1985).¹³

2.4. Major Risk Factors.

2.4.1. Westernised Diet.

"A person should not eat until his stomach is replete but should diminish [his alimentary intake] by approximately one fourth of satiation."

Maimonides [1135 - 1204]¹⁴

A diet rich in saturated fat and cholesterol from animal products is implicated as the chief cause of IHD in prosperous countries. This notion is based on extensive findings from many studies.^{7,8} In 1989 the US National Research Council published a Diet and Health report that reviews in full the large body of evidence that posits a strong link between diet and CHD.¹⁵ In animal species including primates, increased intake of cholesterol and particularly saturated fat from animal products produces an elevation of serum cholesterol and other lipids, this being a prerequisite for the experimental production of severe atherosclerosis. It was unequivocally demonstrated that monkeys develop gross atherosclerotic lesions when given a mixture of foods which are found in a typical western diet. Moreover, it was shown that the atherosclerosis underwent regression when the monkeys were returned to the recommended prudent diet which will protect against the development of atherosclerotic lesions (Wisseler *et al.*, 1971; Srinivasan *et al.* 1980; Wagner *et al.* 1980).^{16,17,18}

Studies undertaken on a community basis show a strong relationship between dietary intake of cholesterol and saturated fat and IHD mortality. In these studies the estimated nutritional intake in the population was determined from household surveys and then correlated with the IHD mortality rate. Conclusions drawn from such studies alone have been criticised because other factors that may differ among communities and that are correlated with nutrient intake may be the primary determinants of the disease.¹⁹

A number of well known clinical trials demonstrate that changing dietary habits result in mean decrease of serum cholesterol. The Western Electric Study began in 1958 with dietary and clinical examinations of more than 1900 middle-aged men, who were re-examined annually for the next 19 years.²⁰ Follow up indicated that a habitual reduction of 200 mg cholesterol/1 000 kcal was associated with a 37% reduction in total mortality or an increase in life expectancy of 3,4 years.

2.4.2. Hypercholesterolaemia-hyperlipidaemia.

The average American diet contains 450mg of cholesterol daily, and 40 percent of the calories are derived from fat.²¹ It is well known that a wide range of serum cholesterol levels is encountered in any group following a similar diet. Nevertheless, even for people within any given population, the higher the serum cholesterol level, the greater the risk of developing premature IHD.

There is a statistically significant relationship between elevated levels of serum cholesterol

and the risk of CHD.^{22,23} The Framingham study is the best known and most important epidemiological study in the cardiovascular field.²⁴ Overwhelming evidence was found for the level of cholesterol in blood being a powerful correlate of the development of myocardial infarction and angina pectoris.

Gofman and co-workers (1950)²⁵ were the first to find that the particular portion of the lipid-protein continuum in which cholesterol is transported is more important than the total cholesterol level. Cholesterol and triglycerides are transported in the plasma as various classes of lipoproteins. The most harmful and atherogenic form of lipoprotein is low-density lipoprotein (LDL, which is 50% cholesterol) as opposed to high-density lipoprotein (HDL, which is about 50% protein / 50% phospholipid). It is not clear how LDL is atherogenic, and it may well be that chemically oxidised LDL has direct effects that damage the arterial wall.

About half of the patients with familial hypercholesterolemia or their family members sustain infarction by their mid-40's.²⁶ The risk of age-adjusted six-year CHD death rates per 1000 men increases linearly as serum cholesterol levels increase above 200mg/dl.²⁷ Tunstall-Pedoe and Smith (1990) gives a survey of cholesterol as a risk factor for coronary heart disease.²⁸ They postulate that coronary risk from serum total cholesterol is graded and continuous. Should cholesterol associated coronary risk be reversible, there would theoretically be no bottom limit at which lowering the plasma cholesterol level would produce no dividend at all for coronary risk. Everyone might be expected to benefit from a specified reduction of serum cholesterol. Indeed, action limits for serum total cholesterol have been computed in South Africa to serve as guidelines for the management of patients with hypercholesterolaemia.²⁹

2.4.3. Hypertension.

Clinical observation indicates that hypertension appears to aggravate coronary atherosclerosis. The Framingham study has demonstrated a curvilinear relationship between blood pressure and subsequent development of CHD.^{30,31} Where hypertension and hypercholesterolaemia coexist, the risk of cardiovascular disease is considerably increased. The relationship between hyperlipidaemia and hypertension as risk factors for cardiovascular complications is covered by Krone and Müller-Wieland (1990).³²

2.4.4. Cigarette Smoking.

"A custom loathsome to the eye, hateful to the nose, harmful to the lungs and in the black, stinking fume thereof, nearest resembling the horrible Stygian smoke of the pit that is bottomless."

James I, King of England [1566-1625]
A Counterblast to Tobacco.

Epidemiological studies generally indicate a strong association between cigarette smoking

and subsequent development of IHD. Unquestionably, high correlations have been shown to exist between cigarette smoking and atherosclerosis.³³ A summary of the influence of tobacco components on various aspects of the cardiovascular system was carried out by Aronow.³⁴ In all cases cigarette smoking is considered to be injurious not only to the cardiovascular system, but also to other areas of human physiology.

Interestingly, those Japanese who are heavy smokers have very little incidence of IHD, but a high incidence of strokes. Elevated lipid levels seem to be essential for severe atherosclerosis of the cardiac vessels, and in its absence (such as in the Japanese who have a diet high in fish and therefore comparatively low in LDL) cigarette smoking affects the cerebral vessels more severely.

Smoking does not have implications for cardiovascular disease alone. McIntyre and Taylor have recently estimated the cost of smoking to the S. A. economy in 1985 to be between R584,4 and R652 million.³⁵

2.5. Minor Risk Factors.

Other factors also contribute to the risk of contracting CVD. They include diabetes mellitus, gout and hyperuricaemia, obesity, stress, sedentary living habits and certain personality behaviour patterns. At this stage of research it is clear that the mechanisms by which most of these factors operate are imperfectly understood. Some may raise coronary heart disease by accentuating the major risk factors. Others are difficult to measure - responses to stress for example may differ markedly. All that is known is that people who display these risk factors have a higher incidence of CVD than those who do not.³⁶

2.6. Combination of Risk Factors.

Much research today is directed at ascertaining the individual's total risk profile of cardiovascular disease, compiled by aggregating two or more of the risk factors above. One method that has been devised for calculating multifactorial risk is the Dundee Risk-Score Risk-Rank calculator. It is a circular slide rule for multiplying together the risks derived from cigarette smoking, blood pressure and serum cholesterol, and is easy to operate. The readout indicates the relative risk that a patient runs of suffering a coronary incident in the five year period after being tested. The formula for this calculator is a multiple logistic function derived from studies in the United Kingdom Disease Prevention Project.³⁷

Neaton and Wentworth (1992) have published the overall findings of the combined effects of serum cholesterol, blood pressure and cigarette smoking on death from coronary heart disease for 316 099 men.³⁸ They found that smokers with serum cholesterol and systolic BP levels in the highest quintiles had CHD death rates that were approximately 20 times higher than nonsmoking men with systolic BP and cholesterol levels in the lowest quintile. It seems superfluous to say that the more risk factors one has, the higher are one's chances of contracting some form of CVD.

2.7. Conclusion.

Table 2.7. shows the mortality due to circulatory disease of males aged 15-64 years in South Africa in 1984.³⁹ A cursory inspection of this table reveals that cardiovascular disease is the prime cause of death amongst SA Whites, whereas it is the third most common cause of deaths of SA Blacks. However, it is interesting to note that while the CVD mortality of Whites is largely due to IHD, that of Blacks is mostly due to cerebrovascular disease.

Table 2.7. Mortality due to Circulatory Disease of Males Aged 15-64 years in South Africa in 1984.

	Whites	Asians	Coloureds	Blacks
Total CVD Deaths	3 358	684	1 508	3 801
% of all deaths.	35,7	36,9	18,5	10,8
Rank order as cause of death.				
% of total due to :	1	1	2	3
Ichaemic heart disease	73,7	62,3	39,0	8,4
Cerebrovascular disease	11,4	17,5	34,3	44,1
Hypertensive disease	2,7	8,2	5,6	9,4
Heart failure	1,5	2,5	3,5	7,8
Diseases of pulmonary circ.	4,4	3,0	5,4	6,5
Rheumatic fever & heart disease	0,5	1,2	2,0	2,4
Cardiomyopathy	0,9	0,6	1,0	3,9
Ill-defined heart disease	0,9	1,6	4,7	11,4
All other circ. disease.	4,0	3,1	4,4	6,1

**By 1988 the rank of cardiovascular deaths among the coloured population had risen to 1.⁴⁰*

Isolated studies in rural Black populations [African] find low levels of IHD and CVD risk factors; a particularly low prevalence of hypertension is reported. The traditional diet followed by most rural Blacks could be described as a very strict cholesterol lowering diet. With urbanisation, lifestyles are adopted that result in increased hypertension, obesity and smoking. The traditional diet changes, and becomes high in salt, fat and cholesterol. Black patients near Pretoria who were hospitalised for myocardial infarction were found to have an adverse IHD risk profile compared to rural control groups with no IHD.⁴¹

This bodes ill for South Africa. As the process of black urbanisation continues apace, and erstwhile rural people adopt westernised lifestyles, one can expect a steep rise in the incidence of CVD. This should place an enormous burden on the medical resources of the country, and will pose a stiff challenge to health officials in the near future. By assigning a monetary figure to the financial costs of CVD in South Africa, it is hoped that policy makers will be induced to make the necessary funds available for programmes that will

raise awareness of the causes of CVD. Long-term, cost-effective economic benefits are to be gained by implementing a population strategy for the prevention of CVD. A recent study found that a population strategy cost only one-tenth of more intensive interventions per coronary heart disease event saved.⁴²

The Heart Foundation of Southern Africa and the Medical Research Council are currently devising a population strategy for the prevention of chronic diseases of lifestyle in South Africa. It is currently thought that an effective policy for the prevention of cardiovascular disease should have a two-pronged approach: a multifaceted health promotion programme directed at the whole population, and a health service element for early diagnoses and management of persons at high risk of developing CVD.

The health promotion approach has the effect of reducing the risk factors and is the more cost effective way of combating CVD. An effective health promotion programme twinned with the costlier health service element would result in a smaller number of people in the high risk category, and would thus obviate many expensive operations and cardiovascular interventions. This effect is shown by Graph 2.7. As people improve their habits of diet and lifestyle, the distribution of risk factors are shifted to the left, and the percentage of patients who require care and expensive services is reduced. This saves money and confers on society the considerable positive externalities of a healthier population.

Ideally, the health promotion campaign should reach children of school-going age. Recommendations should be easy to follow and the norms of the various peoples of the country taken into account. The health service aspect should be embedded in a national plan for the whole group of chronic diseases. No such specific national programme for the prevention and management of chronic diseases is currently in operation in South Africa.

The aim of this work is to furnish policy makers with a realistic assessment of the impact of CVD on the economy. It is hoped that this will render the apportioning of funds for combating the various classes of disease easier to prioritise and more efficient.⁴³

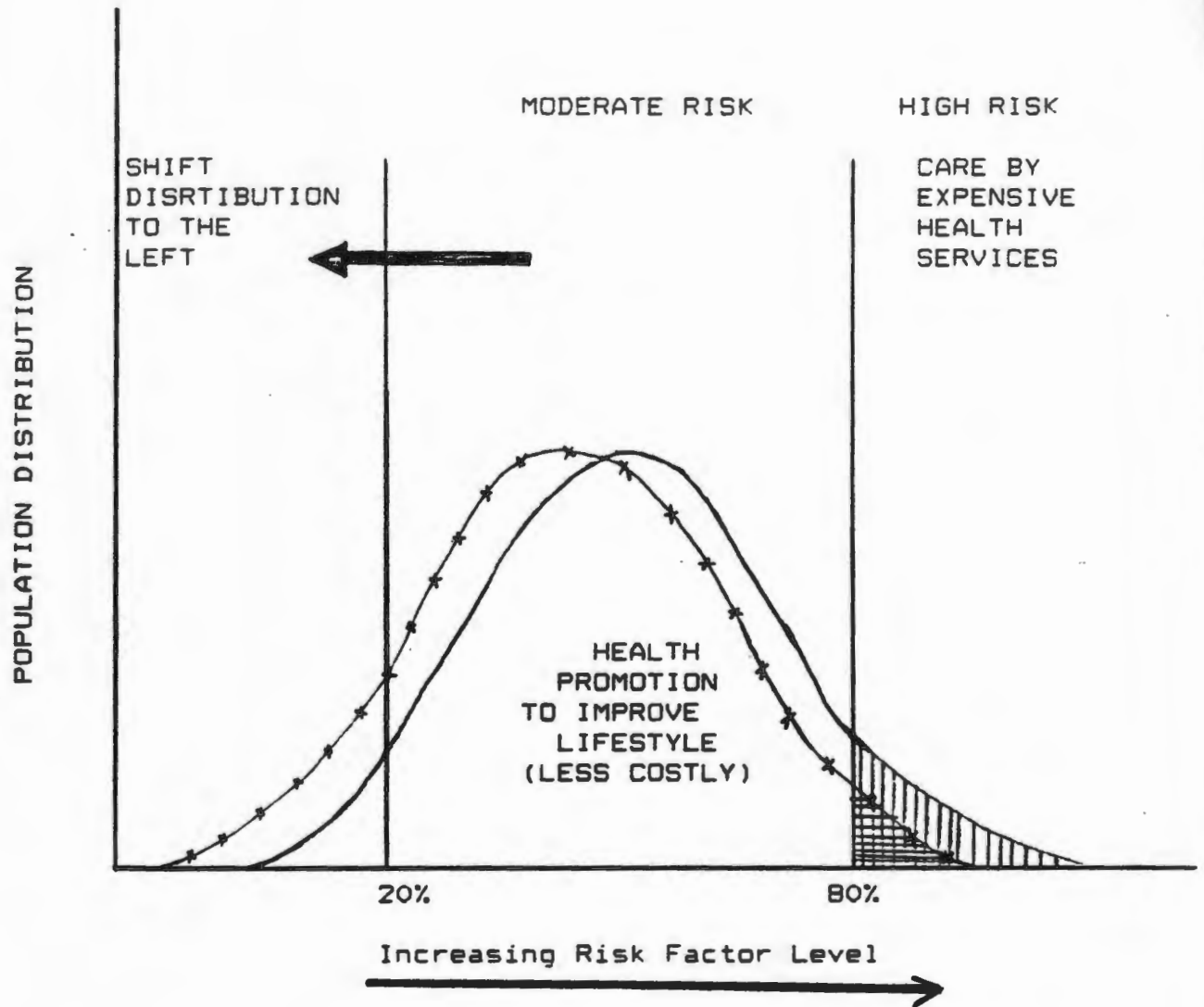
Finally, it may be argued that extending the life expectancy past retirement age has implications for the economic burden to others. The retiree lives off the contributions of others, not himself. This consideration is not an issue in developing nations where life expectancy is well below the age of retirement. However, even in developed countries with ageing populations, it can be argued that by eradicating CVD, those who currently retire at age sixty-five would enjoy better health and extra longevity. They would be more productive at comparative ages in a CVD-free world. This would make a secular rise in the retirement age of people a viable policy option in the future, rendering those currently unproductive, productive, thereby easing the social burden.

Hopefully the programme will succeed. However, reformers know that human habits, especially the pleasant ones which unfortunately in this world have invariably turned out to be hazardous, can be devilishly difficult to change. This inertia and stubbornness, when added to the cynicism and life philosophy of people such as the author of the following quotation, further steepens the road for the intrepid behavioural modifier.

"He neither drank, smoked, nor rode a bicycle. Living frugally, saving his money, he died early, surrounded by greedy relatives. It was a great lesson to me."

John Barrymore, US actor [1882 - 1942].

Graph 2.7. The Change in the CVD Risk Factor Level of a Population as Lifestyle Improves.



A GLOSSARY OF CARDIOVASCULAR PHYSIOLOGY AND RELATED TERMS.

ANEURISM. A localised dilatation of any segment of the cardiovascular system, i.e. the heart and arterial or venous vessels.⁴⁴

ANGINA PECTORIS. Acute chest pain caused by partial occlusion of the blood supply to the heart muscle.

ATHEROSCLEROSIS. The entire spectrum of biochemical and functional changes, as well as the pathological and clinical manifestations that underlie the changes to arteries which result in decreased blood supply to all parts of the body.

CHOLESTEROL.⁴⁵ A compound essential for human life and synthesised in most cells of the human body. Chemically it belongs to a class of fatty compounds called steroids. Raised levels in the blood leads to the development of atherosclerosis.

CARDIAC. Of the heart.

CORONARY VESSELS. Of the heart arteries and veins.

EMBOLISM. The transportation of undissolved material (an embolus) in the bloodstream and its impaction somewhere in the circulation. Emboli may be solid, liquid or gaseous; they may also be infected or non-infected.⁴⁶

LIPOPROTEINS. Molecules in the blood carrying lipids to and from the liver, the intestines and peripheral tissues.

HIGH DENSITY LIPOPROTEIN CHOLESTEROL. (HDL). "Good cholesterol". HDL is the transport vehicle for excess cholesterol from the peripheral tissues to the liver where it is metabolised and excreted. The higher the HDL-cholesterol the better a physiological system can get rid of excess cholesterol. In effect, this is a protective mechanism against the development of atherosclerosis.

HYPERCHOLESTEROLAEMIA. A raised concentration of cholesterol in the plasma. Such raised levels promote the development of atherosclerosis in arterial walls.

HYPERGYCAEMIA. High blood glucose levels.

HYPERTENSION. High blood pressure.

ISCHAEMIC HEART DISEASE. (IHD). The structural and functional abnormalities of the heart as a consequence of an inadequate or interrupted supply of blood to the heart muscle. Atherosclerosis of the coronary arteries is by far the most common cause.⁴⁷

LOW DENSITY LIPOPROTEIN CHOLESTEROL. (LDL). "Bad cholesterol." LDL, a

constituent of blood, is involved in the formation of atherosclerotic plaques on the walls of the arteries. LDL carries cholesterol from the liver, derived from the diet or synthesised by the liver, to the peripheral tissues through the blood vessels. Raised LDL-cholesterol therefore imparts increased risk for IHD.

MYOCARDIUM. Heart muscle.

THROMBOSIS. A solid mass formed in the lumen of a blood vessel (or heart) from constituents of blood. An occluding thrombosis is one which fills the vessel's lumen and obstructs its flow.⁴⁸

STENOSIS. A constriction; the narrowing of a tube or especially a blood vessel.

STROKE.⁴⁹ A clinical syndrome resulting from cerebral damage due to obstruction or rupture of a cerebral artery due to any cause.

INFARCTION. A portion of tissue that is dying because blood supply to it has been cut off.

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CHAPTER 3.

THE VALUE OF A HUMAN LIFE.

"I think at the moment we are not in a position to set an economic value on life. No doubt many people will be impatient with the arguments I have presented. Decisions will have to be made, they will say, so we simply have to have some value for a life. And they will argue that it is manifestly inefficient not to have a uniform value established for all of the government's decision making... It is one thing to say there is a manifest inefficiency; it is another to know how to do better. One point is at least plain: establishing a uniform value to life would not be the best thing to do.

...If we fix no definite economic value on life, the decisions will still get made as they always have. Like many hard decisions, they will have to be made without the guidance of clear criteria."

John Broome ¹

Any cost of illness study will entail the question of the value of a human life. And anyone enquiring into the value to a human life will have to consider Broome's words.

The debate on the value of a human life was particularly intense in the economics literature of the late 1970s, early 1980s. It remains very much a topic of interest, and since 1987 the Journal of Economic Literature has included Value of Life as a separate entry under Human Capital [number 851 in the classification system for journals and articles].

3.1. An Ethical Issue.

Is it morally defensible to place a value on a human life? Both philosophers and economists have tried various approaches, but such is the indecisiveness on the topic that no method has gained clear ascendancy. This is hardly surprising, for at core the issue remains an ethical one, and it is doubtful that any model will ever capture its true essence. The answer with which an individual feels satisfied, will in the final analysis be determined by his or her meta-ethical position. Of late, the emphasis of the debate has shifted from the ethical aspect to the use of appropriate methodology, because most economists are of the opinion that if society is to allocate its resources efficiently, placing a value on a human life becomes inescapable. This shift has served only to deflect attention from the ethics of the topic.

The best that can be done is to try to gain insight into the conceptual schemes that various writers have used to concretise this abstract notion.

3.2. Broome: Pareto Criterion Contravened.

In a much quoted landmark paper, John Broome tried to show that the attempt to value life in terms of money is more or less doomed to failure.² When a project is undertaken, the

whole notion of benefits and costs (values) needs to be supplied both as an exact definition and as a justification. Any project or intervention undertaken will have both beneficial and detrimental effects. Suppose that one of the detrimental consequences of a project is to impair the quality of life of some person or even lead to his death. The "Pareto criterion" then stipulates that each victim who stands to lose from the project should be compensated by the minimum amount he would be willing to accept in full recompense for his loss.

This amount is defined as the value of his loss, and must be accounted for irrespective of which method is used to compute the value of a human life. If the benefits from a project are enough to cover all the losses with some surplus remaining, then the project is desirable in terms of the Pareto criterion.

Broome considers the case of an immediate death where no bequests are allowed. Then the monetary value of a person's life to be lost by any hypothetical project must be infinite. This is because no amount of money is of any use to the dead person. [Of course this is dubious, for the bequest motive can be very powerful indeed; but that has been assumed away here.] But if a death counts as infinite cost, then it seems as though any project that causes anyone's death will be automatically rejected. Broome deems this unacceptable, since a project might at the same time bring benefit to millions but cause the death of a few. Yet such a project would not automatically be wrong. A single death cannot outweigh every other consideration.

It strikes Broome as odd that according to some economists, death cannot be valued, yet the expected value of the risk of death can!

3.3. Mishan: Value of Life as Monetary Compensation for Increased Risk.

A paradox inheres in the above; the theoretically prescribed way to value a death appears to lead to an obviously flawed conclusion. The first person to acknowledge this in print was E.J. Mishan.³ In an attempt to resolve this paradox, Mishan employed a device which has since found wide currency.

Mishan's intention was to circumvent the paradox by reducing the value of death to some finite amount. The device operates as follows: On the whole, government projects do not kill specific people who are identifiable at the time of the launch of the project. Instead, the risk of dying for a number of people is increased. The monetary value of this increased risk is finite, in the sense that people will accept some sum of money as full compensation for it. The true cost of a project can be found by adding the sum of money that covers the total compensation paid to all those at increased risk, to other costs.

For purposes of evaluation, a death is commuted to a risk of death.

3.4. Broome: Value of Life as Monetary Compensation for Risk is Flawed.

Broome argues that Mishan's device is illegitimate. First, moral sensitivities are offended when the identity of the person certain to die is known before the implementation of the

project. An extremely beneficial project that would involve such a death would incur an infinite monetary cost. But it would nonetheless be wrong to reject such a project automatically, so that the paradox remains unresolved.

Furthermore, the device is flawed even in cases where the identity of the victim is *not* known. He lists five cases which illustrate the deficient logic of Mishan's solution. The first two show that if acquaintance with definite victims of a project is delayed, the project will be implemented. Thus, a project that on a subsequent day would have been rejected for being infinitely expensive (since a known death is involved), on the previous day would have been approved because of the temporal ignorance of decision makers.

Two further examples concern the comparative ignorance of the general population *vis-à-vis* decision makers. People can be compensated cheaply for the extra risk they will be assuming, either because they are not fully aware of the actual risks they are about to face, or because they fail to distinguish between a very small degree of probability of death and no chance of it at all.

In another example, Broome considers two alternative projects which have to be compared. Project A will cause the death of a single person of known identity. Project B will lead to the death of one thousand people of unknown identity. According to the proposed method, Project B would be accepted, yet one thousand people die instead of one. This violates utilitarian ethics yet exempts the proponents of the project from deliberate prejudice against any individual.

In summary, Broome distinguishes between an *ex ante* and an *ex post* valuation of a project, the former being carried out before its costs and benefits are known, the latter being made at the time of implementation of the project when all its effects are settled. The two will often differ. Broome claims that of the two, the *ex post* valuation is the correct one because it is the valuation of the actual project, whereas the former is really a valuation created by the project. The *ex ante* valuation is useful only to the extent that it approximates to the *ex post* valuation. But it has been shown that the *ex ante* valuation, in the case of death, is worthless, and furthermore, it can be worthless at the time that it is made. Nonetheless, all decisions have to be made *ex ante*. Section 3.5 deals with Broome's resolution of this dilemma.

3.5. Broome: Relax Pareto criterion.

Having argued that no amount of money can compensate the value of a human life, Broome does not allow the supposed inference that any project that causes death has to be rejected. He resolves the paradox by relaxing the Pareto criterion. If the value of costs exceed the value of benefits, as is the case where even one person is killed, then there is no way of arranging compensation so that no one is harmed.

But there is not the least reason to suppose that such projects are necessarily wrong. A project which damages the interests of some while promoting that of others might well constitute an improvement (*cf.* Bergson criterion). There is no warrant for the belief that,

for a project to be good, no one may lose. However, this is difficult to prove given the problems of interpersonal utility comparisons.

3.6. Critiques of Broome.

Broome's seminal paper provoked numerous replies, notably from Buchanan and Faith (1979)⁴, Williams (1979)⁵, M.W. Jones-Lee (1979) [in an article wittily subtitled 'Why Broome Does not Sweep Clean']⁶ and Mishan (1981)⁷.

In his appraisal of Broome's arguments, Mishan (1981) concludes that Broome is seeking a value of life that not only has universal ethical appeal but is also invariant to time, knowledge, and material circumstance; a value unsullied by distinctions between the *ex ante* and the *ex post*, and impervious in particular to the 'paradoxical' responses of people according as death is a certainty or a risk. Economists must perforce settle for less. They must settle for a value of life that falls short of the stringent standards proposed by Broome.

3.6.1. Mishan's critique.

One of Mishan's arguments against Broome is that there are very few things for sale that carry a risk of death to the buyer of less than one in ten million of being killed. People buy these goods despite being cognisant of the fact that they could be fatally injured by any such article. Assuming that the shops are not to be closed down, what should be done about it? [Note: Mishan is not taking consumer myopia into account here!] One who dismisses *ex ante* valuations of goods and bads at the time decisions are made, might not want to abide by a purely political decision either (i.e. one made in ignorance of any economic calculation). Purely political decisions are beset with inconsistencies and inefficiencies. All decisions having a bearing on mortality and reached through a purely political procedure will have an implicit valuation of life, that will not only be finite, but will also vary widely over time.

Hypothetically, the political decision to spend a million dollars on a highway for the purpose of saving 20 lives a year entails an implicit value of life of \$50 000, a sum that hardly reflects the worth of a human life. It follows that whenever the government has to decide between projects, its decision can entail the saving of more or fewer lives. Instead of being satisfied with such arbitrariness, the economist should rather accept the individual's own valuation of the change [or risk] in question, be it 'paradoxical', perverse or otherwise.

3.6.2. Buchanan and Faith's critique.

Buchanan and Faith (1979) concur that people's own lives are of infinite value to them. Ruling out potential suicides, no-one will choose a course of action that promises certain death. The two economists contend that to choose certain death is nevertheless not at all equivalent to choosing a 'risk of death', which each human being does every day. At the

moment of choice among the alternative 'possibilities', a person may rationally accept a risk of death in exchange for a measurable monetary reward or even the applause of a crowd. In some risky professions (racing car drivers, mercenary soldiers, skyscraper workers etc.) such exchanges become routine.

Whenever risk or uncertainty is involved, the consequences of choice are unpredictable in a deterministic sense. These consequences may involve damages, including the loss of life, and it may prove useful to measure the 'costs' or damages of such consequences. However, these *ex post* 'costs' are wholly irrelevant for behaviour. To say that 'costs' are infinite for the person who loses his life in the draw of a lottery in which he rationally chose to participate, is to say nothing about the value such an individual placed on life at the moment the choice was made. These *ex post* 'costs' can in no way influence the choice behaviour that created the consequences.

Buchanan and Faith concentrate on the definition of cost in their analysis of Broome's criticism. If costs are perceived as 'damages' that may be objectively measured by external observers *ex post*, from which it follows that they may also be estimated or predicted *ex ante*, Broome's criticisms would be apt. Measured damages to the person whose life is lost are infinite. If, however, costs are related directly to choice, and are treated as subjectively estimated barriers to choice by those persons who are to bear the consequences, costs become the value of rejected alternatives. No paradox can arise. The critical element here is that all persons who participate in a project must *agree* to such participation *in advance* of the project's implementation.

3.6.3. Jones-Lee's critique.

Jones-Lee (1979)⁶ critically examines the hypothetical cases discussed by Broome. One of Broome's errors is to believe that where a multistate utility analysis of the value of life is undertaken, it is "...*necessary to speak of the utility of someone who is dead...*" and that for the state in which the *j*th person is to die "*his marginal utility of money is...zero*". Those who have conducted such analyses typically do so from an *ex ante* perspective, so that a utility of wealth function for state 'death' is *not* to be interpreted as a dead person's utility of wealth (as Broome suggests it should), but as a *live* person's utility of current wealth *conditional on the fact that he is to die at some point during the forthcoming period*. Under such an interpretation and given that an individual is (a) able to make bequests and (b) concerned for the welfare of his surviving dependents, the marginal utility of 'money' (i.e. wealth) will most certainly not be zero.

3.6.4. Williams' critique.

Williams (1979) suggests that Broome's arguments for an infinite monetary value of a human life are based on the special (degenerate) case where compensation should actually be paid, and in which "the death in question is to be immediate and no bequests are permitted". The flaw in Broome's argument is that *in the special circumstances postulated*, compensation cannot effectively be paid, because the individual has no opportunity to spend the money in such a way as to improve the quality of his life.

But this is not the context in which those advocating this test envisage its use. The general case would be the one in which an individual is offered an opportunity to choose between an improvement in his standard of living and an improvement in his chances of survival. For example, people routinely risk their lives travelling to and from work to earn a living. If a public project is undertaken which makes the journey safer, those who choose it realise that the population's disposable income must be reduced in order to free the resources necessary to carry out the project. In such a general case, compensation is possible.

3.7. "Value of Life" Debate Still Unresolved.

It is clear that there is a divide between those who argue for compensating variation as the true measure of the value of life, [i.e. those who assume that the cost-benefit analysis of risk exchange (CBR for short) methodology should be firmly founded on an *ex ante* hypothetical compensation test], and those like Broome who would only be satisfied with the full *ex post* compensation for the loss of a life.

The debate remains unresolved, and Broome's reply to these authors embodies a reaffirmation of his original stance:

*"...What makes him [Jones-Lee] think that there is such a thing as a money value of life? Why on earth should economics be expected to deliver a neat answer to morally agonising questions about which ends justify the sacrifice of some number of lives? No doubt it will ease a politicians mind to be given a sophisticated calculation of the precise weight to put on the loss of a life... Politicians ought not to expect the ease of mind that comes from knowing they did the only thing that was right. I think it is better to force them to appreciate the difficulties of their decisions than to give them easy answers."*⁸

Perhaps the impasse exists because of the different grounds in which these two camps are entrenched. On the one side are the pragmatists, ready to supply decisionmakers with valuations which, although subject to doubt, are held to be better than wild guesses or no valuations at all. Opposing them are idealists of a more ethical bent, respectful of the sanctity of human life and therefore unsatisfied by any monetary compensation in exchange.

But Broome does not offer an alternative to CBR; he merely acknowledges that there is no simple answer.⁹ This leaves the technician with no parameters, however broad, within which to value a project. Broome has since continued to be active in this field.^{10,11,12} But his later work has taken a more philosophical turn, as is perhaps appropriate to the question, and his 1985 paper on the economic value of life contains as many references to prominent philosophers as to economists.¹³

Broome's criticisms still stand; an undisputed method of evaluating the worth of a human life is yet to be found. Yet, together with the "many people" to whom Broome has referred, it feels compelling to place a notional, albeit deficient value on a human life. Within the assumptions presented, the best that can be aimed for is to give a figure which

satisfactorily reflects the burden of a loss of a life to the South African economy.

Three methods have been used by economists to determine the value of a human life, viz. the human capital approach, willingness-to-pay and societal valuation. In Section II, an exposition of these methods is presented.

Those wanting a more philosophical treatment on the subject of the value of a life can read Roupas.¹⁴

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SECTION II

CHAPTER 4.

HUMAN CAPITAL.

4.1. Introduction.

Human capital theory is founded on the notion that the value of a human life should be based on the monetary value of life-long earnings. It is assumed that the worth to society of an individual's life is measured by future production potential, usually calculated as the present discounted value of expected labour earnings.

This approach to valuing a human life has a long history. As far back as 1699 Petty used the method,¹ followed by Farr in the nineteenth century.² Later studies improved the underpinnings of the approach, and the state of the art at the level of practical implementation today is found in the work of Dorothy Rice.³ An elaborate treatment of the impact of the death of a wage earner on the savings, earnings and consumption of society is given in Appendix 4.1 at the end of this chapter.

4.2. Economic Value of a Human Life as Discounted Future Earnings.

The rationale and arithmetic of this approach are as follows:

Let Y be an activity which provides a person entering the job market at a particular age (called earnings age zero), with a real net earnings stream of Y_0 during the first period, Y_1 during the next period, and so on until Y_n during the last period. "Activity" is a term used here to indicate any kind of human capital invested in the individual, including not only training but also health and morale. "Net" earnings are gross earnings minus tuition costs over the same period.

"Real" earnings are the sum of monetary earnings and the monetary equivalent of psychic earnings. This clause ensures that the term "investment in human capital" is not restricted to monetary costs and returns, but is applicable also to better health, increased job satisfaction and all other beneficial psychic components arising from this type of investment.

The present value of the net earnings stream in Y would be

$$V(Y) = \sum_{j=0}^n \frac{Y_j}{(1+i)^{j+1}}$$

where i is the discount rate, assumed for simplicity to be the same in each period.⁴

A more precise expression for the loss to the economy consequent on an individual's decease, would be L_1 , where

$$L_1 = \sum_{t=\tau}^{\infty} Y_t P_t (1+r)^{-(t-\tau)}$$

Y_t is the expected gross earnings of (or alternatively, value added by) the person during the t th year, exclusive of any yields from his ownership of non-human capital. P_t is the probability in the current, or t th year, of the person being alive during the t th year, and r is the social rate of discount expected to hold during the t th year.⁵ Since human capital estimates are computed from society's point of view, labour earnings are evaluated *before taxes* as this reflects labour's share of GDP. After tax earnings represent the relevant magnitude to the individual. It is important to note that non-labour income is not included since individual capital holdings and associated earnings simply accrue to others upon the individual's decease. All sorts of refinements illustrating the economist's finesse can be brought into this equation.

A second method used is that of calculating the present discounted value of losses over time accruing to *others only* as a result of death of this person at age n . A precise expression for the loss to the economy based on this method would be L_2 , where

$$L_2 = \sum_{t=\tau}^{\infty} P_t \cdot (Y_t - C_t) (1+r)^{-(t-\tau)}$$

C_t is the personal expenditure of the individual during the t th period as expected at time t . This sort of measure is sometimes referred to as being based on the "net output" approach to distinguish it from the "gross output" approach associated with the L_1 measure. Though occasionally mentioned in the literature, L_2 has not been employed apparently because of the assumed policy implications.

L_2 derives from welfare economics; a worker's contribution to society minus his burden on society equals his contribution to the welfare of society. A chronically ill person who consumes vast medical resources actually relieves society of a burden by passing away, and therefore has a negative value of life on this measure. However, it is not always possible to allocate a monetary value to all people.

4.3. L_1 as the measure of Human Capital.

L_2 might seem, at first glance, to be more acceptable than L_1 , the gross output method. It could be argued, harshly, that what matters to the rest of society is simply the resulting financial loss or gain that accrues to them following the death of one of its members.

But this *ex post* approach might be dangerous. If accepted, it follows that the death of a person with a negative L_2 measure confers a net benefit to society.⁶ Decisions based on this reasoning could have deleterious ethical implications. The L_2 measure also ignores the circular flow of income. The effect of death is not only to halt consumption;

government and businesses alike derive income from a person with a negative L_2 measure.

For these reasons, Human Capital shall henceforth be defined by L_1 .

4.4. Critiques of Human Capital Theory.

Critiques of human capital theory abound. Implicit in the "capital" term of "human capital" is the notion that an individual can expect a return for having undergone training. This idea has come under attack from a few writers. In point 4.5.1. below, the rationale for investment in human capital is debated. Points 4.5.2 to 4.5.8 discuss more general critiques of human capital theory.

4.5.1. One of the earliest critics of this idea was Schaffer.⁷ Schaffer is of the opinion that economics has little to gain and much to lose by the universal application of the capital concept to man. His arguments are as follows:

"Investment in man" is essentially different from investment in non-human capital. Investment in man is not a "rational" investment based on careful comparison of alternative investment opportunities. At least a part of any one direct expenditure for the improvement of man is not investment as the term is normally used. For example, an educational course may be undertaken for reasons other than the expectation of a monetary return. It might have no traceable effects on future output, and it could satisfy wants directly. Therefore it should be seen as consumption expenditure. Even if it were possible to resolve human capital investment into consumption and investment components, it is not possible to allocate a specific return to a specific investment in man. And even if this in turn were possible, it would still be ill-advised - from the point of view of social and economic welfare - to utilise the information thus obtained as the exclusive or even primary basis for policy formation.

Shaffer also cites studies which prove that the income differential correlated with additional education is considerably higher for Whites than for Negroes (US data) owing to greater vocational opportunities. He enquires whether, in the pursuit of a higher return for an investment, a good case could not be made for the decrease, if not the discontinuation, of governmental subsidisation of non-White students.

T.W. Shultz, in a reply to Schaffer, asserts that although it is difficult to separate the consumption from the investment component in human capital, it would be incorrect not to suppose that most students who attend university do not invest in their particular skills in the expectation of higher future earnings.⁸ Shultz agrees with Schaffer that knowledge about economic returns accruing from investment in human capital should not form the exclusive criterion for public expenditure in education. But, while it is altogether proper that people should prize the cultural contributions of education, it would be very short sighted of them not to see its economic contributions. Education is a merit good.

Few students choose a field of study at a tertiary educational institution solely with a view

to maximising future earnings. The faculties that restrict access traditionally offer the greatest return. This higher return is in part a monopoly rent which is maintained by the professional board's control of the education process, and it represents a distortion in the market.

By and large, students choose a field of study for which they have a particular aptitude or liking. They assume that a higher education would automatically grant them a passably good income on which they could live comfortably. One would probably find that those faculties turning out the highest earning professionals do not necessarily attract the greatest number of applicants. It therefore appears that acquiring a higher education *per se* is the primary desired commodity, and not so much the direction of study that is chosen.

4.5.2. Human Capital focusses overly much on the income-earning capacity of the individual, and omits various factors which reflect the subtleties of human existence. It ignores other dimensions of illness and death as well as nonmarket activities that may be deemed more important to an individual than economic loss. Price alone does not capture the utilities involved in consumer or producer surplus. This psychosocial cost is but one component of the burden of illness ignored by Human Capital. [Willingness-to-pay purports to include the latter.]

4.5.3. Human Capital valuation rests on the assumption that earnings reflect productivity.⁹ However, according to neoclassical economics, each employee does not receive the value of his or her personal contribution to output, but rather the value of output added by the marginal or last hired worker. The intra-marginal worker is paid according to the productivity of the marginal worker. But the death of an intramarginal worker burdens the economy with the loss of his actual output, and not the value of the marginal worker's output as computed by human capital. Further, in industries whose production functions are homogeneous of degree one, $TP = MP_N + MP_K$. If capital is left unused because of deaths, then the loss of output per worker will exceed MP_N .

X The theory of marginal productivity and workers' remuneration is well established in labour economics, and rests upon the key assumptions that labour markets are competitive and that firms behave as profit maximisers. Unfortunately, the impact of unfulfilled assumptions, or the robustness of economic models, is frequently unknown. Distortions and other factors in the economy can cause the wage of a worker to diverge markedly from marginal product of labour.

✓ 4.5.4. Human Capital relies on existing earnings patterns, and consequently embodies all discriminatory practices which are inherent in a society, be they statutory or social. It tends to give greater weight to working-age men compared to women, children and the aged; in India's caste system, to Brahmins as opposed to Harijans; in fact, generally to the favoured in any society in preference to the misprised. In countries where earnings differ from value of output because of discriminatory practices, the loss to the economy of workers will be not be accurately reflected by human capital.

Certain forms of employment discrimination exist in the marketplace on the basis of

education screening. In the past, chemists with a three year technikon diploma received lower starting salaries than those with a three year university degree for the same positions in the South African chemical industry. However, this distinction has become blurred recently, with no correlation between starting salary and three-year qualification being discernible.¹⁰ Unequal pay for equal work certainly biases earnings as a measure of the value of output. Conversely, unequal job opportunities for equal qualifications, while inequitable, and most likely reduces national output, does not invalidate Human Capital accounting if the individual's earnings reflect true value of output.¹¹

✓ 4.5.5. Human Capital, in addition to earnings, has to calculate the implicit value of non-market activities such as housekeeping and volunteer services. While it is relatively easy to calculate a shadow price for housekeeping duties,¹² it is more difficult to calculate the value of voluntary duties rendered by beach lifesavers or charity workers. One feels, however, that this objection is perhaps the easiest one for human capital theory to meet, as opportunity costs can be used.

4.5.6. Discounting is a technique used by economists which allows the costs and benefits of projects spread over time to be compared. This is done by appropriately weighting events according to their point of occurrence on the time scale - the further in the future the event, the less importance it is given at the present time. Human Capital calculations are very sensitive to the discount rate.

Table 4.1. shows a range of Human Capital values using different discount rates to estimate the present value of foregone earnings of males by selected age groups.¹³ As can be seen, the values are significantly larger for low discount rates than for higher ones. Furthermore, the relative valuation placed on persons in specific age groups is affected by the choice of discount rate. For example, at a real discount rate of 2,5 percent, 20-24 year-olds are valued higher than 40-44 year-olds, whereas at 10 percent the reverse is true.

The broader issue at stake is that of determining what society foregoes when it invests in life saving programs. Various standard but arbitrary real discount rates have been used to evaluate all health projects [for example, 6% is currently used by the Department of Health in the U.K.]. This has the result that national health programmes which have immediate effects, i.e. those that solve acute as opposed to chronic medical ailments, are given preference by health authorities. The sagacity of this course is at present being contested by a few researchers in the field, notably Parsonage and Neuburger who advocate a zero discount rate on the ranking of health interventions.¹⁴ An excellent paper by Sheldon (1992) sets out all the definitions, critiques and technical issues involved in discounting in health care decision making.¹⁵ Sheldon argues that the routine use of a single discount rate for economic evaluations of health programmes is not justified, and that health policy should have a longer time horizon, reflecting social rather than individual preferences.

Table 4.1. Present Value of Future Earnings of Males by Selected Age Groups, 1977. (In 1977 US dollars).

Age Group (years)	Real Discount Rate		
	2.5%	6%	10%
1 to 4	405 802	109 364	31 918
20 to 24	515 714	286 165	170 707
40 to 44	333 533	242 600	180 352
65 to 69	25 331	21 801	18 825

4.5.7. Certain key personnel such as sole employers having specialist knowledge, by their death engender a far greater economic loss to the community than their foregone earnings. Hardship is often not confined to the relatives of the deceased, but also spreads to the households of employees. Therefore, the computation of a sole employer's loss of earnings underestimates the true loss to the economy since knock-on effects brought about his death are not taken into account. Human capital calculations are more representative where menial workers, who require little training, are lost.

4.5.8. The state of the economy has a bearing on the human capital valuation of a life. Take two economies A and B, both autarkic and of similar size and output, except that A is at full employment while B is not. Further, assume that each person of working age in each economy has two dependents and is equally productive, and that unemployed people consume mostly food and some clothing.

The death of a worker in economy A will represent a significant loss of GDP to that economy since there are no workers available to continue his production, and the welfare services are burdened by two additional dependents. Human capital could in this case provide a fairly accurate estimate of the loss to the economy if it includes the welfare burden as well.

In economy B, the output of a worker is easily continued by recruiting a person from the ranks of the unemployed, and the number of people burdening the welfare services is decreased by one. Apart from the training costs of the new worker, the overall effect is the same as if an unemployed job-seeker had died. The same number of workers now provide for one less non-worker; the same output is consumed by fewer. It is clear that to simply take the foregone earnings of the deceased worker in this case, would be to grossly overstate the burden to this economy. In fact, it could be argued that the actual loss to economy B could be more closely approximated by the value of consumption of one unemployed person, i.e. his demand for goods and services. This can be equated to the value of one unit of social security in countries that have well developed social welfare systems.

APPENDIX 4.1.

The Impact of a Death of a Wage Earner on the Economy.

The deceased person's consumption, earnings and savings are shown in Scheme 4.1A as extending over the length of time he could have expected to live out the full period of his productive life. The consumption patterns of his dependents and other members of society who might be affected by the course of his life are also shown. Note that all which is consumed derives either from earnings or from savings [or from returns from investments, here subsumed under savings]. When the wage earner dies:

- (a) He does not consume C' .
- (b) The savings S' that he would have made in the future are lost. This reduces the consumption patterns D' and R' of his dependents and the rest of society.
- (c) The portion of his past savings S , which he would have consumed in retirement, is transferred to his dependents, D' , and to other members of society, R' .

The net cost of an early death caused by e.g. cardiovascular disease, ignoring any transfers to or from the rest of society, can thus be summarised as follows:

- (i) The victim does not consume C' , part of which would have been financed from his past savings S .
- (ii) His dependents lose $(1-p)(S' + E')$, where p is that portion of his present output, and the income from his present and past savings, which he consumes. [i.e. p is his marginal propensity to consume his earnings and savings].
- (iii) His dependents gain mpS , where m represents the proportional difference in marginal utility associated with the transfer of his past savings to his dependents. [Note: they already consume $(1-p)(S+E)$ while he earns. mpS Thus represents additional income to them.]

The net cost to society is thus equal to

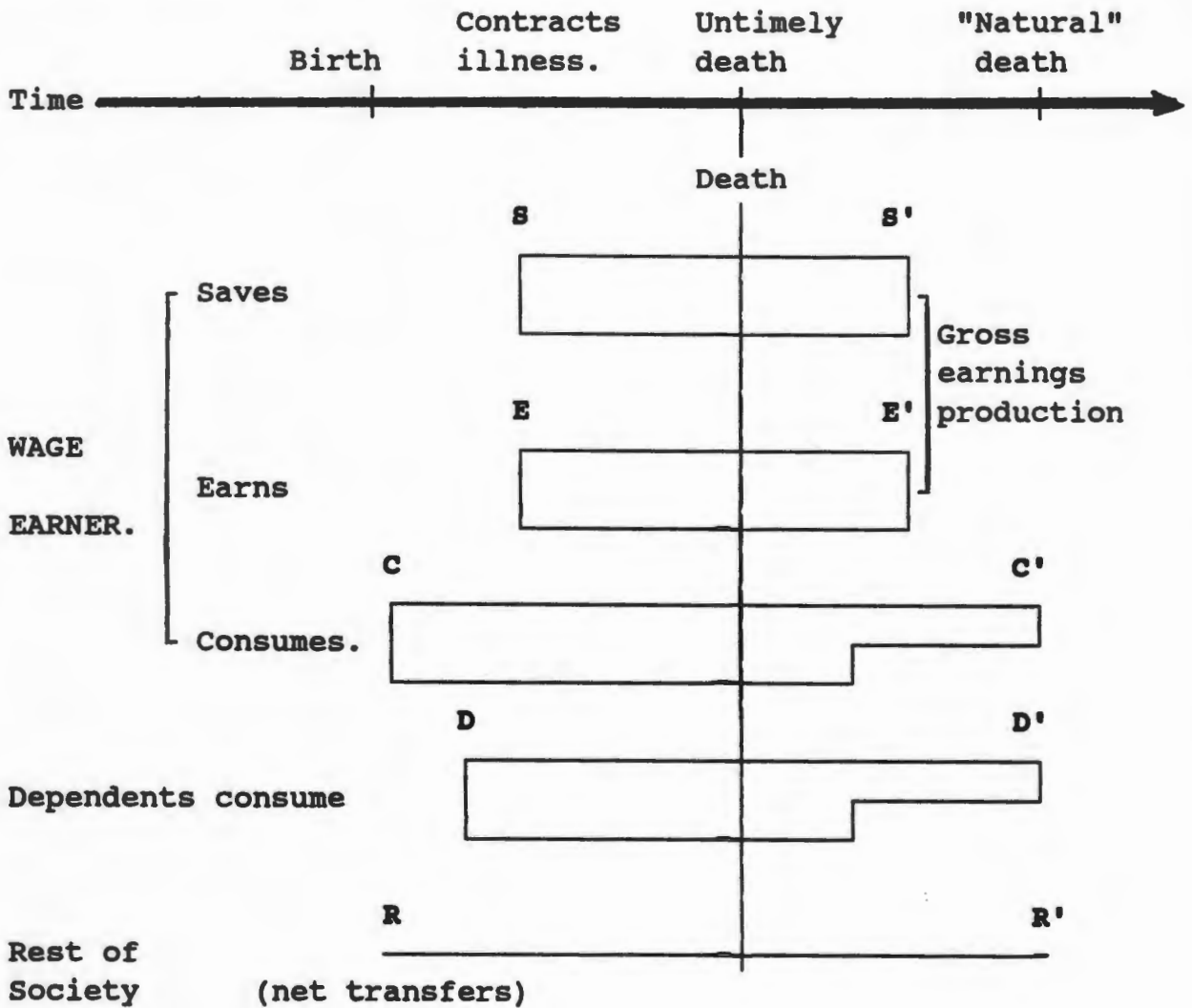
$$\left[C' + (1-p)(S' + E') - mpS \right]$$

The model gives a clear exposition of the financial burden that the death of a wage earner imposes on society. But this production-consumption analysis suffers from the typical disadvantages enumerated by critics of human capital (see Section 4.5).

Scheme 4.1A. How the Untimely Death of a Wage Earner affects the Pattern of Savings, Earnings and Consumption of his or her Dependents and Society.

[Adapted from Heggie.]¹⁶

Time Scale of Events in Wage Earner's Life:



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CHAPTER 5.

A DEFENCE OF HUMAN CAPITAL THEORY AND REASONS FOR ITS UTILISATION IN THIS STUDY.

5.1: A Defence of Human Capital Theory.

"There is one expense no mortal can recover:/ A human life. For money, there are ways."
Euripides, *The Suppliant Woman*. (ca. 421 B.C.)

Despite objections to Human Capital theory, it is still widely used by health economists to evaluate cost of illness. The following advantages of human capital are commonly cited:

5.1.1. Computations based on the Human Capital method are relatively easy to perform since the necessary data are usually readily available. [This holds for first world countries. But it is certainly not the case in South Africa, where medical statistics are available in rudimentary form.]

5.1.2. Alternative methodologies (such as contingent valuation) are not without their detractors; they are sensitive to a myriad of economic variables such as the tax rate, the subjective assessment of risk by individuals, as well as the real discount rate. They require the planning of elaborate questionnaires and prolonged studies by panels of experts. [see Chapter 6].

Attempts at such alternative methodologies have not been made by medical researchers in South Africa,¹ although a willingness-to-pay study has been carried out by Floor and Greenwood (1989) in transport economics.² Their study was beset with difficulties, and did not prove entirely satisfactory.

Problems typical of questionnaires were encountered. Some respondents found difficulties in answering the valuation questions and their answers proved meaningless. Others reacted negatively to questions about how much they would be willing to pay for safer roads in the form of toll fees because of the political controversy which arose from their introduction.³ Some people ignored certain questions altogether. Of those who responded that they would be willing to pay for safer roads, many failed to indicate how much they would pay.⁴ In addition, the initial ordering and wording of the questionnaire had to be altered to enable people to relate more easily to the issues. The gap between willingness to pay and willingness to accept also poses difficulties.

There is no reason why a willingness-to-pay study in health economics would afford improved results. The extremely heterogeneous nature of South African society with its dual economy and multifaceted racial, cultural and sociological divisions makes it extremely difficult to devise a willingness-to-pay type questionnaire having nation-wide

applicability. This is particularly true at this stage of the country's history. In addition, the current culture of violence in the country makes ingress to many areas dangerous.

5.1.3. Human Capital theorists can well concede that they do not measure the value of a life. Psychosocial costs are indeed not included in the calculations, but then, can pain or physical suffering be expressed in monetary terms? For after all, man is but mortal and subject to the vicissitudes of misfortune and unhappiness from time to time.

"Who, except the gods, / can live time through forever without pain?"
(Aeschylus, *Prometheus Bound*, ca. 478 B.C.).

Sooner or later some form of emotional bereavement is bound to befall us. Alas, this has to be endured with the passions, and cannot be allayed by any amount of money. The financial loss brought about as a result of this stress can be captured by the human capital method; to translate the emotional loss into a monetary quantity makes no sense. Since death and pain are inevitable consequences of life, there is no need to impute a monetary cost to them except where they have a direct effect on productivity.

5.1.4. Disease deprives society of labour, and it is this loss that human capital tries to measure. Any theory should be evaluated on the basis of how well it measures this aspect of the burden of disease and whether this is useful.⁵ The justification for the human capital approach is not that it measures the value of life, but rather the cost of disease. Even those who decry human capital as a measure of the value of life, recognise that some form of it is part of the value lost through mortality.⁶

Against this it can be argued that peoples' preference for some modes of death may be recognised by what they are willing to pay to avoid other forms. Willingness-to-pay therefore plays a role in augmenting human capital theory.

5.1.5. Regarding the frequent criticism that some groups are undervalued relative to others and that human capital methodology embodies the inherent discrimination in society: It is the function of a costing methodology to capture the cost of someone's death to the economy at a given instant, and not to redress the injustices which subsist therein. That is the function of other branches of economics and other social sciences. It would be nonsensical to e.g. value the productivity of all people in a highly complex economy equally just because one is of an egalitarian persuasion, whilst the fact of the matter is that people perform diverse functions of different worth to society. In embracing the system as it is, human capital theory gives a truer picture, and it is the best we can do in default of removing discriminatory practices.

In so far as wages diverge markedly from marginal productivity, so far is the human capital method inaccurate. But it would be unfair to discard the method because it entails the effects of discriminatory economic practices. A method which eliminates the errors brought about by discrimination is given in Appendix 5.1. at the end of this chapter.

5.2. Human Capital Theory as Applied in this Study to Calculate the Indirect Costs of Illness.

Three issues must be clarified before the human capital method can be applied in this study. They are

- (i) The Discount Rate,
- (ii) The State of the Economy,
- (iii) Disruptive effects and Re-employment costs.

5.2.1. Discounting.

The sensitivity of human capital figures to the discount rate (see paragraph 4.5.6.) cannot be seen as an indictment of the method. The fault lies in our present indecision as to which is the correct rate to use for particular interventions. If the chosen discount rate is sound, the problem of its use in human capital calculations will vanish. This is another instance where two issues are conflated; resolving the matter into its component parts sheds clarity.

The debate on the appropriate discount rate is still raging, with rates ranging from zero,⁷ through six percent,⁸ to the ten percent⁹ of the US Office of Management and Budget Policy being routinely argued for and used. The South African Treasury prefers a figure of eight percent.¹⁰

Given this lack of clarity, it was thought best that a sensitivity analysis be performed on data, using discount rates from zero to ten percent (see Chapter 19).

5.2.2. The State of the Economy.

As has been demonstrated (paragraph 4.5.8), the state of the economy has an important bearing on the cost of illness to the economy. The South African economy is at present in recession, with unemployment at high levels. Of course, a stock of unemployed labour need not necessarily be seen as an encumbrance to an economy in recession since it can easily be exploited once the economy regains momentum. But this is the case only where unemployment is cyclical in nature.

The South African economy is beset with serious structural problems. For a country that has an abundance of labour, South Africa has a historical comparative advantage in goods which are associated with capital-intensive production techniques.¹¹ The country's unemployment is not cyclical, but structural and chronic. It is bound to persist for many years and will require protracted correction.

The above has to be borne in mind when assessing the figures reflecting foregone earnings from CVD (chapter 19), even though mortality figures have been adjusted to reflect the foregone earnings of employed people only.

5.2.3. Disruptive effects and Re-employment costs.

To ensure the smooth running of an economy, it is essential that production units continue to function with minimal disruption. Illness and death cause the rate of production to slacken. The new worker, even if qualified, has to fine-tune his broader training to suit the narrower requirements of his new position. This of course, takes time; the more complex the job, the less steep the slope of the learning curve, and the longer it takes the worker to reach the proficiency of his predecessor.

Such effects burden the economy, and manifest themselves as (a) training costs to the firm and (b) foregone profits for the period it takes the new worker to reach full proficiency. Discounted foregone earnings alone do not take this into account.

Each time a worker leaves the work force, a replacement has to be found if the economy is to continue producing at the same level of output. Employers incur re-employment costs when they seek another person. Advertising, interviewing and travel costs are among the expenses incurred, and these have to be added to the burden of illness. Chapter 17 discusses the difficulties experienced in trying to quantify these costs. A simple way of modelling disruptive and re-employment costs to an economy is given in Appendix 5.2.

APPENDIX 5.1.

A theoretical method to eliminate discriminatory practices in the economy which cause the productivity of a wage earner to divert from true marginal productivity.

The magnitude of the error computed by the human capital method where discriminatory practices are present in an economy can be shown by the following hypothetical example:

Consider a firm or an industry with two categories of workers doing the same job. Let group A be the favoured group (men, say), and Group B be the discriminated-against group (women, say). Group A has dk number of workers, Group B has ad number of workers (see Diagram 5.1.). Assume that the firm pays, across all workers, the average of their marginal revenue product w , but group A earns h above this while group B earns l below this. Further, assume a state of full employment in the economy.

Then, the total wage packet of group B is given by $abcd$ whereas that for group A is $dghk$. Note also that according to the assumptions, $befc$ is equal in area to $fghi$.

Suppose now that n_1 workers in the low income group B and n_2 workers in the high income group A fall victim to a certain illness and die as a result. Then the cost to the economy given by human capital calculation (see Diagram 5.2.) will be given by area $abcghk$, whereas the true labour cost to the economy is $afik$. The error is thus area $eghi$ minus area $bfec$, or

$$\begin{aligned}
 & [n_2 \times (h-w)] - [n_1 \times (w-l)] \\
 = & (\text{number of high earners} \times \text{excess wage } [h-w]) - \\
 & (\text{number of low earners} \times \text{deficient wage } [w-l]).
 \end{aligned}$$

Diagram 5.1.

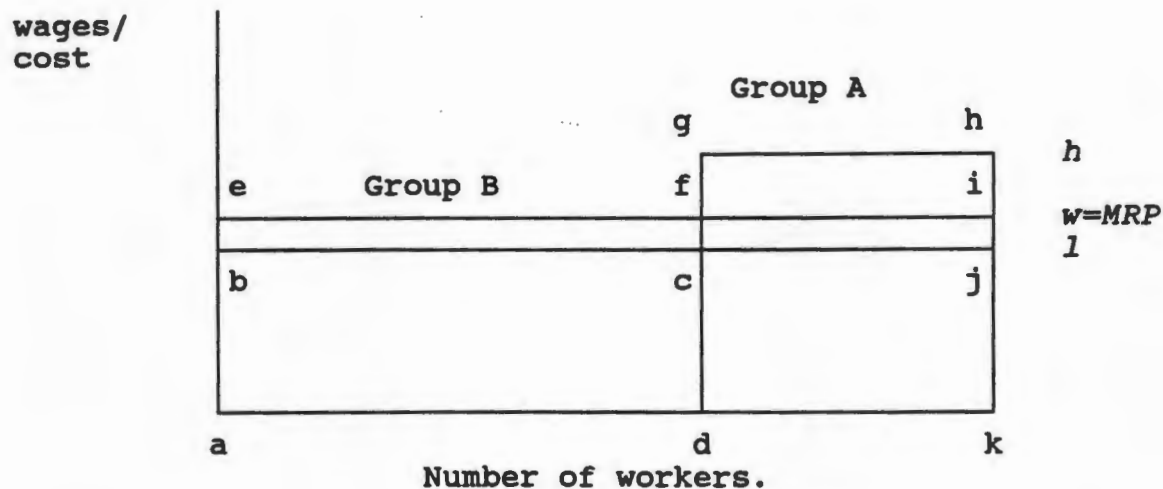
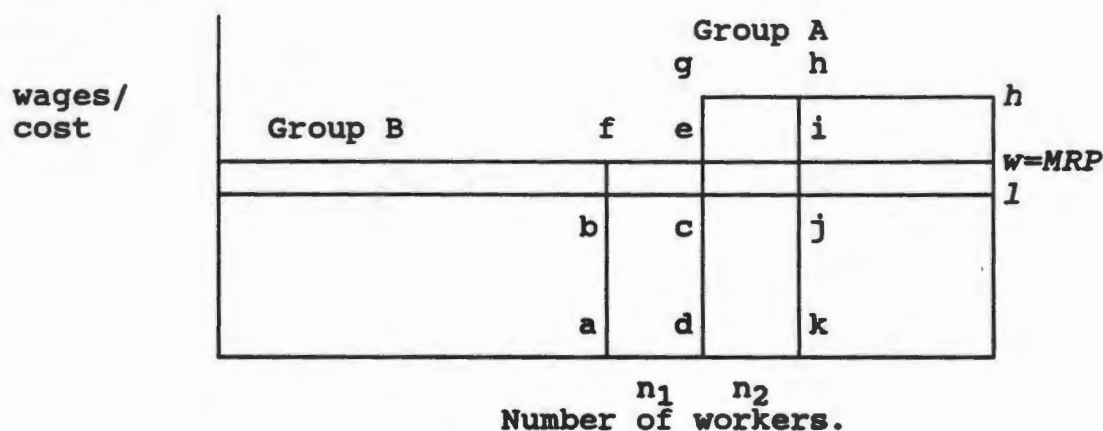


Diagram 5.2.



This correction can be introduced into the calculations for a given industry. Furthermore, if the disease under study affects the two groups unequally owing to genetic differences between the groups, then it becomes a simple matter to introduce corrective weighting factors if the composition of workers in the industry is known. Of course, shadow prices could also be used.

Clearly, then, the mere fact that discriminatory wage practices are inherent in human capital calculations should not invalidate the method in itself.

APPENDIX 5.2.

A Simple Way of Modelling Disruptive and Re-employment Costs.

The burden that disruptive and re-employment costs (DRC) of CVD impose on the

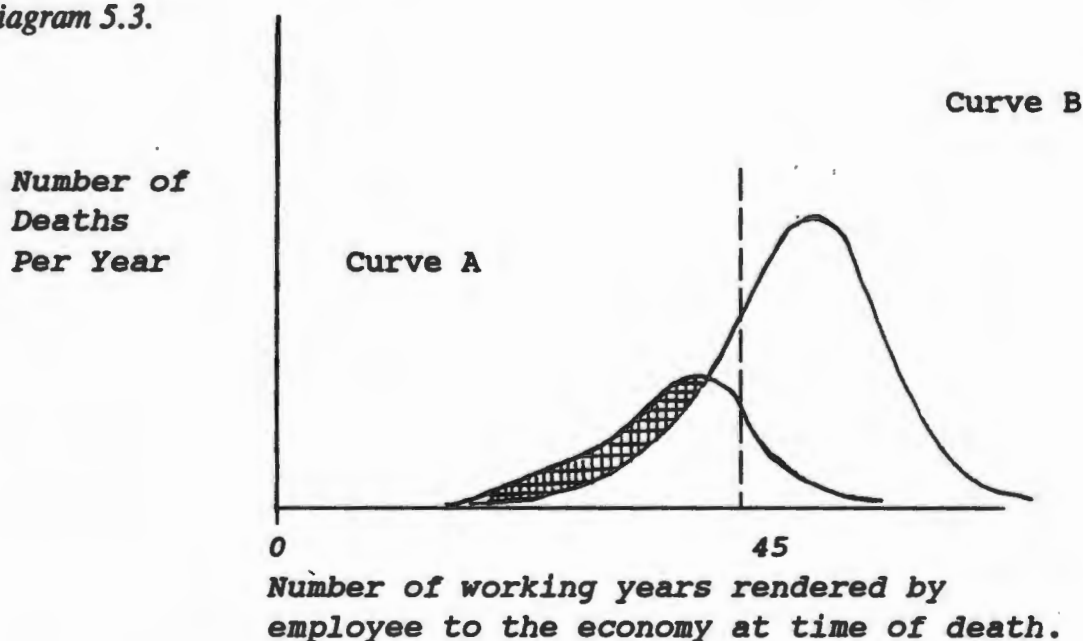
economy can be expressed as a function of the (higher) rate of replacement of the workforce. This in turn depends on (i) how many employees become economically inactive as a result of disease per year, n_d and (ii) the higher frequency with which victims of the disease have to be replaced when compared to other members of the population, r_d .

$$DRC = f(n_d, r_d)$$

Diagram 5.3 gives an approximate representation of the higher disruptive and re-employment costs due to CVD. The mortality pattern of those who die from CVD is given by the bell-shaped curve A. The pattern of mortality due to all other causes is given by curve B. Note that the mean of A is lower than the mean of B. If everyone starts working at age 20 and lives to the retirement age of 65, then in absence of disease, the firm has to undertake one re-employment action at cost C for every 45 man-years of work rendered to it. This sum is incurred when a worker retires, but when averaged over the economy, can be regarded as a fixed cost of $1/45 C$ per worker per year.

In the absence of CVD, curve A would be shifted to the right and have the same mean and distribution as curve B (see Diagram 5.3). The prevalence of CVD accounts therefore for the shaded area in Diagram 5.3.

Diagram 5.3.



If the mean age CVD_a at which cardiovascular patients leave the workforce is known, and similarly the mean age that the rest of the workforce R_a discontinues work is known, then the total extra replacement cost per year can be given by

$$n \times C \left[\frac{R_a - 20 \quad (\text{i.e. years of work of non-patients})}{CVD_a - 20 \quad (\text{i.e. years of work of CVD patients})} - 1 \right]$$

where n is the number of CVD patients leaving the workforce per year.

In practice this would work as follows: Take two economies A and B each having 100 000 workers. They are identical in all respects except for the fact that in economy A, n workers have to be replaced at an average frequency of 1.2 times the rate of others owing to CVD. Then each of the n workers in economy A imposes a cost of $1.2 C$ upon his death. The extra burden to economy A is therefore
 $(1.2 - 1)C \times n = [0.2 \times C \times n]$ per year.

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CHAPTER 6.

PROCEDURES FOR ESTIMATING THE VALUE OF RISK REDUCTION TO THE INDIVIDUAL.

The expressed preferences approach to the valuation of a human life arose out of attempts by economists to overcome the inadequacies associated with the Human Capital (HK) approach. It was recognised that the value that an individual places on his life differs from that which society might place on it. Attempts at finding this value became constructed around the amount that an individual would be prepared to pay for a reduction of a risk to his life.

Two general approaches to the evaluation of a statistical life fall within the ambit of risk reduction methodology. They are:

- 6.1. The Expressed Preference or Questionnaires approach, which includes the
 - 6.2. Willingness-to-Pay (WTP), and the
 - 6.3. Loss of Relative Utility (LRU) methods; and
- 6.4. The Revealed Preference approach, which includes
 - 6.5. Labour Market methods, and
 - 6.6. Consumption Activity methods

A clarifying note: The taxonomy of these methods is inconsistent in the literature. Some authors subsume both the expressed and revealed preference approaches under the willingness-to-pay heading (eg. Landefeld and Seskin, 1982)¹ while others take the willingness-to-pay method as being a branch of the expressed preferences approach. The latter classification is adopted here.

A brief discussion of each method follows. This chapter is intended to serve as a readily accessible introduction and summary to risk-reduction methodology for South African medical researchers.

6.1. The Expressed Preferences or Questionnaires Approach.

This approach tries to capture the dimensions of illness and death as well as non-market activities that HK ignores. These include pain and suffering, aversion to risk, and loss of leisure which itself has value for the individual and perhaps for others as well. One of the earliest theoretical discussions on the valuation of a human life suggested that the

"potential Pareto improvement principle" be used as the only logically consistent basis for valuation (Mishan 1971).²

A "potential Pareto improvement" exists when those who gain from a social change are able to compensate those who stand to lose from the change and still retain a net gain. Thus, Mishan concluded that the relevant question to ask was "how much are individuals willing to pay (or accept in compensation) for a change that will affect loss of life?". In most public safety decisions, the issue is not the value of an identified life; rather, it is the value of a reduction in the probability of death for a given population. That is to say, it is the aggregate value a population at risk places on programmes that save "statistical lives" or the amounts individuals are willing to pay *ex ante* to "buy" small reductions in the probability of their death.

6.1.1. General objections to the Expressed Preferences Approach.

Inherent in this approach are all the problems associated with any survey method based on questionnaires. What individuals say they will do may well vary considerably from what they will actually do when confronted with a true market test. For example, they may deliberately understate their WTP if they believe that they will be assessed for amounts equal to their WTP for the provision of a "public good" such as a programme that decreases the incidence of CVD for all. [This is the well-known 'free-rider' problem.] Also, people respond to questionnaires as if there were no income effect. They answer as though their future income were to remain constant after paying their premium; i.e. they substitute a current bundle of wealth for one that is on the same indifference curve.

For these reasons, some willingness-to-pay proponents maintain that information about such preferences should be limited to consumers' market transactions. Beesley argued: *"Evidence of what consumers do, or have done, as part of their experience, is better than what they might do or seem to do in hypothetical conditions set up by the observed (laboratory test)".*³

In defence of the questionnaire method it can be emphasised that deriving additional information from consumers by asking "transfer price" kind of questions is not the same as subjecting them to controlled experiments. The thinking underpinning the questionnaire method is shown by the following quotation from Sen.⁴

"That behaviour is a major source of information in preference can hardly be doubted, but the belief that it is the only basis of surmising about people's preferences seems extremely questionable. While this makes a great deal of sense for studying preference of animals, since direct communication is ruled out (unless one is Dr. Dolittle), for human beings surely information need not be restricted to distant observations of choice made. There is, of course, something of a problem interpreting answers to questions as correct and in taking the stated preference to be the actual preference, and there are well-known limitations of the questionnaire method. But then there are problems, as we have seen,

with the interpretations of behaviour as well. The idea that behaviour is the one real source of information is extremely limiting for empirical work and is not easy to justify in terms of the methodological requirements of our discipline."

Another problem associated with these methods is that they typically exclude costs and benefits which do not accrue directly to individual consumers. This is true in the case of the willingness-to-pay based valuation of disability, because the costs borne by society such as output losses, medical, policing and damage costs, etc. do not figure in an individual's valuation when he or she is asked to trade options involving alternative risk scenarios. The estimation of such costs does not however pose any methodological problem, and they can be added to the behaviourally determined values of avoiding non-fatal injuries [for example Jones-Lee (1989)]⁵.

6.2. Willingness-to-Pay Approach.

Arguments in favour of the WTP approach are based on the well-known welfare proposition that if social welfare is to be maximised, public sector investment and regulatory decisions should be made in accordance with consumer preferences.⁶ This proposition can be accepted on ethical grounds if the initial distribution of income and wealth is socially optimal; distributionally weighted social cost-benefit analysis can be introduced where this is not the case.⁷

In theory, WTP represents a comprehensive measure of the private valuation that individuals place on small reductions in the risk of death. WTP theorists argue that because there is a certain disutility associated with death, one can assume that an individual would be prepared to forfeit some present wealth to effect a reduction in the probability of death in the same period. Conceptually, everything that contributes to an individual's well-being would be captured in the WTP measure, including non-labour income, the value of leisure, aversion of risk as well as the value of avoiding pain and suffering. In addition, WTP would incorporate an implicit rate of time preference reflecting the weights placed on future benefits of living.

An example may help to illustrate this point. Suppose each person in a population of 200 000 is willing to pay \$30 for a programme that is expected to reduce overall probability of death from 0.0007 to 0.0005. This is equivalent to a reduction in the death rate from 140 to 100 per 200 000. The implied value for each of the 40 "statistical" lives saved is $(200\ 000 \times 30)/40 = \$150\ 000$.

The WTP approach is strongly justified with respect to efficiency since the benefits from life-saving are based on the value attached to the particular population at risk. Schelling [1968] was the first to assess how the value of a person's life implied by his WTP differs greatly from the widely used human capital value.⁸

6.2.1. Objections to WTP methodology:

Social psychologists, reviewing WTP attempts to value life, have raised questions about the ability of individuals to respond rationally and consistently to the abstract and complex questions involving hypothetical risk [Slovic, Fischhoff and Lichtenstein, 1979⁹; Tversky and Kahneman, 1974 and 1981].^{10,11} The following example illustrates this:¹² An increase of 0.00002 in workers' risk of death would represent an increase in the overall work fatality rate of approximately 25 per cent. One would be sure to get quite different WTP responses depending on which of these two ways were used to characterise this change in risk in a survey questionnaire.

A psychometric survey that illustrates the bias of patients, students and physicians as to the mode of treatment of lung cancer was carried out by McNeil *et al* in 1982.¹³ In all three populations, the attractiveness of surgery relative to radiation therapy was substantially greater when the problem was framed in terms of the probability of living rather than in terms of the probability of dying, or in terms of life expectancy rather than cumulative probability. Here is conclusive evidence that the way in which the same information is presented, openly and without artifice, can and does influence human assessment of a given [medical] state of affairs, and hence the choice of ensuing intervention.

Furthermore, individuals are often myopic and refuse to accept the validity of certain risks they face. The average smoker probably dismisses the increased health risks he faces as not applying to him in particular. The capacity of the human mind to delude itself is well documented by psychologists.

Equality poses a major problem for WTP methodology. It is unlikely that all individuals in a society will attach the same value to a given reduction in risk. The rich may be willing to spend more on risk reduction than the poor since risk reduction is worth more to them [Schelling 1968¹⁴; Usher 1973¹⁵]. If the resulting unequal life values are accepted by the policy maker, then the resources devoted to life saving programmes will reflect a bias towards those programmes favouring the better-off.

6.3. The Loss of Relative Utility (LRU) Approach.

The origins of the LRU approach are founded on recent developments in the clinical literature on the health status of individuals. Quality of life measures were initially required to assist with such diverse clinical decision making as determining compensation, predicting prognosis and estimating care requirements. They were also required to facilitate the choice between various health states in questionnaires.

Essentially, the method entails the initial establishment of utility scores associated with different health states (an example of a standard index is the EuroQol Descriptive Classification). Next, a description for a particular injury state or incapacity arising from

disease (e.g. a patient who has had major heart surgery) is "mapped" onto the health utility index. Utility scores for each disability state are then read directly from matrices in the index and the corresponding utility loss is computed. When multiplied by the duration of the disability, the number of Lost Years of Functioning (LYF) associated with each injury type is calculated. The LYF of each disability state is subsequently weighted by its probability of occurrence, and an overall LYF value for a classified health state is derived.

A monetary cost can be accorded to any incapacity brought about by disease by multiplying the Value of a Life Year by the number of LYFs lost through that disease.

The calculation of the monetary value of a LYF can be calculated by the following mathematical formula:

$$M_i = M_d \frac{|\delta p|}{|\delta q|}$$

where

M_d = an individual's MRS of wealth for the risk of death;

M_i = an individual's MRS of wealth for the risk of a non-fatal state of injury or disability.

$|\delta p|$ = an individual's MRS of the probability p of a fatality $|\delta q|$ during the coming year for the probability q of a non-fatal injury.

Since there would seem to be no good reason for supposing that M_d and $\delta p/\delta q$ are significantly correlated, it follows that we can write

$$M_I = M_D \frac{|\delta P|}{|\delta Q|}$$

where M_D , M_I and $\delta P/\delta Q$ denote population means.

6.3.1. Objections to this method.

It is apparent that all the problems associated with questionnaire methods and the assessment of small risks apply here as well. Furthermore, this method, which is used to determine a monetary value of morbidity rather than mortality, depends on the availability of a figure for the value of a life that has been obtained by some other method. All errors or conceptual difficulties embodied in that figure will consequently be reflected in any set of figures that are calculated by this method.

There are dilemmas involved with the classification of various illness states. Identifying the dimensions that should be used to define health states is clearly a complex and controversial matter. Utilities of various health states have a high degree of personal

subjectivity to them, and will vary between different cultures and social structures of communities.

The choice of subjects whose utilities are to be measured poses a further complication. Torrance [1980] noted an enormous variation in individuals' perception of utility loss associated with the same injury due to different perceptions concerning the ability to adjust.¹⁶ Brooks *et al* [1991] noted that in the Swedish EuroQol study, the rater's own health appeared to influence ratings.¹⁷ The level of education of the rater also had some bearing on valuation.

Many researchers therefore favour the use of expert or professional groups [e.g. Guidex (1986)].¹⁸ It is argued that those who deliver health care have the closest contact with patients. Such contacts make them more able to reflect patients' views and feelings than the patients themselves. Others advocate the use of victims of particular injuries or diseases on the grounds that they know first-hand how their quality of life has been altered and to what extent. There appears to be little consensus as to the best way to deal with this difficulty.¹⁹

6.4. Revealed Preferences Approach.

The rationale behind the revealed preference approach is that the value of a life can be observed from market data which reflect the actual behaviour of individuals. This is deemed by some researchers to be superior to expressed preference approaches because the "validity of response" problem inherent in the hypothetical answers given to questionnaires is obviated.

This approach is however beset with difficulties of its own. The use of market data is based on the assumption that the individual's subjective probability of an event occurring may be approximated by the relative frequency with which the event actually occurs. This assumption is not valid since information about the relative frequency of events occurring is lacking to policy makers, let alone to individuals.²⁰

Market data also incorporate methodological problems with respect to the calibration of probabilities. A safety premium which costs R10 has a value of R500 000 when the perceived risk reduction is 2×10^{-5} but a value of R250 000 when the perceived risk reduction is 4×10^{-5} . But as was the case with the expressed preferences approach, many individuals may not differentiate between two such probabilities. Thus, perceived risk, which influences individual behaviour, may differ from actual risk (i.e. relative frequency).

The use of market data, i.e. the actions of informed consumers with respect to risk are efficient in the sense that they reflect the preferences of the individual for improved health or safety. In all instances, the individual is free to elect a level of risk which maximises

his utility, *given his monetary and other constraints*. The inequality underlying the differential response is acceptable to society since freedom of choice is valued.

However, where public authorities have to decide on the implementation of risk-reducing policies, the assignment of unequal values to lives is less likely to be acceptable. Individuals in a democratic society are perceived to have certain rights such as the right to survival, and such rights are not traded in the market place.²¹ From the perspective of public policy, equality may be a more forceful criterion than efficiency. This is of special relevance to South Africa today where there is a large inequality between the various sectors of the population. The poor simply do not have the means for engaging in risk-reducing activities in the market place. They are forced to accept what they can get.

6.5. Labour Market methods.

Labour market studies typically examine the extra compensation necessary to induce workers to accept risky jobs. The assumption here is that since people differ in their tastes for risk, they will sort themselves out in such a way that the more risk averse seek safe jobs and the less risk averse do dangerous jobs. This method also implicitly assumes that

- (i) markets operate freely;
- (ii) people can choose freely as to which jobs they accept, and
- (iii) workers are aware of all the risks attached to jobs.

Quite questionable assumptions indeed! In addition, there are characteristics of certain seemingly "safe" jobs that contribute to a risky environment, for example repetitive and tiring work. Estimated wage differentials may thus be attributed to general working conditions as well as safety considerations, and it may not be possible to disentangle these factors.²²

A consequence of calculating the value of a human life according to this method is that the value of life will be lower for holders of dangerous jobs. Labour market studies carried out according to this procedure have yielded disparate values. Landefeld and Seskin showed that labour market researchers have provided dollar estimates for the value of a statistical life ranging from \$270 000 to \$5.9million (1977 US\$).²³ Brown tried to equalise these values by including a number of worker characteristics omitted from other studies (e.g. educational level, marital status, etc.).²⁴ Despite this exercise, he was unable to narrow the range of the estimates.

Landefeld and Seskin attribute the large range obtained from labour market methods to at least five general problems:

- (i) Workers have incomplete information of the risks to which they are exposed.

- (ii) Wage premiums may not be accurate measures of worker preference if there are significant imperfections in the labour markets. This may be the case if new, inexperienced workers have relatively little bargaining power to demand appropriate premiums for risk.
- (iii) Self-election poses a problem. That is, either because of low incomes, lack of economic opportunities, or specific individual preferences, those who work in risky jobs will exhibit less risk aversion than the rest of the population.
- (iv) Statistical problems arise in separating the risk of death from risk of injury since compensating wage differentials will be accounting for both types of risk in most hazardous jobs.
- (v) Finally, data constraints may bias statistical estimates. In some studies aggregate industry data are used instead of individual (micro) data. This practice overstates the value of a statistical life for the riskier workers in that industry (e.g. of blue-collar as opposed to white-collar workers).

6.6. Consumption Activity methods.

Consumption activity methods were designed to circumvent some of the problems associated with labour market methods. They depart from the premise that the only fairly accurate way to determine the value people place on their lives is to note their risk-reducing consumption activities. This can take the form of the purchase of risk-reducing devices such as smoke detectors [e.g. Dardis 1982],²⁵ to the intensity of use of seat belts [e.g. Blomquist 1979].²⁶ The "free-rider" problem is avoided by this method, as is the issue of sample self-selection.

Estimates from consumption activity data span a narrower range than those from labour market studies (1977 US\$ 101 000 to 385 000).²⁷ But both methods are faced with similar problems concerning the availability of reliable data and statistics; quantitative information on the risk-reducing potential of various activities is scarce.

The following hypothetical example illustrates this: A new but very expensive vaccine against AIDS is put on the market. Governments do not have the funds to make it available to the population at large. An economist wanting to compute a value for a statistical life from sales figures of the vaccine would need accurate knowledge of the following data:

- (i) The true efficacy of the vaccine.
- (ii) The general risk that a member of the population runs of contracting AIDS.
- (iii) The risk that the purchasers of the vaccine run of catching AIDS.
- (iv) The extent of knowledge about the existence of the vaccine amongst the population, and
- (v) The price of the vaccine.

Points (i) to (iii) are extremely difficult to ascertain, making the final figures that can be computed by this method rather questionable. In addition, the ethical problem of who can

afford the vaccine remains. The value of a life calculated by this method depends on income distribution, which is not equitable in many societies.

6.7. Critiques of Revealed and Expressed Preferences Methodology, and Reasons for their Unsuitability in this Study.

The appeal of expressed and revealed preferences approaches lies in the fact that

- (a) they assume a comprehensive consideration of the potential costs of illness and disease, and
- (b) they have some grounding in Pareto optimality theory, more particularly on the Hicks-Kaldor compensation approach.

However, they have been difficult to implement and are used in few cost-of-illness studies.²⁸ Reasons commonly cited are the following:

(i) In practice, the expressed preferences approach is difficult and expensive to implement. A very large sample is required to give statistical significance to results. Responses that are aggregated across sample sizes too small for statistical reliability will be misleading.²⁹ *Such resources as are required to give significance to an expressed preferences investigation could in no way be accessed by the meagre budget of this project.*

(ii) Much of the difficulty in analysing data according to these methods arises as a consequence of the large disparity in values among respondents. Many individuals have difficulties in conceptualising probabilities of death or certain kinds of disability when asked about hypothetical situations, especially when they are not at risk.^{30,31} *In South Africa, there exists in addition inconsistencies due to the heterogeneous racial, cultural and sociological nature of the population. Clearly, no truly sound, representational WTP estimates can be carried out in the country at present or in the near future.*

(iii) Revealed preferences are conditioned by external factors, especially income. Willingness to pay cannot be separated from ability to pay, even when willingness to pay is expressed as a percentage of income. It is indeed true that ability to pay does not reflect one's worth to society. But in default of income, it is difficult to construe a binding constraint to give real effect to the demands of people for competing projects.

(iv) An individual's current health status influences willingness-to-pay; those who are sickly value health more.³² This means that interviewees who are healthy have an implicit myopic discount procedure. If, for example, the values given by the sick only are taken as the basis for policy, most of the GDP would be allocated to health.

(v) Values respondents give to health in the willingness-to-pay framework appear neither stable nor reliable.³³ People's inherent value system should not change within short periods especially if health status has not changed. But when respondents are asked to

place values on health, their assessments vary widely in a matter of minutes, let alone days.

(vi) A telling point against WTP methodology is that the existing distribution of income is assumed to be a proper basis for the allocation of resources.³⁴ For those who believe that the ability to pay should not be related to the valuation of health, as a future South African government probably would, this method is unacceptable.

APPENDIX 6: MODELS USED IN WTP METHODOLOGY.

This appendix briefly reviews studies representative of the expressed and revealed preferences approach to the value of a human life. It is designed to give an idea of the technical aspects of the computations. Three approaches will be considered. The first approach is a simple expressed preferences model advanced by Linnerooth [1979].³⁵ It is an expected utility maximisation model for the purpose of defining the "value of human life" within the context of consumer price theory. This model provides the basis for more elaborate models, one of them by Conley.³⁶ Rappaport's expected utility analysis of a value of life is summarised next.³⁷ As an example of the revealed preferences approach, a consumption market activity model by Dardis is discussed.

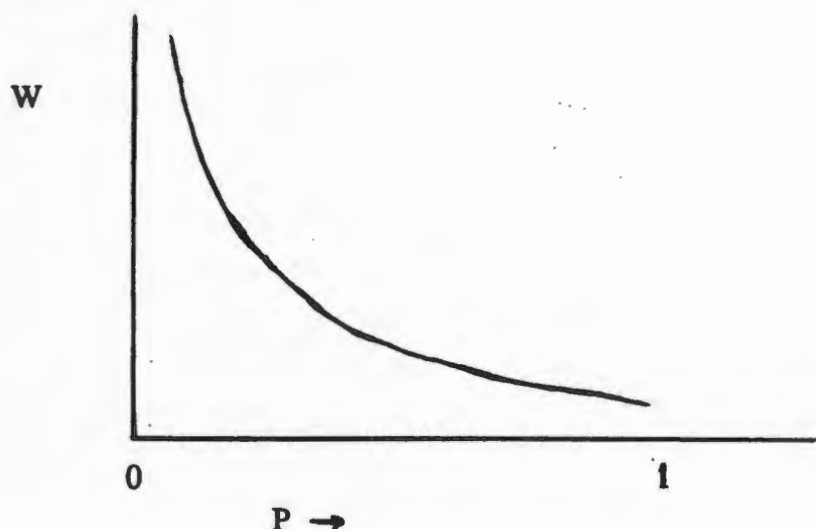
Appendix 6.1. A Simple Expressed Preferences Model.

In most of these approaches, what is actually measured is "value of risk reduction" rather than the more contentious and provocative term "value of a human life". What the analyst measures is the monetary value that an individual places on the removal of a marginal risk of death to himself. In other words, for a small probability of the loss of life there is a conceptual value of life which, when multiplied by this probability, yields the maximum that a person would pay for the stated improvement in his survival chances.

Methodology and Assumptions.

This concept can be illustrated by the tradeoff between wealth W and survival probability P or by the slope of the indifference function shown in Figure 6.1A. The convexity of this function assures a nonunique value of life since the payment for a marginal increase in P depends on the level of P . If, for example, the average person is willing to pay \$250 to reduce the risk of death from 10^{-7} to 10^{-10} , this does not mean that the person is willing to pay \$250 to reduce the risk of mortality by 10^{-3} when the risk is originally 10^{-5} , nor that he is willing to pay \$250 000 to eliminate certain, immediate death. The \$250 000 figure is a measure of the value of life only in the sense that the analyst can justifiably use it as a index of benefit; in particular the benefit that could result from a policy that would reduce the per-capital mortality risk reduction from 10^{-7} to 10^{-10} over a population numbering 1000. The expectation here is the saving of one life.

Figure 6.1A. An Indifference Function Showing the Tradeoff of Wealth for Survival Probability.



The non-linearity of the indifference function in Figure 6.1A is intuitive, and its shape has been verified by a simple model of consumer choice, where the consumer has knowledge and control over his survival chances.³⁸ Survival can be thought of as a probabilistic term for an increase in life expectancy; the demand for survival would then be reflected by the individual's willingness to pay for this increase.

Consider an individual who commences the current period with full information on his expected lifetime. His probability of surviving any given period, i.e. his age-specific survival rate, can be denoted as p_t , and his probability of being alive at the end of any given period, as P_t . Assume that p_t occurs on the first day of the period. Then $P_t = S_t p_t$, where S_t is the probability of surviving until year t or $S_t = p_{t-1}, p_{t-2}, \dots, p_0$. It follows that the demand for an increase in life expectancy can be expressed in terms of the demand for an increase in any age-specific survival rate, p_t . This demand in turn could depend on

- (i) the individual's current age or expected lifetime,
- (ii) the individual's current wealth and income,
- (iii) the number of dependents that the individual has, and
- (iv) the nature and timing of the individual's death.

Linnerooth begins by considering the problem in its simplest form by making four assumptions that simplify some of the complications of points (i) - (iv) above. In effect, he assumes that the individual is a "lone bachelor" who regards his lifetime as fixed if he survives the initial period, and who has a fixed wealth that he distributes throughout his lifetime. There are no opportunities for saving, investing or bequeathing. The individual also behaves as an expected utility maximiser. If utility is assigned to each year of his life, he then behaves so as to maximise his expected utility or his total utility weighted by the probability of his survival. *In this way, expected years of life enter the individual's*

lifetime objective function indirectly as a weighting factor. He is assumed to make a quantity-quality tradeoff by buying increases in his survival probability until he has maximised his expected lifetime utility.

Linnerooth then expresses the objective function, or expected lifetime utility, as a function of lifetime consumption. Since the individual begins the initial period with a certain wealth (lifetime consumption), this objective function can be written

$$(1) \quad E(U^L) = P_0 U(C)$$

where $E(U^L)$ represents expected lifetime utility, P_0 is the probability of surviving the current period, and $U(C)$ is the utility of lifetime consumption. The individual would then be indifferent; that is, he would maintain the same expected utility, given changes in consumption and survival probability which hold the expression in (1) constant. His implied marginal rate of substitution between P_0 and C can be calculated by taking differentials of (1). Given *that* $dE(U^L) = 0$; the result is

$$(2) \quad \delta C / \delta P_0 = -(U(C)) / (P_0 U'(C))$$

where $U'(C)$ represents marginal lifetime utility with respect to lifetime consumption. It then follows from the assumed equivalence of lifetime wealth and lifetime consumption that (2) specifies the slope of the indifference function in Figure 6.1A., thus representing what has been defined by Linnerooth in the paragraphs above as the value of a human life. It must be taken into account that factors such as family responsibilities, opportunities for wages and savings, and insurance options would complicate the model considerably.

Linnerooth disclaims any pretense of reality in her simplified model. However, one important property of equation (2) can be expected to be independent of the restrictive assumptions adopted. That is the nonlinear relationship between changes in willingness to pay for marginal increases in survival probability. As a person's survival chances decrease, his willingness to pay increases at an increasing rate; the indifference function in figure 6.1A. approaches but never intersects the W-axis. This formulation resolves the paradox that an individual, although placing an infinite value on his own life, willingly accepts small probabilities of death for finite compensation [Bergstrom (1974)].³⁹

This type of model also leads to the anomaly that the cost-benefit analyst who follows the precept of revealed preferences would *not* recommend that funds be allocated across projects such that the expected number of lives saved is maximised. [i.e. Policies implemented according to this model will not be strictly utilitarian in nature.] Rather, in choosing between life-saving projects competing for the same funds, the cost-benefit analyst will recommend the allocation of relatively more money per expected life saved to that project which marginally reduces a higher risk level.

Appendix 6.2. Rappaport's Variation.⁴⁰

Rappaport, without loss of generality, sets the level of consumption at which a person can no longer survive at zero so that the lifetime utility function passes through the origin. As a special case, death therefore corresponds to an income of $C=0$.

Given this assumption, one can analyse the individual's response to a risky prospect yielding a P chance of income, C , and a $Q = 1-P$ chance of zero income. [This approach is similar to the expected utility analysis of risky prospects that is taught in undergraduate microeconomics courses.] Since the utility of zero income is zero, the expected utility $E(U^L)$ of this prospect can be expressed as

$$E(U^L) = PU(C) + QU(0) = PU(C) \quad (1)$$

If the individual has a lifetime consumption of C' , then the expected loss of utility from the risky prospect can be seen in figure 6.2A. as l_u , which is the difference between $U(C')$ and $E(U^L)$. In this figure, $E(U^L)$ is simply P times $U(C')$. The monetary compensation that restores the individual to his original level of utility [i.e. to $U(C')$] is l_c , derived from the slope of the function. For very small values of Q (which is in keeping with the real-life risks that an individual would face), l_c can be approximated as

$$l_c = l_u / (dU^L/dC) \quad (2)$$

But $l_u = QU(C')$, therefore (2) can be rewritten as

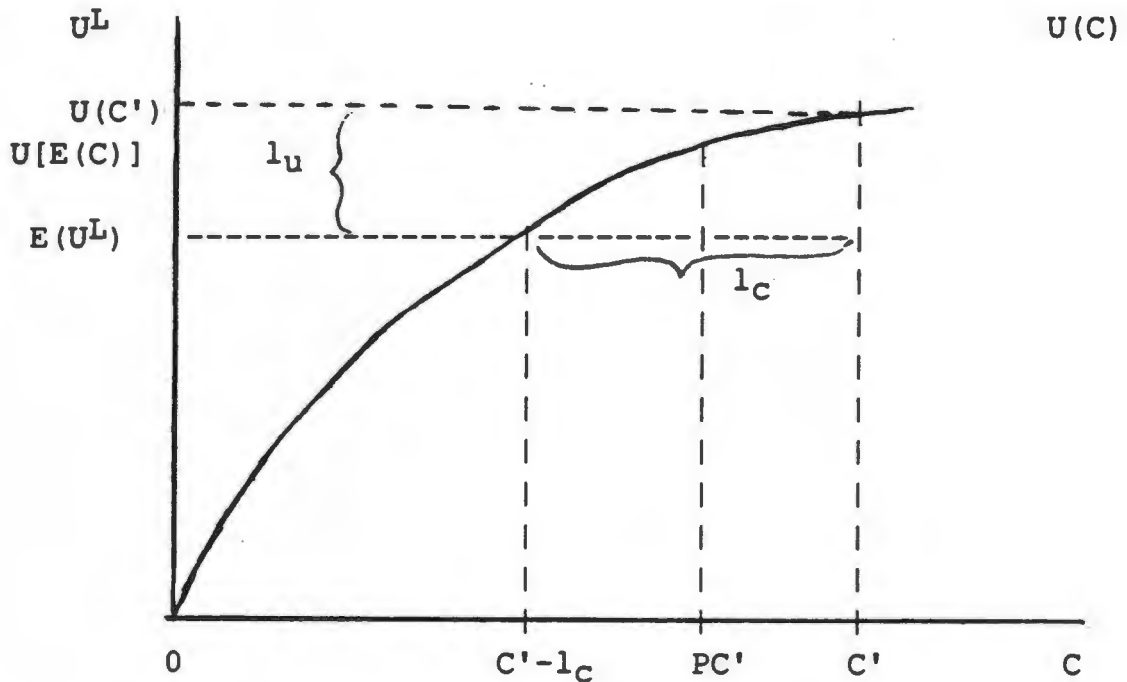
$$l_c = Q[(U^L(C')) / (dU^L/dC)] \quad (3)$$

it follows from (3) that since Q is the probability of dying, $(U^L(C')) / (dU^L/dC)$ must represent the value of human life. [Intuitively: where $Q = 1$ or certain death, then l_c , the value needed to compensate a person for this absurd level of risk must be equal to $(U(C')) / (dU^L/dC)$, the value of his life.]

Given an assumption of the shape of an individual's consumption utility, the value of life can be calculated from data on personal consumption. For example Usher,⁴¹ assuming that the utility of consumption takes the form

$$U_t(C) = \sum_{i=0}^{t-1} (C_i)^b / (1+r)^i \quad (4)$$

Figure 6.2A.



was able to estimate values for $U_t(C)$ (in aggregate using Canadian time series data on net national product) by postulating a range of values for b and r . $1/b$ represents a measure for the degree of diminishing marginal utility of consumption, and r is a subjective parameter representing the degree of utility time preference. By substituting $U_t(C)$ into his derived value of life, and with data on age specific mortality rates at his disposal, Usher was able to estimate a range of values for a human life (in the aggregate).

Appendix 6.3. Consumption Market Activity.

The voluntary purchase of devices or products with safety features by the public can be used to estimate the value of risk reduction to an individual. Dardis investigated the voluntary purchase of smoke detectors to estimate consumer willingness to pay for risk reduction.⁴²

The WTP model that Dardis uses is almost identical to that of Rappaport in Appendix 6.2. In essence, the amount of money an individual is prepared to pay for risk reduction (in this case the purchase of a smoke detector) may be used to estimate the value of a life.

Methodology of Dardis's Market Consumption Model.

Dardis considered the reduction in the probability of death and hospitalised injuries owing to purchases of smoke detectors, selected because they are the most feasible and affordable

fire protection and control option available to households. The cost of smoke detectors was then compared to the weighted change in the probabilities of death and injuries. An important assumption made by Dardis was that the subjective probabilities may be approximated by relative frequencies. That is to say; the individual perceives his risk of dying in a domestic fire to be identical to the actual risk obtaining in the world. Jones-Lee argues that over a large sample of individuals, there seems no reason to suppose a systematic divergence between subjective probabilities and relative frequencies when information concerning the latter is freely available.⁴³ This assumption underlies the expected utility approach.

The formula for estimating "b", the value of life, is given by

$$z = bw'x \quad (5)$$

$$\Rightarrow b = (z)(w'x)^{-1} \quad (6)$$

where z = annualised cost of smoke detectors based on capital recovery factor; b = value of a life; w' = weighting vector representing the individual's attitudes towards death or hospitalised injury; and x = probability vector representing changes in the probability of death or hospitalised injury due to the purchase of smoke detectors. As equation (6) stands, it means that the value of a life is equal to the price one is prepared to pay for a certain perceived improvement in one's chances of living.

The technical aspects and calculations of this method are set out clearly in Dardis' paper and should be easy to reproduce for similar studies. The method is neither free from detraction nor criticism, and Dardis herself enumerates a few methodological problems underlying this analysis.

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CHAPTER 7.

SOCIETAL VALUATION.

7.1. Rationale Underlying Societal Valuations.

The societal valuation approach uses the decisions made by policy makers or courts to estimate the value of a life. Decisions by various government agencies are analysed with respect to programme costs and the number of lives saved, and the figures arrived at are used to determine an implicit value for a life.

The rationale underlying the use of implicit values is that they reflect the preferences of the society to whom the decision maker is accountable. A court can award a certain sum in compensation for an injury or a death, or a public body can determine what it is able to spend on a project that will save a certain number of lives per annum. It is argued that because these bodies are representatives of society and have its interests at heart, members of the public should accept their figures in good faith.

When courts assess compensation for damages due to personal injury or death, two components of loss are considered, viz. the financial or pecuniary loss suffered by the individual, and losses of a more personal nature such as the loss of a limb or an eye.¹ These latter losses involve changes to the individual's quality of life and are also termed *intangible costs*.² The financial loss is largely compensated for by the foregone earnings approach. A good example of the methodology employed in compensation is given by Koch [1984].³ The South African law courts at present base their compensations⁴ on the case of *Pitman vs. Scrimgeour*,⁵ in which an accountant was compensated for injuries sustained in a motor vehicle accident by his foregone future earnings multiplied by the extent to which he was incapacitated to do work.

Intangible costs are by their nature difficult (although according to some thinkers not impossible) to identify and to measure. Losses to the person's body are compensated for erratically by the courts. In general a kind of *solatium*, i.e. a sympathetic payment is made, admittedly less than is really due.⁶ This amount might differ from court to court and from country to country. Awards are made in excess of foregone earnings only if certain needs such as home nursing and similar medical services are established.

7.2. Critiques of Societal Valuation.

7.2.1. Considerable variation in implicit life values have been observed, which indicates a lack of consensus on the part of policy makers.⁷ Implicit life valuations tend to reflect the values of the policy maker or the programme provider rather than the programme beneficiaries. It is often in the interest of policy makers to attend to whichever issues are topical or in vogue with the media. This leads to amounts being spent on the prevention of some classes of

diseases or occupational hazards far exceeding that of others, even though the underlying life values are the same. Also, victims of cases which involve heightened political sensitivity or injustice might be awarded disproportionate sums in compensation for injuries sustained (e.g. The Rodney King incident which led to the 1992 Californian riots). Such awards distort the value of a life.

7.2.2. Court awards reflect explicit valuation by members of society in those countries where the legal system incorporates a jury. However, court awards represent values attached to specific, identified lives while the decisionmaker is concerned with the value of a statistical life. Schelling shows that values attached to identified lives will generally exceed values of statistical lives.⁸ The nature of human sympathy is such that society will spend far more to save an identified life than to reduce the risk of death for an unknown individual.

7.2.3. Court awards can result in unequal treatment of individuals. Court awards are often based on a compensatory sum necessary to give the dependents of a dead worker the same financial security they enjoyed prior to his death. Past earnings are used to measure the loss of future earnings with a deduction in consumption since only compensation to dependents is taken into account. This focus on net earnings means that the lives of non-earners are undervalued relative to earners. The wage of the deceased will also affect the valuation put on his life. This is highly unsatisfactory to those who hold egalitarian views.

7.2.4. The inequity is particularly striking in the case of children. In some countries, court procedures limit the expected benefits from the continued life of a child to the period of minority, and in many instances, the value of the child's companionship is excluded on the grounds that it has no pecuniary value. If the focus of child-death actions is the value of the child's services less the cost of raising the child, it can be seen that the recovery to parents will be small or nonexistent, because the cost of raising the child will almost always exceed any financial contribution it makes.⁹

7.3. A Concluding remark on court awards.

The economist must carefully inspect the grounds on which court awards are made. In particular, the methods that the courts use must be scrutinised. Insofar as forgone earnings are used to compensate individuals, this method affords no advance on human capital. And to simply take a weighted average of the awards made by courts to the estates of deceased persons over the past five years, say, and thereupon compute a figure for the value of a life is to pass the methodological buck from the economist to the jurist. To be sure, courts follow established procedures in their appraisal of a claim, and attune figures according to the special circumstances that obtain in each case.

It does not befit an economist to be satisfied with such a level of arbitrariness. The economist must face the methodological issue squarely and consider other ways by which a more accurate figure may be computed. Or, failing that, must arrive at a value through techniques which are at least more sound in their economic foundations.

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CHAPTER 8.

A NON-MONETARY APPROACH TO COST-OF-ILLNESS.

Because of its convenience and generality, most economists use money as the universal standard to measure costs of illness. This is understandable; monetary sums are most easily conceptualised by those who allocate budgets to competing projects. If the aim of costing studies is to rank diseases according to their greatest cost to society, and if policymakers are to allocate funds for the combating of disease in the most cost-effective way, then it is advisable that health economists express cost in monetary terms.

However, there are aspects of disease which are conceptually impossible to translate into monetary terms. Debilities which are confined to the body and psyche of the individual and which do not extend into economic loss to the community fall into this category.

8.1. Two meanings of cost.

This presents a dilemma in determining "cost". The pain, physical suffering and anguish which result from disease are unquestionably a liability to the individual. These represent costs over and above forgone productivity. But exactly what sort of costs are they? Part of the difficulty here arises because the noun "cost" can be used in two senses. "Cost", used in a narrow sense, pertains strictly to financial units. In a broader sense, "cost" takes on the meaning of "general hardship" or "sacrifice".

Value judgements are thus involved. Where "cost" is taken to pertain only to pecuniary matters (as by human capital theorists), these costs are disregarded since pain cannot be allayed by any amount of money. WTP economists favour the broader interpretation of "cost", and purport that their figures include intangibles because the hypothetical, perfectly-informed individual internalises all risks he faces from disease, including pain and suffering.

A third possibility would be to argue that although money cannot diminish actual pain and suffering, *relief* from pain can be bought in those cases where treatment is possible, and should therefore serve as a good proxy. But the administration of relief is accounted for in the costing of medication and health services. So, an unquantifiable entity remains, seemingly not possible to transpose into monetary terms. It is ironic that that which is most tangible eludes the grasp of the cost accountant.

Does this however mean that there is no way that pain can be expressed? Some economists think not. One idea would be to find some cardinal scale on which to measure pain and suffering. The results issuing from a hypothetical costing study could for instance be presented in two parts: (i) a certain loss of productivity to the economy due to illness expressed in money, and (ii) a certain quantity of pain suffered by the victims of disease. The

problem with this solution is that neither pain nor pain intensity are quantifiable in any unit. And even if this were possible, it would not make sense to aggregate pain in any way.

8.2. Alternative Approaches.

There have been various attempts to derive non-monetary measures for human welfare. Two possible routes to this goal will be considered, one general, the other specific. The first, by Van Praag, consists in deriving a modified individual welfare function of income, and denies the possibility of restoring individuals to their original level of welfare by compensating them according to a principle of equimarginal utility. The second, by Lubeck and Yelin, devises a method to design in common terms as many of the indirect costs of illness as can be reliably done.

8.2.1. *The Perception of Income Inequality: Van Praag.*¹

Equitable compensation for the loss of welfare (as a result of disease, say), involves restoration to the initial level of welfare. Each person has a different perception of utility of income. Bernard van Praag had the intuition that individual welfare functions of income were lognormal in shape;² later empirical evidence supported this.³ That is to say, given a certain level of constant annual income y , the evaluation of that income $U(y)$ in the interval $[0,1]$ is typically sigmoidal in shape. Important to note is that this individual welfare function of income does not indicate any objectively measurable property of income, only the relative welfare as perceived by the individual; it is measured as the ratio of the welfare attained to that of the best imaginable situation. The individual's utility of income is affected by many other factors, but the standard by which an individual measures his income is provided, more or less, by the mean income of his reference group.

8.2.1.1. A possible way for authorities to compensate individuals in an equitable fashion.

Equality is traditionally defined as follows: If there are n individuals with incomes y_1, \dots, y_n , complete equality is attained if $y_1 = y_2 = \dots, y_n$. However, if the first person has a family of two and the second a family of four, it is clear that the situation may be called one of equality but not one of equity. So the distribution of welfare rather than the distribution of income must be considered for equitable compensation.

Let the individuals have welfare functions

$U_i(y)$ ($i = 1, \dots, n$) with corresponding marginal welfare functions $u_i(y)$. Assume that each individual evaluates the income distribution using a social welfare function

$$SW(Y) = W(U_1(y_1), \dots, U_n(y_n)), \quad (1)$$

which is democratic, i.e.

$$\frac{dW}{dU_i} = \frac{dW}{dU_j} \quad \text{for } i, j = 1, \dots, n.$$

In other words, the weighting given to all citizens is the same. If this holds for *all* income distributions, the social welfare function must be of the Bergson-Harsanyi type

$$SW(Y) = SW(y_1, \dots, y_n) = \sum_{j=1}^n U_j(y_j) \quad (2)$$

For optimal distribution, $SW(y_1, \dots, y_n)$ is maximised

$$\text{subject to } \sum_{j=1}^n y_j = Y. \quad \text{The first order conditions are}$$

$u_j(y_j) = u_i(y_i)$ for all i, j . This corresponds to income equality when the marginal welfare functions are identical. If this is not the case, equality of marginal welfare implies *inequality* of income.

Van Praag does not allow that an individual has an appreciation or understanding of the welfare functions of others. He supposes that individual i assumes that *all* other individuals evaluate their income (or ought to evaluate) their income according to his own welfare function $U_i(y)$. Then the social welfare function for individual i becomes

$$SW_i(y_1, \dots, y_n) = W(U_i(y_1), \dots, U_i(y_n)) \quad (3)$$

Obviously, this individualisation of the social welfare function ends any pretense that *the* social welfare function should describe society's preference ordering over the set of income distributions. The function SW_i describes only individual i 's preference ordering, where he assumes all fellow citizens to be like himself. The function SW defined in (2) could be regarded as the SW function used by authorities, but such a specification implicitly assumes that the authorities are able to compare the welfare levels of different persons, measured according to their *own* individual scales. *In essence, it is virtually impossible for policymakers to compensate individuals for a loss in welfare according to an equimarginal principle.* This is because it is impossible for them to gauge the level of welfare of each individual, and also because individuals who derive a higher welfare from lower levels of income would find it unfair that they receive less in compensation for the same monetary loss.

Van Praag proceeds to evaluate the effect that overall changes in income distribution have on $(\sigma^2)_u$, the variance of the natural logarithm of $u(y)$ which is a measure of inequity. One of the results obtained from his work indicates that given a policy that raises everyone's income proportionately, the rich will regard it as reducing inequality whereas the less affluent will

consider it quite the opposite! The circumstances of the individual affect the way he evaluates a given policy.

This analysis sheds light on the difficulties facing the policy-maker who wants to compensate individuals for a loss of welfare as a result of illness.

8.2.2. Lubeck and Yelin: Qualitative evaluation of health states.

Lubeck and Yelin⁴ observed that although people have an inherent value system for their health, they were not able to or would not translate these values into monetary terms. The importance of Lubeck and Yelin's contribution lies in their emphasis on the non-monetary, qualitative evaluation that people subjectively place on their own health states.

Their programme necessitated determining which activities constituted daily living. Sociologists had discovered that human activities could easily be classified into about eight major domains: household chores, shopping and errands, social relations, religious activities, leisure and recreation, transportation, public service and work (including volunteer activities)[Chapin, 1974].⁵ About 75 activities, approximately 9 per domain, cover most of the detail of daily life. Individuals were then asked to value each activity in qualitative and not monetary terms [e.g. "On a scale of 1 to 5, how important is it to you to be able to shop for food?"]. Controls were introduced to ensure that their method complied with the guideposts required of cost-of-illness methods.

8.2.2.1. A practical application of qualitative evaluation.

Lubeck and Yelin applied their methodology to arthritis as an example of the impact of chronic disease. Two groups of 150 patients were selected, each one suffering from rheumatoid arthritis and osteoarthritis respectively. One hundred non-sufferers formed the control group. The three groups were similar in age and sex, and were drawn from the same areas of residence. A telephonic survey was used to ask all individuals to value the importance of 75 daily activities on a scale of 1 to 5. They were next systematically asked whether they performed each of the activities at the time of the interview, and whether they performed it a decade before, i.e. prior to the onset of disease for the arthritics.

Analysis of data revealed the proportion of persons in each group to have experienced activity losses, as well as the mean number of losses experienced in each activity domain. The inherent evaluation of activities of the respondents with and without subsequent losses were compared to determine whether actual loss of activities rather than health status were affecting the evaluations. Information was presented as to how people of different ages and sexes value their activities in order to eliminate the bias of ageing. The results were then tabulated.

The above method, with necessary modifications, gives a clear snap-shot of the cost of disease. By simply inspecting the relevant table for a particular disease, one can see what percentage of people in excess of the control group suffer loss of a particular activity, as well

as how much the performance of the activity is valued by both the sufferers and the control group. No monetary value ever comes into the picture.

Lubeck and Yelin's approach might appear similar to other measures of health status, notably the loss of relative utility approach. It could be argued that if combined with WTP data on a few of these activities, their method could be monetised. However, their method does differ in two respects. First, most measures of health status emphasise the patient's ability to perform activities of daily living, whereas Lubeck and Yelin enquire whether the full range of work-related, social and leisure activities *are actually performed*.⁶ This is important, since if an individual has a capacity to work yet never did, then illness did not cause a lowered income, and there are no costs in the form of lost productivity. Second, the majority of health status instruments do not assess changes to the individual's ability to perform activities over time, whereas Lubeck and Yelin's method does.

But their approach is not yet a solution, as they rightly acknowledge.⁷ These ideas require extensive elaboration and expansion before they can be rendered suitable to a degree that meets standard psychometric criteria.

8.3. The Future of Non-Monetary Approaches.

The use of money as a unit of account for cost-of-illness is sensible because policymakers have a ready grasp of dollars and rands, and because they budget in these units. But if people do not value their health in monetary terms and give inconsequential answers to questionnaires involving money, then no refinement of approaches involving money will give an accurate picture of cost of illness. Activities may well be important to people on some internal scale that has no parallel in monetary terms. Accordingly, asking people to reveal that special value system in simple qualitative terms may provide more accurate measures of value. Herein lies the value and expedience of this method.

Non-monetary approaches have strong intuitive appeal, and will probably gain prominence as the methodology improves. Much work will have to be done before their use becomes widespread, the most daunting part of which will be the education of policymakers into thinking along non-monetary standards of value.

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CHAPTER 9.

DIRECT COSTS OF ILLNESS: A Theoretical Preamble.

9.1. Introduction.

Previous approaches adopted by cost-of-illness researchers were considered before this project was undertaken in order that a suitable methodology be selected. Of course, it was understood that what would be practicable would be determined ultimately by the quality of the data and statistics available.

A few landmark guides on aspects of the methodology of direct costs have been published, notable among which is Anne Scitovsky's (1982) comprehensive overview on issues as they applied in the United States in 1982.¹ Hodgson and Meiners wrote a more general paper on cost-of-illness methodology in the same year.² More recently, David Evans discussed principles involved in costing in the Medical Journal of Australia.³ Technical issues were discussed in detail by Drummond *et. al.* in their 1987 book on methods for the evaluation of health care programmes.⁴ The work of Dorothy Rice has also contributed immensely to this field. What follows below is a selection from the above works.

9.2. The Definition of Direct Costs of Disease.

In the broadest sense, the direct costs of a disease can be defined as the value of those resources other than labour that could be allocated to alternative uses in the absence of that disease. Direct costs include medical and non-medical (e.g. transport costs) expenditures occasioned by the illness or disease.

It is important to draw the distinction between *total direct costs (TDC)* and *net direct costs (NDC)*. Total direct costs measure the value of medical care used to prevent, diagnose and treat a particular disease. Net direct costs indicate the net expenditures incurred as a result of that disease only. The difference arises because those patients no longer succumbing to a particular disease survive to suffer from other illnesses.

$$\text{NDC} = \text{TDC} - \text{Costs due to other diseases to which the individual would be prone in the absence of CVD.}$$

Both total and net direct costs provide important information about costs of disease. Net direct costs, while assessing economic impact more accurately in the long term, are difficult to compute. *In this study, direct costs should be understood to mean total direct costs of disease.*

9.3. An Outline of the Direct Cost of an Illness.

Scheme 9.1 gives the progressive stages of any illness, and shows the types of services a patient is likely to require from the time he falls ill, until he fully recovers or dies. In an ideal world of perfect information, where it is exactly known how many resources each patient consumes at each stage per episode of illness, the direct costing of projects would simply involve the aggregating of costs per disease category over all patients.

Scheme 9.1. Services Demanded at Various Stages of Illness.

Stage. MEDICAL EVENT	SERVICE CONSUMED.
1. Patient feels unwell Sees a medical practitioner.	Transportation. Physician's fees.
2. Diagnosis of case.	Laboratory fees. Med. training of lab. personnel.
3.(a) Treatment. (mild)	Drugs.
3.(b) Treatment. (severe)	Hospitalisation. Nursing Home. Medical devices. Machinery. Drugs.
4.(a) Discharge from Hospital (mild) with recovery.	Some drugs
4.(b) Discharge from Hospital (serious) with eventual recovery	Drugs. Medical devices. Doctor's fees. Home nursing. Domestic services.
4.(c) Discharge from Hospital (serious) with little chance of recovery (e.g.. chronic disease)	Same as 4(c) above. Transportation. Out-of-area living costs. Moving costs (if required)
5. Death.	Nil. (Burial costs eventually have to be borne)

Such detailed statistics are however beyond the financial means of any health administration. The manner in which medical statistics are collected, classified and grouped by the different

health institutions forcibly delimit the parameters within which costing projects can be carried out. Health economists have made suggestions as to how the collection of statistics could be made more useful for future costing assignments (e.g. Scitovsky 1982). In addition, solutions to overcome problems that surface in the attribution of costs to particular diseases have also been forwarded. But in the end, the available statistics determine both the viability and the success of the study.

9.4. Two Methods of Determining the Direct Cost of Illness.

Two general approaches under the rubric of human capital methodology can be used to estimate the costs of disease by diagnosis or diagnostic groups.

The most commonly employed is the prevalence-based approach. This involves the determination, for any disease category, the direct and indirect costs attributable to all cases of the condition which are prevalent in a given year. The extent to which various health care services are used by each diagnostic category forms the basis for the allocation of expenditures. All costs are allocated to the primary diagnosis.

The alternative is the incidence-based approach, for which a generally applicable methodology was not developed until the work of Hartunian *et.al.* (1981).⁵ Here, the lifetime direct and indirect costs of *new* cases of a condition or group of conditions which have their onset (incidence) in a given year are calculated. This method requires the estimation not only of direct costs attributable to new cases of the disease in question, but also of the present value of direct costs which may accrue to this group in the future, until the patient dies.

The two methods yield similar estimates for the direct costs of acute conditions having a short duration, and even of chronic conditions in a steady-state. However, when medical and technological breakthroughs are in transition, thereby drastically reducing the incidence of a disease, the two methods yield different results.

Prevalence-based estimates indicate the current costs of different conditions and can serve as guidelines for policy decisions. Incidence-based estimates are more useful for estimating the benefits which can be derived from reducing the incidence of certain conditions. The complementary nature of the two methods assures each of its rightful place in the repertoire of the health economist. Sections 9.5 and 9.6 below give a synopsis of each.

9.5. Prevalence-Based Studies.

For a particular disease category, the extent of utilisation of every facet of health care and other services in a given year is computed. The type of expenditures to be included in the study will depend on how comprehensive a project is planned. Researchers determine the scope of the category to be costed and calculate identified expenditures.

Different methods can be used to allocate the various types of expenditures among the disease categories. The availability of data and especially the manner in which statistics have been aggregated will determine the route to be followed. Even in countries where fairly comprehensive data are available, care has to be taken to avoid many of the pitfalls of simple aggregation. For example, in two separate cost-of-illness studies [Rice, 1966; Rice and Cooper, 1976],^{6,7} recourse was made to the hospital services data of the Health Care Financing Administration (HCFA), a source not without deficiencies.

The peculiarities of the HCFA's mode of data compilation is described in detail by Gibson.⁸ Expenditures for hospital services, the largest single item of health care costs, is a composite item which includes the costs of resident and non-resident physicians, as well as the costs of drugs and other supplies. Estimates for the categories of physicians' services, the second largest item of health care costs, were based largely on the gross income of self-employment reports by physicians to the Inland Revenue Service (a dubious source in itself!). The simple aggregation of these categories of cost results in an overestimation of hospital expenditures and an underestimation of the expenditures for physicians' services, since part of physicians' salaries (viz. outpatient work) is reflected in the category of hospital care.

Furthermore, the US National Health Expenditures by type of expenditure, 1977-1979⁹ lists a figure for expenditures on drugs and medical sundries based on the estimate of the Department of Commerce for personal consumption expenditures. Hospital and Nursing Home care expenditures include drugs and medical sundries. This leads to an inflated figure being estimated for hospital and nursing home care expenditures, and an underestimation for the category of drugs, since a large fraction of the latter category will be reflected in the former category.

This incorrect attribution of costs to the various categories of health expenditure may seem trivial, but it tends to distort final costing figures since various illnesses require differing lengths of stay in hospitals. Scitovsky has urged some improvements to the way data is collected in the US which could eliminate some of the entanglements.¹⁰ The ease with which these improvements could be implemented is however not that obvious, for a major bureaucratic overhaul would be required before the way in which data is collected can be revised. South African medical statistics pose an even more formidable challenge.

9.5.1. Shortcomings of the Prevalenced-Based Method.

(i) *Comprehensiveness and bias of data.* Any method of cost-accounting is only as good as the data upon which it is based. Careful attention must be given to the reliability of figures. Where it is difficult to evaluate the quality of the data on which the allocations are based, the intuition and good sense of the economist is called for.

(ii) *Multiple Conditions.* Perhaps the most serious shortcoming of this method is that all costs are attributed to the primary diagnosis. 1975 US data have shown that 52% of all hospital discharges involved patients with multiple diagnosis.¹¹ This poses a major problem

for hospital care expenditures because these constitute a large percentage of total US national health care expenditures (40% in 1978). According to a US National Center for Health Statistics survey for 1965-1967 (1971), 49.5% of the civilian non-institutionalised population of the United States reported one or more chronic conditions, and the average number of chronic conditions per person was 2.2.¹² In addition, there are those who have not frequented hospitals and remain beyond the statistician's net.

Given this scenario, it becomes easy to appreciate that a widespread misallocation of direct costs results from the attribution of all costs to the primary diagnosis. There is a complexity of interrelationships among different conditions; some diseases aggravate others. For example, a diabetic who has pneumonia is likely to remain in hospital longer than a patient with uncomplicated diabetes. If all costs are allocated to the primary disease, as is usually the case with most studies, then diabetes costs would be overestimated while costs of pneumonia would be underestimated.

Moreover, the cause of certain diseases is often unclear and may even be omitted. The death of HIV positive people is for example often attributed to causes other than AIDS.

(iii) *Hospital Expenditures*. In the 1980s, total US hospital expenditures among diseases were allocated on the basis of days of inpatient care by diagnosis. This oversimplification leads to gross inaccuracies. For example, the average length of hospital stay for US cardiovascular patients in 1980 exceeded the average stay of all other patients by a ratio of 1.2. Yet they incurred 3.27 times higher per capita hospital costs than the average patient.¹³

Total hospital expenditures also include a substantial amount of expenditures for outpatient care, where the case mix is likely to be very different from that of inpatient care. It is easy to see that when hospital expenditures are allocated on the basis of inpatient care mix alone, at least some portion of costs will be misallocated among different diseases.

(iv) In default of better data, some studies have assumed that physicians' charges are the same for all categories of disease.^{6,7} This is unwarranted. The average charge for a breast cancer office visit is considerably higher than the average office visit since it includes relatively expensive radiotherapy. More refined studies for actual costs of physicians services led to more reliable figures.¹⁴

9.6. The Incidence-Based Method.

Hartunian *et al.* refined this method and applied it to the major disease categories of cancer, coronary heart disease, stroke and motor vehicle injuries.¹⁵ For the first time a detailed and systematic methodology for incidence-based estimates was presented which could be applied to any type of disease or disease category.

Four basic steps in the estimation of direct costs of specific conditions are followed in this procedure:

- (i) Estimation of the incidence of the conditions;
- (ii) Estimation of mortality rates and life expectancies of patients who survive the initial attack of the illness;
- (iii) Estimation of the direct costs of *all* patients in the first year as well as the future direct costs of those who survive the first year but with some impairment, and
- (iv) The selection of a discount rate to convert future direct costs to their present value.

The direct costs that the surviving victims are likely to incur in the future are calculated on the assumption that

- (a) existing debilitation-over-time profiles for the disease under study will remain as they are at present, and
- (b) that the intake of patients under study does not differ in terms of resistance to disease from those who have succumbed to it in the immediate past. This inductive process allows the calculation of costs likely to be incurred by the survivors in subsequent years.

9.6.1. Shortcomings of the Incidence-Based Approach.

- (i) The method requires extensive and specific data, much of which is difficult to obtain. There is often a lack of knowledge of the true incidence of disease. In South Africa, where health services have become progressively more accessible in all areas, the incidence of some diseases is likely to diminish (or fluctuate) as medical treatment becomes more widespread.
- (ii) It is difficult to estimate the life expectancies of patients who survive an initial attack of illness. Constantly improving medical technology may drastically shorten the course of disease and lengthen the life expectancy of patients. Even if current methods of treatment were not to change over time, very few sets of hard data are available on the life expectancy of patients stricken by chronic illnesses.
- (iii) Estimation of the first year costs of new cases are subject to the same data inadequacies as the prevalence-based approach.
- (iv) The step involving the estimation of future costs is beset with the typical uncertainties of all forecasting methods. Many variables to be costed are subject to autonomous changes in medical breakthroughs and sudden outbreaks of new complications. Above all, prices will fluctuate, as there are likely to be future shifts in the relative charges for different medical services.

Common to all methods is the problem of selecting an appropriate discount rate.

Despite these shortcomings, Scitovsky encourages incidence-based estimates of specific illnesses, partly because they serve a different purpose from prevalence based estimates, and partly because they can serve as a valuable check on the latter.¹⁶

9.7. The Choice of Direct Costing Methodology for this Study.

In this study, the prevalence-based approach to direct costing was adopted for reasons that became obvious after some reflection. First, reliable data on the incidence of CVD are not available to conduct an incidence-based study. Second, the incidence-based method is beset with the same inadequacies of data as the prevalence-based approach for first-year costs. Its use therefore provides no additional advantage in this respect. Thirdly, the vicissitudes inherent in future variables was deemed to impart an additional, unacceptable level of inaccuracy to an already broad range of figures.

In Section 3, the layout and planning of the direct costs of cardiovascular disease in South Africa are presented, as are the figures computed.

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SECTION III

CHAPTER 10.

Introduction.

The subject matter of this study is novel and has never been attempted in South Africa. In this section, the empirical results of quantifying the financial burden of cardiovascular disease on the South African economy is presented. Before this section is assessed, it is important that caveats be clearly spelt out lest undue significance be attributed to the figures.

Scope of this Study.

First, the scale on which this costing study was carried out must be clarified. The actual attribution of costs to CVD was done in partial fulfillment of an M.Phil degree in economics. The budget allocated to the project was not large enough to permit work that required the fine-tuning of figures beyond the broadest of ranges.

The collection of data posed many problems. Reliable medical and other statistics, so readily available in western countries, are lacking here. The project's fruition was made possible by the amiable cooperation of many disinterested people who often divulged information, some of it off the record, without any quid pro quo. Often, information from professionals whose primary business did not concern our project had to be relied on. In some instances this led to information promised months ahead of schedule not meeting the set deadlines for the work. As a result, the completion of the project was hindered and there are in gaps in the data; the section on hospital costs of CVD was especially affected.

Elements of Subjectivity.

There are substantial elements of subjectivity in this thesis. Issues of overall methodology have been argued in Section II, and the eventual choice made was based on firm economic theory. However, there are many minor methodological and stylistic turns which have emanated from unsubstantiated *a priori* assumptions, or which have been used because of their intuitive appeal. The way in which Scheme 11.1 in Chapter 11 was devised is a good example of this; it satisfied cognition. [Scheme 11.1 gives an outline of the planning of direct costs of CVD.]

In addition, certain costings were designed with an eye to computational facility. Narrowing the ranges of costing figures is an activity that demands an increasing expenditure of effort for diminishing increments in accuracy.

Issues of Social Import.

This study aims to give a snapshot view of the cost of CVD to the South African economy in 1991. South Africa is currently undergoing a political and social metamorphosis. Economic indicators such as inequality in income distribution, per capita GDP, and growth and development strategies have shown swift change over the past decade. Factors of political stability are foremost in people's mind, and the socio-political situation a few years hence may radically alter the account of disease that is given at present.

The exact trends afoot in this country are indeterminable at present. Planners have presented various scenarios reflecting their level of optimism for the future of the country. In an optimistic "high road" scenario, it is envisioned that per capita GDP of the country will show gradual increase as confidence grows and investment takes off. If high earning whites stay in the country and the black middle class expands, adopting a westernised lifestyle, there will be a redistribution of medical expenditure, presumably away from third world, infectious type diseases to diseases of lifestyle. In this situation, one can expect the cost of cardiovascular disease to rise dramatically.

On the other hand, if a pessimistic, "low-road" scenario results from the changes currently in progress, then as high-earning whites leave the country and people get poorer across the board, the cost of CVD can be expected to diminish. Although the mortality rate due to all diseases is expected to rise under such circumstances, the incidence of CVD in particular will decrease. Hospitalisation levels and other direct costs associated with CVD will decline. Workers will also earn less, so that the opportunity costs of layoffs will fall, which will lead to a lowering of the indirect costs of CVD disease.

The cost of CVD is also a function of the extent to which an efficient hospital service can be maintained; if no funds are available for treatment, then, of course, no money is spent on the disease.

Researchers and policy makers who intend using these results in the future are advised to take note of the socioeconomic conditions which prevail at the time. In a country where all facets of public life are in a state of flux, this point cannot be sufficiently emphasised.

CHAPTER 11.

The Planning of Direct Costs.

Cardiovascular disease is a generic term which encompasses a wide range of illnesses listed under the International Classification of Disease (ICD) code numbers 390–450. It was realised that it would be impossible to cost each disease category separately. Instead, efforts were concentrated on the four major subgroups of CVD, namely:

- (i) Ischaemic heart disease and complications, including cardiac failure.
- (ii) Cerebrovascular disease (including strokes).
- (iii) Peripheral arterial vascular disease and aneurysm.
- (iv) Hypertension.

These four sub-categories are nonetheless quite comprehensive in scope, and effectively cover the majority of medical expenditures on CVD. Costs of patients with multiple conditions (see Section 9.5.1.) were allocated to the primary cause of diagnosis.

11.1. The Plan for the Assessment of Direct Costs of CVD.

The plan was devised in three stages:

Stage 1.

A simple, yet thorough plan to capture the possible areas of direct costs that any CVD patient would incur through the various stages of the disease was devised. This plan is sketched in Scheme 11.1 and follows the prevalence-based methodology. Costs incurred in Scheme 11.1 must be met either by the patient, the employer, the taxpayer or by members of a medical aid scheme.

Stage 2.

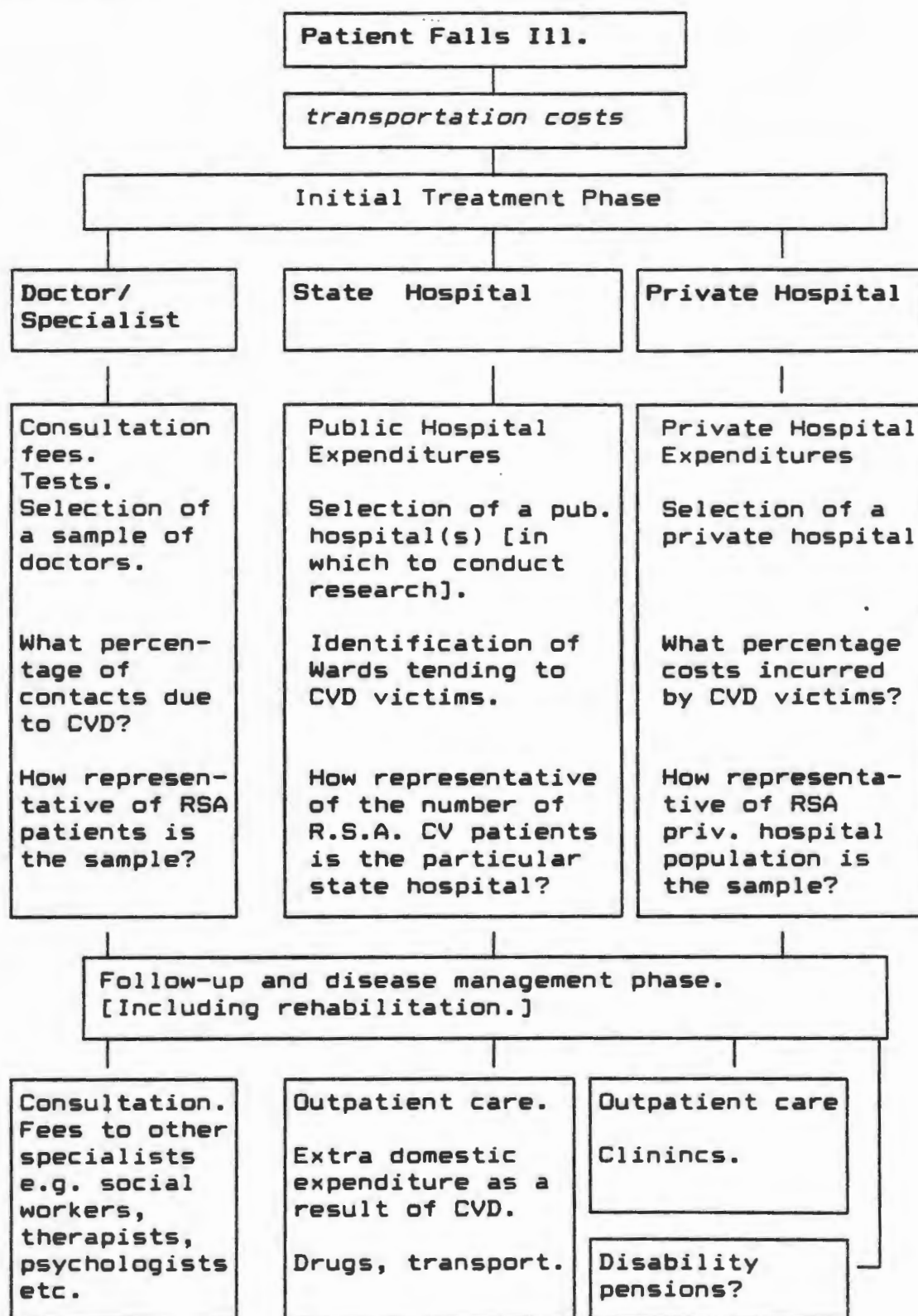
A suitable base year for which figures were valid had to be selected. The year of the most recent census, 1991, was considered most appropriate, since it was the most recent year for which comprehensive statistics were available. Where data for 1991 were not readily available, figures for other years were adapted using a relevant price index.

Stage 3.

A snap-shot view of the disease in the population finds patients in all phases of treatment. Any cost-of-illness project has to assess each category of cost for the time-period under scrutiny. In the next stage of the exercise, each category of costs identified in Scheme 11.1 had to be individually assessed so that a method of cost accounting best suited to the resources of the project could be selected. Details of how this was done for each cost category are given in chapters 12 to 18. Some categories of cost [e.g extra domestic expenditure as a result of CVD] were either very difficult or impossible to assess, and are discussed at relevant junctures.

Indirect costs are discussed in chapters 19 and 20.

Scheme 11.1. Direct Costs Incurred by CVD Patients at the Various Stages of Disease. (Personal services).



CHAPTER 12.

Transportation Costs.

Transportation costs, while not comprising a significant portion of the overall costs of CVD, are an important burden to the more indigent sectors of the population. For those earning below R750-00 per month, the charge for each outpatient visit to Groote Schuur hospital in Cape Town was R10-00 (in 1993). The 1993 price of a one-way trip for any distance on an urban taxi in Cape Town was R1-00. This implies that transportation costs make up at least $[(2/12) \times 100 =]$ 16.67% of the cost of each visit for people in this earning category.

12.1. A Plan for the Calculation of CVD Transportation Costs.

Patients are conveyed to hospitals or doctors either by public transport or ambulance, or by their own transport. Considerable difficulties arise in ascertaining which percentage of cardiovascular patients make use of each type of transport. Without the facilities of random sampling, the only reasonably plausible way to ascribe a value to these costs is to set an arbitrary income level below which it is assumed individuals could not afford their own transport. Furthermore, an average distance that patients travel to a doctor or hospital must be determined. It was arbitrarily taken that patients had to travel on average 6km to see a doctor (3km each way) and 20 km for each trip to the hospital and back. These are only proxy values and were chosen because they seemed both conservative and reasonable.

12.2. Transportation Costs of CVD Patients Incurred by Travelling to General Practitioners and Physicians.

12.2.1. General Practitioners.

A comprehensive study of the morbidity spectrum seen by general practitioners in South Africa was conducted by Bourne, Bloom and Sayed in 1991 (for details, see Chapter 13).¹ Their study suggested that cardiovascular diseases are responsible for 8,23% of the total number of GP contacts in South Africa. The total number of contacts that general practitioners had in 1991 is estimated at about 32 344 000, which means that there were about 2 662 000 contacts with CVD patients in South Africa that year, each necessitating two trips by public transport.

For purposes of costing, a low and high figure can be attributed to this category of transportation cost. A low figure can be obtained by assuming that 75% of patients use

public transport and 25% their own. A high (and more likely) figure can be obtained by assuming that 25% of patients use public transport to visit GPs in private practice, whereas 75% use their own transport. This is a fairer assumption since CVD patients who are wealthy enough to consult private GPs can usually also afford their own transport.

The comprehensive cost of running a car worth R30 000 (1600 cc) per kilometer in South Africa in 1991 was R0,272.² The cost of a one-way trip by urban taxi (the cheapest form of urban transport), irrespective of distance up to 10km in the same year, was R0,80.

The calculation of a low and high figure for this category of transportation cost is as follows:

Low cost:

$$(0,75 \times 2\,662\,000 \times 2 \times R0,80) + (0,25 \times 2\,662\,000 \times 6 \times 0,27) = R3\,194\,400 + R1\,078\,110 = R4\,272\,510.$$

High cost:

$$(0,25 \times 2\,662\,000 \times 2 \times R0,80) + (0,75 \times 2\,662\,000 \times 6 \times 0,27) = R1\,064\,800 + R3\,234\,330 = R4\,299\,130.$$

Note that the two figures would diverge significantly if the distances assumed were altered.

12.2.2. Specialist Physicians:

Because of the seriousness of CV diseases as a group, a high proportion of CVD patients is referred to specialist physicians. Of the total number of cardiovascular complaints seen by GPs, 64,28% are due to hypertension (see Table 13.1, Chapter 13). The rest are complaints requiring more elaborate investigation. If it is assumed that hypertensive patients are not referred to specialists, and that roughly a third of the rest of CVD cases are also not referred to specialists, then the number of trips taken by CVD patients to physicians will amount to 25% of the number of contacts they have with GPs.

This suggests further transportation costs of between R1 068 128 and R1 074 782.

12.3. Private Transportation Costs to Hospitals.

The last Census of Hospitals and Clinics (1987), showed 39414 CVD patients discharged from hospitals during May and June 1987, of whom 6 945 came from private institutions.³ This means that if there is no seasonality in admissions and discharges, six times this

number or approximately 236 500 patients were transported to hospitals during 1987, of whom 41 670 were private patients. [The admission figures of CVD patients to hospitals in South Africa shows no significant seasonality.]

An estimate of the percentage of patients transported by ambulance can be calculated from statistics provided by the Cape Town Ambulance Services. In a predominately urban area with a population of 2 102 764, 5 560 patients with cardiovascular complaints were conveyed by the service from July 1991 to June 1992. The 1991 total population of South Africa was 26 288 390, of which 17 886 198 people lived in the provinces, and 8 417 624 lived in self-governing territories such as Kwazulu (See Appendix 12.A).⁴ The rural dweller in the provinces is provided with an ambulance service that is almost as good as the urban dweller.⁵

The calculation of the number of trips undertaken by ambulances in South Africa is as follows:

Pop of SA Provinces

————— x no. of Cape Town CVD Ambulance Trips
Pop of greater Cape Town

17 886 198

————— x 5 560
2 102 764

8,605 x 5 560

= 58 973 CVD patients conveyed by ambulance in 1991.

Subtracting this number from the total number of CVD patients: 236 500 - 58 973 ambulance trips = 177 527 CVD patients who travelled by public or private transport in 1991.

The 177 527 patients who were not transported by ambulance used either public transport or their own. One can safely assume that patients making use of private hospitals are wealthy enough to afford their own transport [ambulances convey patients predominately to public hospitals]. Furthermore, because CVD affects the more well to do, it can be assumed that between 20 and 35% of CVD patients who attend state hospitals can afford their own transport. [For example, in May and June 1987, 27 125 CVD patients were White, Coloured and Asian whereas only 12 289 were Black].

Calculations:

Transportation costs of CVD patients at private hospitals =

no. of patients x distance travelled x cost per km

$$= 41\,670 \times 20\text{km} \times R0,27/\text{km} = R225\,018$$

Transportation costs of CVD patients at state hospitals:

Low figure:

= cost of private transport + cost of public transport

$$= 20\% \times 135\,857 \times 20\text{km} \times R0,27 + 80\% \times 135\,857 \times R1,60$$

$$R146\,726 + R173\,897 = R320\,623.$$

High figure:

= cost of public transport + cost of private transport

$$= 35\% \times 135\,857 \times 20\text{km} \times R0,27 + 65\% \times 135\,857 \times R1,60$$

$$R256\,770 + R141\,291 = R398\,061.$$

Therefore, total private transportation costs were between R545 641 and R623 079.

12.4. Ambulance Costs

The acute nature of some cardiovascular conditions makes transport to hospital by ambulance a necessity in about 25% of cases. Most ambulance services keep records of the diagnosis of each patient conveyed. The Cape Province Ambulance Services were approached for statistics for the whole of the Cape Province, but their data could only be collected over a period of time that exceeded the deadline for this project. This necessitated working on a smaller scale, and the Ambulance and Rescue Service of the Western Cape was approached, a service which performs practically all ambulance work in the greater Cape Town region. It is recognised that this would lead to an upward bias in the results.

The Ambulance and Rescue Services in Pinelands serves a population of 2 102 764 people (the greater Cape Town region). Records are kept by illness category of patients

conveyed. Three cardiovascular categories are recorded, viz. angina, other cardiac and stroke. These categories accounted for 5 560 of the 136 522 trips undertaken by ambulances of the service, or 4,07% of the total patients conveyed from July 1991 to June 1992. The budget for this financial year was R22 723 525. The cost of CVD trips for the period therefore amounted to R925 439.⁶

The 1991 budget for the Cape Province Ambulance Services, which serves practically all 5515965 people in the province, was R91 554 000. This higher per capita cost, as compared with the Cape Town metropolitan area, reflects the higher costs of maintaining ambulance services in rural areas as well as head office administration costs.

Ideally, national data should be collected; in its absence an estimate is made by extrapolating Cape data to the rest of the country. The ambulance budgets of other provinces were not made available timeously. It was therefore necessary to make two assumptions, viz. that the acuity of cardiovascular conditions was the same all over the country and that every province in the country was equipped with an equally efficient ambulance service. CVD ambulance costs would then approximate the following:

Population of RSA provinces

_____ x % CVD trips x Cape Budget

Population of Cape Province

17 886 198

_____ x 4,07% x R91 554 000

5 515 965

= R12 082 819

12.5. Calculation of Total Transportation Costs.

Cumulating over sections 12.2 to 12.4 and rounding off, the following total CVD transportation costs are obtained (1991 prices):

	Low	High:
Visits to GPs:	4 272 510	4 299 130
Visits to Physicians	1 068 128	1 074 782
Transp. to Hospitals	545 641	623 079
Ambulance Costs:	12 082 819	12 082 819

Total Transportation costs: R17 969 098 R18 079 810

*** Caveats.**

The validity of these assumptions may be questioned but are deemed reasonable given the availability of data. Points of particular concern were the following:

Different areas of the country might not have as excellent an ambulance service as Cape Town.

The figure of ten kilometers travelling distance is arbitrary. It was derived from a small sample of addresses at the Informatics Department of Grootte Schuur hospital and tempered by our knowledge of the geography of Cape Town. Clearly people in rural areas will have further to travel than those in urban areas.

Much energy could be expended trying to devise studies to narrow these figures, but such effort was deemed unwarranted given the small numbers involved relative to other CVD costs.

Appendix 12.A: Self Governing Territories.

The ambulance costs of the self-governing territories have not been included, but this is not expected to unduly inflate the above figures for two reasons. First, the self-governing territories do not provide an ambulance service of the same standard as the provinces.⁷ Second, given that the racial composition of the self-governing territories is predominately black and rural, hypertension is likely to be the only major cardiovascular problem. The few acute CVD conditions occasioning trips by ambulances does not warrant inclusion in this chapter as a separate cost category.

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The cost per km of running a 1600cc motor vehicle in mid-1993 was R0,37 [Source: Automobile Association]. The AA could, however, not provide figures for 1991.

3. Central Statistics Service, *Census of Hospitals and Clinics, 1987*. Report No. 93-01-01 (1987). Table 16, p. 120.
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6. Statistics from the Chief Officer, Ambulance and Rescue Services, Western Cape. Alexandra Road, Maitland 7405. City of Cape Town, City Administration Department.
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CHAPTER 13.

The Calculation of Private General Practitioners and Physicians' Consultation Costs Incurred by Cardiovascular Patients.

Patients who suspect that they have any cardiovascular complaint first consult their general practitioner, or go to a hospital or a clinic. If the seriousness of a patient's condition warrants it, (s)he is referred to a specialist physician. In this section, the cost to CVD patients of consulting private general practitioners and specialist physicians is determined.

13.1. General Practitioners (GPs).

One method of calculating this component of CVD cost would be to select, by simple random sampling, a large number of GPs and determine what percentage of their contacts result from CVD. If the cost of a GP's consultation fee is known, as well as the number of consultations that they carry out in a certain period of time, then a simple calculation readily yields the desired figure.

Furthermore, the average CVD consultation would be more expensive than the average consultation, so that its cost must be weighted accordingly. In order to establish the procedures that are routinely performed on a patient suspected of having CVD, a number of private practising GPs were consulted (see Table 13.2).

The Medical Association of South Africa in its *Guide to Fees for Medical Services* periodically publishes the recommended costs of each test and medical intervention performed in South Africa.

Two rates were assessed:

The MASA rate, which is recommended by the Medical Association of South Africa, and charged to private patients, and the S/B rate, which is the Representative Association of Medical Schemes' Scale of Benefits in respect of services rendered by medical practitioners. This represents the rates that medical practitioners could claim from medical aid schemes, and is generally lower than the MASA rate.

A comprehensive study of the morbidity profile seen by general practitioners in South Africa was conducted by Bourne, Bloom and Sayed in 1991.¹ Information was obtained from a survey of a representative sample of 8% of the medical practitioners in South

Africa in 1985. Over seven working days, each practitioner recorded the reason for contact, diagnosis, whether a contact was new or a repeat, and demographic details of the patients.

Tables of contact rates for 70 causes of morbidity (ICD abridged list) were presented, as well as a chronicity index for each condition (the ratio of repeat to new contacts for each condition). The relevant data is given in Table 13.1.

Table 13.1. Cardiovascular Disease Categories in the General Spectrum of Total Morbidity in General Practice in South Africa, 1985. 2

CVD subcategory.	All contacts %	Chronicity. %
C34. Hypertensive disease.	5,29	9,05
C35. Ischaemic heart disease.	0,82	3,95
C36. Cerebrovascular disease.	0,23	2,42
C37. Venous thrombosis and embolism.	0,23	1,60
C38. Other diseases of the circulatory system.	1,66	1,23
% CVD contacts of total	8,23	
Total	100,00	
Total no. of contacts in sample.	65·764	

* *Chronicity is the number of subsequent contacts divided by the number of first contacts.*

Bourne's study revealed that:

- (i) Cardiovascular diseases as a category share the highest chronicity along with diabetes mellitus and malignant neoplasms.
- (ii) Cardiovascular diseases are responsible for 8,23% of the total number of GP contacts in South Africa, of which roughly 35.7% (2,94% of the total) are due to causes other than hypertension.

Patients who visit GPs with a cardiovascular complaint incur costs in addition to the simple consultation fee. In order to establish what these were, a number of practising GPs were asked which tests and procedures they would carry out for patients in the five CVD categories above. The following information emerged:

Table 13.2. Routine Tests that GPs Perform on Patients Suspected of Having CVD.

<i>CVD Subcategory.</i>	<i>Tests Performed on Patient.</i>
Hypertension.	ECG and cholesterol test on approx. 50% of patients.
Ischaemic heart disease.	Effort ECG + lipid test.
Cerebrovascular disease.	ECG + lipid test
Venous thrombosis and embolism.	Effort ECG + lipid test
Other diseases of the circulatory system.	ECG + lipid test.

13.1.1. Calculation of Annual CVD GP Consultation Fee Cost:

The annual CVD consultation costs can be calculated by the following formula:

$$\text{Tot. Annual GP consult. cost} = 0.0823 \times 67\,764 \times 235/7 \times 100/8 \times \text{ratio } 91/85 \times \text{GP}_{\text{con}}$$

Each figure in the equation is extracted from Bourne's study, and is explained as follows:

0,0823 is the proportion of total GP contacts due to CVD.

67 764 is the number of contacts that an 8% sample of all GPs in the country had in seven working days (the period of study).

35/7 is the number of working days in a year divided by the number of days over which the Bourne's survey was conducted.

100/8 is the fraction which converts the 8% sample of GPs surveyed by Bourne's study to 100%.

ratio 91/85 is the ratio of doctors registered in South Africa in 1991 to those in 1985, and is required to update Bourne's statistics (valid for 1985) to the base year of study (1991).

GP_{con} is the 1991 price of a GP consultation.

Substituting:

$$\text{Tot. Annual GP consult. cost} = 0.0823 \times 67\,764 \times 235/7 \times 100/8 \times 1.172 \times \text{GP}_{\text{con}} = \text{R}2\,742\,877 \times \text{GP}_{\text{con}}$$

According to MASA rates

$$= \text{R}2\,742\,877 \times 55.20 = \text{R}151\,406\,810$$

According to S/B rates

$$= \text{R}2\,742\,877 \times 24.80 = \text{R}68\,023\,350$$

13.1.2. Annual Cost of Interventions that GPs perform on CVD patients:

This cost equals the number of each intervention carried out multiplied by the unit cost of each.³ The calculations below are numerical elaborations of the annual number of procedures given in Table 13.2.

For hypertension = $0.0529 \times 0.50 \times 67\,764 \times 235/7 \times 100/8 \times \text{ratio } 91/85 \times (\text{cost of ECG} + \text{cost of cholesterol test})$.

MASA rates:

$$= 0.02645 \times 33\,327\,787 \times (41.40 + 42.50) = \text{R}75\,959\,525.$$

S/B rates:

$$= 0.02645 \times 33\,327\,787 \times (18.60 + 19.20) = \text{R}33\,321\,455.$$

For angina and IHD = $0.0082 \times 33\,327\,787 \times (\text{cost of effort ECG} + \text{cost of lipid test})$.

MASA rates:

$$= 0.0082 \times 33\,327\,787 \times (59.80 + 102.20) = \text{R}44\,272\,632$$

S/B rates:

$$= 0.0082 \times 33\,327\,787 \times (26.90 + 46.10) = \text{R}19\,950\,013$$

For cerebrovascular disease (strokes) = $0.0023 \times 33\,327\,787 \times (\text{cost of ECG} + \text{lipid test})$.

MASA rates:

$$0.0023 \times 33\,327\,787 \times (41.40 + 102.20) = \text{R}11\,237\,463$$

S/B rates:

$$0.0023 \times 33\,327\,787 \times (18.60 + 46.10) = \text{R}4\,959\,508$$

For venous thrombosis and embolism = $0.0023 \times 33\,327\,787 \times (\text{cost of effort ECG} + \text{cost of lipid test})$

MASA rates:

$$0.0023 \times 33\,327\,787 \times (59.80 + 102.20) = \text{R}12\,417\,933$$

S/B rates:

$$0.0023 \times 33\,327\,787 \times (26.90 + 46.10) = \text{R}5\,595\,735$$

Other diseases of the circulatory system (e.g. peripheral vascular disease etc.) = $0.0023 \times 33\,327\,787 \times (\text{cost of ECG} + \text{cost of lipid test})$

MASA rates:

$$0.0166 \times 33\,327\,787 \times (41.40 + 102.20) = \text{R}79\,445\,446$$

S/B rates:

$$0.0166 \times 33\,327\,787 \times (18.60 + 46.10) = \text{R}35\,794\,710$$

These costs are added together in Table 13.3. It can be seen that the cost to the S.A. economy (1991) of CVD patients consulting GPs is between R167,645m and R374,750m.

Table 13.3. Total Annual Costs of CVD Tests carried out by GPs.

<i>CVD subcategory</i>	<i>MASA rates</i>	<i>S/B rates</i>
Hypertension	75 959 525	33 321 455
Angina	44 272 632	19 950 013
Cerebrovascular	11 237 463	4 959 508
Venous thrombosis	12 417 933	5 595 735
Other CVD	79 455 446	35 794 710
Total (interventions)	223 342 999	99 621 421

Adding these totals to the cost of GP CVD consultation fees:

Cost of Interventions	223 342 999	99 621 421
Consultation fees	151 406 810	68 023 350
Total costs	374 749 809	167 644 771

13.2. Specialist Physicians' Costs.

This component of CVD cost proved more difficult to calculate than that for GPs. No study similar to Bourne's has been undertaken in South Africa to assess the morbidity profile seen by specialist physicians; this represents a serious lacuna in South African medical statistics. A study of office visits to cardiovascular specialists has been published this year (1993) in the United States, and could serve as a model for a future South African study.⁴

A proxy for this component of CVD cost can however be calculated using the following formula:

Annual CVD cost of specialist physicians = number of private physicians who practice cardiovascular medicine x percentage of time spent on CVD x annual gross income.

This formula has three components, only one of which is known with any degree of accuracy. Each component is discussed in sections 13.2.1 to 13.2.3. below.

13.2.1. The Number of Private Physicians doing CVD work in South Africa.

The following information is available from the annual yearbook of the Dept. of National Health.

Year	Med. Practitioners (Inc. Specialists)	Interns	Specialists	GP's
	A	B	C	(A-C)
1985	20 477	1 169	5 088	15 389
1991	24 614	1 459	6 585	18 029

This data presents three problems. First, it does not take into account the large number of doctors who remain registered with the South African Medical and Dental Council but who have left the country or returned. Secondly, it does not distinguish between doctors employed in state hospitals and those in private practice. Fortunately these figures are fairly well known, and are presented below.⁵

Table 13.4. The No. of Registered Medical Doctors in the RSA.

No. of Registered Doctors in RSA 1993. (including Specialists)	No. Outside RSA	No. No longer active	Doctors in state hospitals	Private doctors
25375	1972	1500	10500	10500
Specialists only				
~6800			~3000	~3800

Thirdly, of the 3 800 private physicians in South Africa, not all are involved in CVD work. Table 13.5 gives a breakdown of the total number of registered medical specialists in the country.⁶

Of this total, specialists in community health, venerology, paediatrics, psychiatry, orthopaedics, obstetrics and gynaecology, and ENT and eye disorders do not specialise in CVD, and can be ignored for the purposes of costing. This accounts for roughly 37.95 percent of all specialists, leaving the other 62.05 percent as specialists involved with CVD work, or roughly 2360.

Table 13.5. Registered Medical Specialists in the RSA According to Speciality, 1988.

<i>Specialisation</i>	<i>Percentage.</i>
Community Health	1.34
Surgery	15.78
Venerology	0.05
Paediatrics	7.50
Psychiatry	4.87
Obstetrics and Gynae.	9.99
ENT and Eye	7.55
Anaesthetics	12.00
Radiology	9.58
Orthopaedics	6.65
Pathology	7.66
Medicine	17.12

13.2.2. The Proportion of Professional Time that Physicians Spend on CVD Work.

This was yet another figure which proved difficult to establish. A cardiologist spends 100% of his time on cardiovascular work, but as for the other categories, only guesstimates were available. Conversations with general physicians revealed that between 40 and 60% of their time was spent on CVD complaints. Anaesthetists might spend 30% of their time on CVD work. The best that could be done under the circumstances was to assume a figure of 40-60%.

13.2.3. The Gross Income of Physicians.

Income data is notoriously difficult to gather. There is a widespread reluctance on the part of medical professionals to divulge income data. Professional bodies also exhibit an ignorance of the average earnings of their members. A few specialists brave enough to venture figures requested anonymity and confined themselves to strict off-the-record statements.

One point, however, was clear: cardiology emerges as a high income profession. A cardiologist in the employ of the state ventured some figures based on salaries he was offered by private practices. He suggested that the pre-tax earnings of an average cardiologist with an established practice is R1,5m per year. This was subsequently denied by practising private cardiologists who suggested a figure half that size.

General physicians by contrast were earning a pre-tax R200-000 and R400-000 after expenses (i.e. net). Given these figures, a conservative gross estimate of the earnings of specialist physicians can be put at R500-000.

13.4.2. *Calculating the Cost of Physicians' CVD Work:*

Annual CVD cost of specialist physicians = number of private physicians practising CVD x percentage of time spent on CVD x annual gross income.

Assuming that physicians gross R500 000 per year (including salaries of their staff and expenses on equipment), the calculations are as follows: [These figures are subject to revision.]

$2360 \times 0,40(\text{to } 0.60) \times R 500 000.$

$2375 \times 0.4 \times 500 000 = R 475 000 000.$ (Lower bound)

$2375 \times 0.6 \times 500 000 = R 712 500 000$ (Upper bound)

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CHAPTER 14.

14.1. The Calculation of the Annual Expenditure by State Hospitals on Cardiovascular Disease.

Unlike the private sector (see Chapter 15), records of bills sent to CVD patients by state hospitals are not readily available and their retrieval would prove too cumbersome to be undertaken. But in essence, this component of total CVD costs can be calculated if the following data are known.

- (i) The annual budget allocated to state hospitals in South Africa.
- (ii) The percentage of CVD patients admitted to state hospitals, and
- (iii) The average cost of treating a CVD patient in a state hospital. [This is needed to determine the factor by which the cost of hospital care of a CVD patient exceeds that of the average patient.]

Information on (i) and (ii) above was available, but no data could be found for (iii). Serious consideration went into devising ways by which a proxy for this figure could be advanced. Four different methods were eventually tabled, and are briefly described in Sections 14.2.1 to 14.2.3 below. The first three were rejected, but the fourth was accepted and executed.

14.2. Possible Methods by which the Average Cost of a CVD Patient's Stay in a State Hospital can be Calculated.

14.2.1. The Use of North American Data.

Canadian and US researchers have conducted studies of the economic impact of CVD in their countries, and the factor by which a CVD patient's hospital costs exceed that of the average patient was calculated. It was thought that this figure could serve as a good proxy for South African data.

This option was rejected by medical and economics personnel alike for two major reasons: First, South Africa is largely a third world country, and the profile of disease for the general population differs markedly from that of the North American population. Secondly, the relative (and absolute) prices of CVD treatments and interventions differ greatly between South Africa and these two economies.¹

14.2.2. Costing all Interventions Performed on CVD Patients.

This method entailed the costing of all interventions incurred as a result of CVD. If it were possible to determine what percentage of blood tests, operations, x-rays, etc. performed in the hospital were due to CVD, then, since the cost of each intervention can be accurately known, it would be easy to determine the total CVD costs to the hospital.

While accurate, this method would be too laborious and difficult to implement. For example, x-rays are performed on patients for many reasons, and the primary illness of the patient is not always recorded on file. Moreover, records are not always systematically kept by the staff.

14.2.3. Average Mean Hospital Stay of CVD Patients.

In this rather crude option, the mean stay of CVD patients at a large state hospital like Groote Schuur would be used.

Since

- (i) the number of CVD patients,
- (ii) the daily cost of keeping at patient at GSH, and
- (iii) the cost of running the hospital

are all known, it is possible to calculate the cost incurred by this class of disease.

Unfortunately, it is not possible to know how much each patient in each CVD category was billed. This would aid the future costing of any category of disease enormously, let alone CVD. There are also problems in the determination of outpatients' costs.

A further problem with this method is that the average CVD patient requires much more expensive treatment than the average non-CVD patient. As a class, CVD is an expensive category of illnesses to treat. The magnitude of these relative costs can be seen in Table 14.1, which was obtained from US data.

Although CVD patients in the US spend $10,5/7,8 = 1,346$ times as long as the average patient in hospital, they incur $1950/496 = 3,93$ times the per capita cost, a large discrepancy indeed. It was especially this information which rendered the method ineffective.

Table 14.1. US Data on CVD Resource Utilisation Compared with all Other Illnesses (1980).

Category	All	Hypert.	Other CVD
Mean ambulatory visits.	5.7	7.9	12
Hospital utilisation, >17years			
Hosp. admissions / 1000.	194.0	188.8	630
Hospital days.	1517.4	1133	6400
Average length of stay, days	7.8	6.0	10.5
Surgical procedures/1000	136.5	141.5	340
Total per capita charges, \$			
All services	837	819	2650
Hospital admissions	496	376	1950
Prescribed medications	44	96	180
Ambulatory visits	195	257	415
Other health services	103	90	110

14.2.4. The Stratified Sample Technique:

This method involves close monitoring of all the procedures performed on a random sample of cardiovascular patients at a large hospital from admission to discharge. Since cardiovascular disease is not seasonally dependent, the time of year when such a project is conducted is not relevant. A team of researchers would record the details of each patient selected.

After the patient's discharge, each intervention performed would be costed and a global cost per case computed. This figure would be compared to the cost per patient for a random sample of patients suffering from all diseases, thus enabling relative costs to be determined.

Such a project was in progress at the time that this thesis was being edited (August 1993). Three medical students were collecting data under the supervision of the author and Dr. Dinky Levitt of the Epidemiology Department at Groote Schuur Hospital (GSH).

The project involves two steps:

Step 1.

- (i) The assessment, over a period of two weeks, of the number of patients admitted to GSH with a cardiovascular complaint (ICD categories 390-450). [This information should also be available on the computer network of the GSH Informatics Department.]
- (ii) The assessment, for each point of entry, (i.e. casualty and admissions), of the relative frequency of each of three categories of CVD, viz. stroke, ischaemic heart disease and vascular disease. These are the expensive CVD categories to treat.

Step 2.

- (i) With the relative frequency of each type of CVD known, an accurate costing of the treatment of 15-20 patients in the major disease category of IHD, cerebrovascular and arterial disease could be carried out. The costing of a random sample consisting of all disease categories would serve as the control.
- (ii) The costing had to be conducted according to set procedures that avoided the pitfalls of double-counting and other difficulties. This information would be computed, and costs determined. A final figure would be then be derived.

At the time of this thesis's going to press, Step 1 had been completed and Step 2 was underway. The project took much longer than had been anticipated. Administrative and bureaucratic barriers took long to clear, and the full cooperation of hospital staff at various levels was only obtained after much explanation. Moreover, medical students who were prepared to participate in the project were only available at certain times of the year. The results will be published as soon as they become available.

The relatively higher cost of treating a CVD patient is thus not yet known. However, a one-to-one ratio is not a fair reflection and would hopelessly bias the costs of CVD patients downwards. All indications are that the cost of hospital treatment of hypertensive patients does not differ much from the cost of treating the average patient. The cost of non-hypertensive CVD patients could be weighted by their relatively longer hospital stay, *and for the time being, by a further arbitrary but conservative factor of 1.5 to account for the higher cost of this class of diseases (see Table 14.1.).*

14.3. Data Relevant to the Calculation of State Hospital Direct Costs.

14.3.1. Total State Hospitals' Budget, 1991.

The annual budgets of all state hospitals and hospitals funded by the state is published by the Hospital and Nurses Yearbook of Southern Africa. The latest yearbook available was published in 1992, and lists information of hospitals by province. Budgets were as follows:

Table 14.2. Budgets Allocated to State Hospitals, South Africa 1991/1992.

Province:	Net Expenditure(R)	Units(patient days). (EDAC)
Cape Province	1 778 518 855*	6 504 470
Cape Province- Aided Hospitals	50 397 641*	633 969
Natal	718 546 134	3 152 760
O.F.S.	374 712 942	1 657 655
Transvaal	2 018 666 418*	9 267 304
S.A. Development Trust Hospitals	42 582 083	377 214
House of Assembly Hospitals	54 272 000	196 150
Totals:	5 037 696 000	21 789 522

* Figures adjoining an asterisk were not available for 1991/2 by the time the 1992 edition of the SA Hospitals and Nurses Yearbook went to press. They represent 1990/1 figures inflated by the ratio that the 1991/2 health budget exceeded that of 1990/1, viz. 1,164.²

Thus, the state spent approximately R5,037 billion on 21 million patient days in 1991.

A brief note on the outpatient/inpatient cost mix is appropriate here: The index currently used to compare the cost between hospitals is the estimated daily average cost per unit (EDAC). This cost standardisation is calculated by dividing the net expenditure of a hospital for one year by the sum of the total number of inpatients and a third of all outpatient visits. That is, an outpatient is accorded one-third of the weight of an inpatient in terms of costs incurred at hospitals. Lombard *et al.* have called this ratio into question, and suggest that a more realistic ratio for the Cape Province would be 0.43.³ Their figure

has however not yet been systematised, and was therefore not taken into account in this study.

14.3.2. The Proportion that CVD Inpatients Comprise of the Total Number of Inpatients Discharged from State Hospitals.

Information on the admissions of patients to SA hospitals is published in the *Census of Hospitals and Clinics*, a publication of the Central Statistical Services.⁴ The last such survey was conducted in 1987. In May and June of that year, 30 949 out of 496 449 discharges from state funded hospitals were due to CVD (6,32%).⁵

Groote Schuur Hospital's 1425 beds (1991) comprise over 1% of the total number of state hospital beds in South Africa. This hospital treats a slightly larger percentage of CVD inpatients than the average state hospital; 8,45% of inpatients treated at GSH (1991 data) were CVD patients, whereas the corresponding figure for all state hospitals was 6,32% (1987 data).⁶ Note that data are for two different years. The discrepancy in the figures is not large enough to attribute a bias to the patient profile at GSH. The CVD figures of GSH can thus be considered as being fairly representative of state funded hospitals in general.

14.3.3. The Proportion that CVD Outpatients Comprise of the Total Number of Outpatients Attendances at State Hospitals.

This statistic has not been collected on a national scale. Figures for two institutions were however available. In an analysis of outpatients for the period 30/06/1991 to 01/07/1992, the Informatics Department at GSH noted that 1,2% of all outpatients treated at GSH had cardiovascular complaints, 46,30% of which were hypertensives.⁷ This proportion is much lower than the 8,45% of inpatients treated for CVD.

The reason for the relatively lower percentage of CVD outpatients attending GSH is that patients who require management of chronic illnesses are often referred to primary and secondary health institutions. GSH is a tertiary hospital which performs secondary and primary care; it is much more cost-effective to treat patients who require primary care at primary care centres.

This shift of patients is plain to see when figures for GSH are compared with those of a primary care clinic in the Western Cape. In a study conducted by SASPREN between August and December 1991, the patient profile seen by 38 doctors in the Western Cape, including two at the SACLA clinic, was assessed by questionnaire. [SACLA provides health care to an indigent, mostly black population, in Cape Town.] Uncomplicated

hypertension was the most common cause of contact, and accounted for 7.8% of all diagnoses treated by doctors at the clinic.⁸

If the percentage of total outpatients attending state hospitals with CVD was known, it would permit the further refinement of state hospital costs, allowing costs to be proportionately allocated between the two types of patients. In the absence of these figures, it was decided to allocate the CVD costs of all state hospitals on the basis of inpatient data.

14.3.4. The Relative Prevalence of the Different Categories of Cardiovascular Diseases.

*Table 14.3. Classification of Patients Discharged from Groote Schuur Hospital, 30/06/1991 - 01/07/1992.*⁹

Inpatients:

	Number	Mean Stay*	St. Dev.**
Diseases of the Circulatory System (ICD 390 - 450)	5 194	7,500	0.116
Hypertension (ICD 401-405)	530	6,408	0.206
Non-hypertensive CVD	4 664	-	-
Other Diagnoses	38 161	6,652	0.041
Total	43 885	6.750	0.039

Outpatients:

	Number
Diseases of the Circulatory System (ICD 390 - 450)	5 881
Hypertension (ICD 401-405)	2 724
Non-hypertensive CVD	3 157
Other Diagnoses	465 070
Total	470 951

* *The Mean Stay is the mean duration of stay of patients in hospital (days).*

** *Standard deviation (68% confidence interval).*

Cardiovascular diseases comprise a number of conditions differing in prevalence, not all of which require the same intensity of treatment (see Tables 13.1 and 14.1). For the purposes of cost accounting, the distinction to be made is between hypertensive patients, who are as expensive to treat as the average inpatient, and patients with other classes of CVD, which are more expensive to treat. Table 14.3 gives a classification of inpatients discharged from GSH.

Table 14.3 shows that 10,2% of all CVD inpatients are hypertensive patients; the other 89,8% are non-hypertensive CVD patients.

14.4. The Calculation of CVD Costs Incurred in State Funded Hospitals.

The costs of CVD attributable to state hospitals can be calculated by the following formula:

$\text{CVD Costs} = \text{State Hospitals' budget} \times \% \text{CVD patients} \times (\text{weighting factor})$

where (weighting factor) = prevalence \times relative costs of hypertensives and non-hypertensives respectively.

Hypertensives:

= R5 037 696 000 \times 6,32% \times 10,2% \times 1,0 = R32 475 003.

Non-hypertensives:

= R5 037 696 000 \times 6,32% \times 89,8% \times 1,5 = R428 861 080.

The total CVD state hospitals costs thus amount to approximately R461,3 million.

Caveats.

This figure was obtained by assuming that the percentage of outpatients with CVD conditions admitted to state hospitals is the same as that for inpatients.

Furthermore, the figure was computed under the (conservative and temporary) assumption that non-hypertensive CVD patients cost 1,5 times as much to treat as the average patient.

However, the methodology according to which the costing was performed allows for the facile revision of figures once more accurate information becomes available.

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The national health budget for 1990/1 was R7,024 billion. Source: *Statistical Economic Review in Connection with the Budget Speech [W.P.B. - '90]*. p. 41.
3. Lombard, C.J., Stegman, J.C. and Barnard, A. "Modelling Net Expenditure of Hospitals in the Cape Province". *SAMJ*, Vol. 80. 16 November 1991. pp. 508 - 510.
4. Central Statistical Services. "Census of Hospitals and Clinics, 1987". Report No. 93-01-01 (1987).
5. Central Statistical Services. *op.cit.* Table 16.1 p. 120.
6. Information from the Informatics Dept. of Groote Schuur hospital. In a sample consisting of 76% of all patients treated from 30/06/1991 to 01/07/1992, 5 194 out of 43 885 inpatients at the hospital were treated for a cardiovascular condition.
7. Informatics Department, Groote Schuur Hospital. Between 30/06/1991 and 01/07/1992, 5 881 out of 470 951 outpatients at the hospital were treated for a CV condition, of which 2724 were hypertensives.
8. *Unpublished data, SASPREN survey, 1991.*
9. Informatics Department, Groote Schuur Hospital. Programmer: Robin Hawkings. Note: 24% of the medical summaries were outstanding for the period.

CHAPTER 15.

The Calculation of the Annual Expenditure of Patients in Private Hospitals on Cardiovascular Diseases.

It is to be expected that cardiovascular treatment accounts for a larger proportion of costs in private hospitals than that of state hospitals in South Africa. This is because cardiovascular disease is partly a disease of lifestyle and affects the rich more than it does the poor. More importantly, hospital care utilisation patterns are different at higher income levels for CVD patients. Table 15.1 shows that the average number of hospital visits in the US, both in total and condition specific, was greater for families whose incomes were over \$35 000 (1980) than for those below. This suggests that utilisation levels are higher at higher income levels. Persons with higher incomes, if they have CVD, are likely to purchase significantly more medical care than are others with the same illness.

In South Africa, health care at private hospitals is expensive, with only the wealthy being able to afford the often exorbitant cost. It would not be accurate therefore to assume that the cost structure at private hospitals is similar to that of state hospitals, which care for the less affluent. This necessitated an investigation to ascertain what percentage of total costs expenditures on CVD comprise at typical private hospitals.

15.1. The Private Hospital Sector in South Africa.

Zwarenstein and Price use nature of ownership as the criterion that classifies a hospital as private.¹ Subsequent authors have abided by this classification. Note that private ownership does not necessarily coincide with source of financing, i.e. whether private or public.

The private hospital sector can be divided into two groups; viz. private hospitals caring for private patients, and private hospitals caring for non-private patients. The former group comprises fee-for-service hospitals, charity/welfare hospitals and industrial hospitals. These are all privately owned and privately financed. The latter comprise the South African National Tuberculosis Association (SANTA) hospitals, province-aided hospitals and contractor hospitals. This group is privately owned but all or most of their recurrent costs are borne by the state. Descriptions of each type of hospital can be found in a publication by Broomberg *et al* (1992).²

Table 15.1 Mean Total and Condition-related Ambulatory Visits for Persons 17 Years of Age and over with Cardiovascular Conditions, by Condition and Family Income: United States, 1980. ³

Condition and Family Income	Total	Condition related	Percent Condition related.
All Persons			
All incomes	5.7	---	---
Mean Visits.			
Less than \$10 000	6.9	---	---
\$10 000 to \$19 999	5.6	---	---
\$20 000 to \$34 999	5.2	---	---
\$35 000 or more	5.2	---	---
Persons with Cardiovascular Conditions			
Hypertension alone	7.9	2.4	30.4
Less than \$10 000	8.2	2.8	34.1
\$10 000 to \$19 999	7.2	2.3	31.9
\$20 000 to \$34 999	8.6	2.5	29.1
\$35 000 or more	7.4	2.1	28.4
Cardiovascular Disease:			
With Hypertension.	11.6	6.3	54.3
Less than \$10 000	10.9	6.1	56.0
\$10 000 to \$19 999	10.6	5.1	48.1
\$20 000 to \$34 999	11.0	5.2	47.3
\$35 000 or more	16.9	11.2	66.3
Alone	12.1	4.5	37.2
Less than \$10 000	11.4	3.4	29.8
\$10 000 to \$19 999	11.6	3.9	33.6
\$20 000 to \$34 999	10.2	5.0	49.0
\$35 000 or more	18.4	8.0	43.5
With Complicating Conditions.	13.9	8.9	64.0
Less than \$10 000	15.0	9.8	65.3
\$10 000 to \$19 999	13.1	8.0	61.2
\$20 000 to \$34 999	13.3	7.9	59.4
\$35 000 or more	13.9	9.4	67.6

Table 15.2. Distribution of Hospital Beds in the Private and Public Sectors, 1989.⁴

Type of Hospital.	Number	Percentage.
Public Sector.	111 920	70,3
Private Sector.	46 253	29,0
Accessible to private patients only		
Charity	916	0,6
Private		
fee-for-service	11 117	7,0
Industrial	9 585	6,0
Accessible to all patients		
Contractors	14 517	9,1
Province-aided	4 783	3,0
SANTA (TB)	5 335	3,4
Military	1 072	0,7
	<hr/>	<hr/>
	159 245	100
	<hr/>	<hr/>

15.2. The Calculation of CVD Costs for the Privately Owned, Privately Funded Hospitals.

15.2.1: Religious and Charity Hospitals.

Charity hospitals constitute a small (and shrinking) percentage of privately owned hospitals in South Africa. They are run by religious or independent charitable organisations. Some provide rehabilitation services for patients with drug and alcohol related problems, a few of the other provide a wider range of services.

Cardiovascular treatment offered by these hospitals is minimal and can be practically disregarded.⁵ Hypertension is practically the only cardiovascular condition treated at these institutions.⁶

15.2.2. Fee-for-Service Hospitals.

Most of the cardiovascular treatment carried out in the private sector is performed by this group of hospitals. The methodology of choice would be to select a hospital that is an unbiased representative of the fee-for-service sector in terms of CVD treatment, to

calculate what percentage of work done there is cardiovascular, and to multiply this figure by the factor that the private sector budget exceeds that of the chosen hospital's budget.

The search for a suitable private hospital in which to conduct research proved problematical. The hospital had to be unbiased in the sense that the proportion of cardiovascular patients treated there approximated that of the sector as a whole. Because of their relatively small size, it was difficult to ascribe representativeness to any one in particular. Furthermore, all private hospitals tend to concentrate to some extent on a particular field of medicine. For instance, City Park hospital, a private hospital in the centre of Cape Town and eminently well located for researchers at the local university, was deemed unsuitable because of the high concentration of cardiovascular medicine practiced there. On the other hand, Constantiaberg Clinic, another conveniently situated private hospital, hardly performs any cardiovascular work at all. Investigating more than one private hospital was not possible.

The fee-for-service hospital sector has an oligopolistic market structure, with 8 200 of the 15 200 beds (1993 data) being controlled by five private companies, viz. Clinic Holdings, Afrox, Medi-Clinic, Medicor and Lifecare. The 666 beds at day clinics are also counted in this group. Since these companies provide a practically identical range of services, the percentage of cardiovascular work performed by any one company was bound to approximate that of the sector as a whole; bias could thus be removed by working at this more highly aggregated level.

The cooperation of elements in the private medical sector is usually obtained at great effort after layers of suspicion have been eroded. Prolonged enquiries and persistent entreaties were required before someone prepared to divulge information about this sector was found. The financial director of Medi-Clinic Corporation Ltd. pledged his cooperation. This company has eight hospitals and 1 600 beds under its aegis, constituting 10,5 % of the beds in the fee-for-service sector.

Medi-Clinic holdings has computerised the accounts it sends to patients. Records of patients are kept by primary diagnosis category and surgical intervention performed. Total expenses for each hospital stay are subdivided into five categories, viz. bed, theatre and pharmaceutical costs, as well as equipment charges and charges for specific interventions such as angiograms, etc. This is standard practice in the sector. NOTE: The costs of physicians are not included in these accounts so that the error of double counting is avoided (see Chapter 13). However, pharmaceutical costs are included and must be subtracted to avoid double counting (see Chapter 16).

The availability of a computerised data-base with records differentiated to this degree readily allows the computation of costs incurred by cardiovascular patients. An inspection

of records over a few months revealed that between 10 and 15% of the total income of Medi-clinic Corporation was generated by CVD categories. Other professionals in the fee-for-service sector confirmed the reasonableness of this estimate. The pharmaceutical component of the fee-for-service turnover is estimated at approximately 40%.

Benefits paid by Schemes for the year ending 31 December 1991 were as follows:
[Source: Registrar for Medical Schemes].

Total benefits paid:	R 6 892 208 377
Paid to Private Hospitals	R 1 194 627 460 (17,3%)

Approximately 15% of patients treated at fee-for-service hospitals are not covered by medical-aid. Income for this sector in 1991 thus amounted to *ca.* R1 405 million.

This figure can be roughly double-checked as follows:

Fee-for-service beds	15 200
Available bed days per annum	5 548 000
Estimated industry occupancy 60% (seven days per week basis)	
Occupied bed days	3 328 800
Income per bed per day estimate (R) (deflating 1993 costs by 20% p.a.)	416
Fee-for-service estimated income	R 1 385 million

If an estimated 10 to 15% of this income is attributable to CVD, the costs of this class of diseases in the fee-for-service hospital sector in 1991 amounted to between R140,5 and R210,8 million.

At 40% of this cost, the pharmacy component can be put at between R56,2 and R84,3 million, leaving the rest of the private fee-for-service CVD costs at between R84,3 and R126,5 million.

15.2.3. Industrial Hospitals.

Industrial hospitals are run by large corporations for the exclusive use of their employees. There were 9 585 beds in 87 such hospitals in 1989. The expensive categories of cardiovascular medicine are not practised by industrial hospitals, for these hospitals do not have a large enough demand to warrant the maintenance of sophisticated technical equipment or surgical teams. Almost all cardiovascular surgery and interventions such as angioplasty are contracted out to fee-for-service hospitals.⁷

Most of the medicine practiced at these hospitals is of an orthopaedic variety, but treatment of cerebrovascular patients and other cardiovascular conditions is routinely performed. With a health budget of R1,2 billion in 1993, a not insignificant portion of health care expenditure occurs in these hospitals. However, statistics that allow for the easy differentiation of patients into ICD categories are not available. Furthermore, hospitals in this sector have different administrative modes; to collect figures from these disparate sources is a large undertaking requiring extensive co-ordination.⁸

The CVD costs incurred by this sector could thus not be included in this study. This must be borne in mind when the total costs of CVD are assessed in Chapter 21.

15.3. The Calculation of CVD Costs for Privately Owned, Publicly Funded Hospitals.

15.3.1. Contractor Hospitals.

Contractor hospitals are privately owned, but contract with the state for the care of certain categories of patients, e.g. long-term psychiatric and tuberculosis patients. Payment is on the basis of a fixed fee per day.⁹ In 1989, 23 hospitals of this type provided 14 517 beds, the vast majority being operated by one corporation, Lifecare.

Contractor hospitals have recently begun to provide acute medical and surgical care. Lifecare Corporation manages 800 beds in private clinics but these have been included in the fee-for-service sector. Discussions with the management of Lifecare revealed that most of their hospitals are situated in rural areas. Some hospitals under their control were started by mission centres in the past. Most of these hospitals specialise in the treatment and care of patients with chronic illnesses. Tuberculosis, psychiatric, and geriatric patients form the bulk of those treated. A few hospitals are community hospitals. No surgery or acute interventions are performed and little if any cardiovascular work is done by these institutions, except perhaps the treatment of hypertension in the community hospitals.

The economic impact of CVD in this sector is therefore minimal and can be disregarded.

15.3.2. SANTA hospitals.

SANTA hospitals provide care for tuberculosis patients only. No CVD costs are thus attributable to these institutions.

15.3.3. Province-aided hospitals.

These hospitals are privately owned and found predominantly in the Cape Province, receiving subsidies of varying amounts from the provincial authorities. There were 75 such hospitals with 4783 beds in 1989.¹⁰ Since most of the recurrent costs at these institutions are ultimately borne by the state, the CVD costs incurred by them are included under public hospital costs in this study (see Table 14.2).

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 3. "Health Care Utilization and Costs of Adult Cardiovascular Conditions, United States, 1980." Series C, Analytical Report No. 7. Public Health Service, Centers for Disease Control, US National Center for Health Statistics, November 1989, p. 20.
 4. Adapted from Broomberg et al. *ibid.* p. 330.
 5. In May and June 1987, 1 520 out of a total of 29 897 (5,10%) patients seen at these institutions were treated for cardiovascular conditions (i.e. mainly hypertension). Source: Central Statistical Services, Report No. 93-01-01 (1987). "Census of Hospitals, Clinics and Other Health Services Establishments, 1987." Table 16, p. 124.
- A figure for CVD can thus be allocated to this sector if the total budget of charity hospitals is known.
6. Personal communication, Wiggan, J. Hospital Manager, Little Company of Mary Hospital, Groenkloof. This charity hospital has 127 beds, or 13,86% of all beds run by charity hospitals. The practice of intensive cardiovascular treatment is usually beyond the means of charity hospitals because of the large capital outlays required. The treatment of hypertension is just about the only cardiovascular intervention performed by these hospitals.
 7. Personal communication, Mr. Craig Tingle, financial director, Medi-Clinic Corporation Ltd.

8. Information about the industrial sector hospital supplied by personal communication; Dr. B. Fourie, Medical Director, Chamber of Mines.

9. Broomberg et al. *op.cit.* p. 331.

10. Broomberg et al. *op.cit.* p. 331.

CHAPTER 16.

Expenditures on Cardiovascular Drugs, South Africa 1991.

16.1. A Brief Overview of the South African Pharmaceutical Market.

The pharmaceutical manufacturing industry in South Africa can be divided into 120 local subsidiaries of international firms and 137 South African companies.¹ This makes the field very competitive, and it is consequently difficult to obtain information from the industry as companies regard any enquiry into their databases with suspicion and mistrust.

The estimated total size of the pharmaceutical market for 1993 at wholesale level is R5 849 million.² Roughly half of this sum is spent on drugs, the remainder being spent on products such as beauty creams, lotions and non-prescription medicines. About 70% of the rand value of drugs is bought by the private market, whereas the other 30% is bought by the public sector despite the fact that the public sector purchases bigger volumes; this situation arises because of the state tender system.³ Cardiovascular drugs are among the most costly on the market.

Various agencies were approached for information on expenditure on cardiovascular drugs. The government office controlling state drug spending could only provide projected expenditure over the coming year, but not details of historic expenditures(!). Our information from the private hospital sector (see chapter 15) revealed that between R56,2m and R84,3m was spent on cardiovascular drugs in this sector alone in 1991.

16.2. Information from Private Market Research.

A private market research company was able to supply us with the requisite information. Decision Surveys International (DSI), a firm specialising in pharmaceutical market research, assessed the 1992 rand sales at the manufacturing selling level at R328m.⁴ Table 16.1 gives a summary of the Cardiovascular Drug Market at the manufacturer selling level in South Africa in 1992. The private market accounts for the greater portion of the rand value of sales.

Table 16.1. Rand Sales of Cardiovascular Drugs at the Manufacturing Selling Level, 1992.

Private Market:	R284 million
- Over the Counter	R 20 million
- Prescription	R264 million.
Provincial Hospital Market.	R 44 million *
Total	R328 million

** The Provincial Hospital Market includes sales to provincial hospitals via Comed. Direct Sales in the Cape and Transvaal are excluded. This rand value for the provincial hospital market represents the sales for the 12 months ending March 1992.*

16.2.1. Private Market Coverage.

The statistical survey by DSI covered 95% of the retail pharmacy market, 80% of the dispensing doctors, and 55% of the private clinics. Their weighted coverage of the total private market is estimated at about 85%. Data was obtained from wholesalers supplying pharmacies and other outlets.

The price structure of medicines in South Africa entails a 21.2% mark-up from wholesalers to pharmacies, who in turn increase prices by 50%. The private sales (1992) of cardiovascular drugs can now be calculated:

$$100/85 \text{ (sample coverage)} \times 181,2/100 \text{ (overall markup)} \times R264m = R562.8m.$$

In order to get the corresponding figure for 1991, the above figure can be deflated by the consumer price index for medical care and health expenses [Central Statistical Service]. Where 100 is the arbitrary index set for 1990, the figure for 1991 was 122,9 and that for 1992 was 147,1. Therefore total CV drug expenditure in 1991 =

$$R562.8 \text{ million} \times 122,9/147,1 = R470.2\text{million.}$$

16.2.2. Provincial Hospital (State) Market Coverage.

Decision Surveys International obtained this data from Comed, the central authority responsible for distributing products to provincial hospitals (indirect sales). This sector represents about 10% of the total pharmaceutical market for cardiovascular drugs. A minor proportion of the drugs used by provincial hospitals are not purchased through Comed but are sold directly by the manufacturer to the hospitals. The figure of R44 million (1991) does not account for direct sales in the Transvaal and the Cape Province. According to a spokesperson for Decision Surveys International, they had persisted for over a year in trying to obtain these figures, but without success.

However, the inaccuracy of the above figure is not particularly bothersome because the budgets of state hospitals given in Chapter 14 includes expenditures on drugs. This portion of drug costs has thus already been accounted for, and to include it here as a separate entry would amount to double counting.

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CHAPTER 17.

MINOR COSTS: Research, Hospital Buildings, Re-employment and Disability Pensions:

17.1. The Annual Research Costs into Cardiovascular Diseases in South Africa.

The Medical Research Council and related bodies allocated R2,9m to scientists to conduct research into cardiovascular disease in South Africa in 1992.¹ An enquiry by the Medical Research Council into the funding of practically all scientists doing CVD research, revealed that they received as much money from industry and private sources as they did from the MRC.

This means that about six million rand was spent on Cardiovascular research in 1992. This is a rough estimate and the figure is small. It can therefore be taken to be valid for 1991 without modification.

17.2. The Annual Budget Allocated to the Building and Maintenance of Hospitals and Clinics in South Africa.

17.2.1. Costs to the State.

The amounts of money allocated to the maintenance and building of hospitals used to be reported separately in the budgets of each of the three houses of the apartheid tri-cameral parliament.

The reports issued by the Works section of each Department of Local Government, Housing and Works revealed the following data for 1991:

House of Assembly (White): ²	R9,335m
+ departmental hospitals:	R6,364m
House of Representatives: ³	R5,000m
House of Delegates : ⁴	R5,234m
Total.	<hr style="border: 0; border-top: 1px solid black; margin-bottom: 5px;"/> R25,933m <hr style="border: 0; border-top: 1px solid black; margin-top: 5px;"/>

The percentage of this cost that can be allocated to CVD roughly coincides with the percentage of the total number of patients reporting to state hospitals with the conditions. The latest Census of Hospitals, Clinics and Health Service Establishments reports that in

May and June 1987 32 469 patients out of a total of 526 346 state patients were discharged from hospitals with CV complaints, or 6,17%.⁵

Therefore, $0,0617 \times R25,933m$ or R1,6m can be ascribed to CVD for state hospital building costs.

17.2.2. Costs to the Private Sector.

The cost of buildings to the private sector must be financed out of the fees charged to their patients. To include the costs for buildings of private hospitals would constitute double counting.

17.3. Pensions and Disability Payments made out to CVD Sufferers in South Africa.

The annual payments made to CVD sufferers constitutes a burden to the fiscus and health insurance premium holders. However, well differentiated statistics are required before these payments can be included as a separate cost category. Only early pensions, i.e. payments made from the time of disability till retirement, need be taken into account. Official publications do not list government disability payouts by cause of disability, and the Department of Pensions and Welfare could not provide adequate responses to enquiries.

Those making provision for disability generally take out policies that cover *any* future contingency. *Ex ante*, CVD undoubtedly increases the risk of disability, and this higher risk is reflected in the higher premiums charged by insurance companies. In principle it is possible to allocate a proportion of total policies paid out to CVD *ex post*. It could however be argued that a premium exacted for an exclusive CVD policy would differ significantly from a policy where it is aggregated with other risks. This renders inaccurate the simple *ex post* apportioning of a fraction of total disability pay-outs to CVD.

In summary: apart from the loss of productivity to the economy, the burden of morbidity manifests itself as a higher rate of taxation and as higher insurance premiums. South African statistics are not readily available in this area.

The relative size of this cost can be surmised by studying Canadian data. Canadian data lists the pension payments made to CVD patients in 1986 as 247 310 000 Canadian dollars. This constitutes 26.1% of the total value of pension payouts, making this group the second largest recipients of this source of funds (after musculoskeletal diseases). Canadian CVD pension payouts amounted to 14% of the size of Canadian morbidity costs.

Workers' compensation expenditure on cardiovascular diseases is not significant in Canada. This category of expenditure is swamped by payments for injuries, which constitute 96.5% of the total expenditures for this category of cost.

17.4. Re-employment Costs.

Re-employment costs include all the costs involved in replacing a worker who leaves the work force because of disease. Advertising and searching costs are incurred, there is a break of continuity in production and the new worker takes time to acquire the skills and proficiency of the previous worker.

Interviews were conducted with a few managers in industry to ascertain the severity of these costs. Vague answers were given which did not permit the ready allocation of figures for various classes of workers. It soon became apparent that an elaborate study would be required to determine these costs.

What emerged from these interviews was common knowledge. Essentially, replacement and retraining costs increase as the business cycle improves. It costs more to entice a worker away from existing jobs during booms, whereas workers are easily replaced during recessions. In addition, as the level of mechanisation in the economy increases, so do retraining costs. A more capital intensive economy requires more expert retraining than one which is labour intensive.

It is tempting to allocate an arbitrary figure to each worker in the economy who leaves the work force because of CVD. But in the interest of accuracy the issue is best left unresolved until proper studies have been carried out.

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CHAPTER 18.

The Calculation of the Total Costs of Administering Long-term Therapy to CVD patients.

Patients who suffer from serious CVD conditions require long-term treatment, and require the services of a wide range of paramedical personnel. In this chapter, a framework in which the annual costs of long-term therapy of CVD patients can be calculated is presented. Severe deficiencies in the data prevented the addition of these costs to total cardiovascular costs; this should be borne in mind when the final figures are assessed. These costs warrant an exclusive study, but the data collected below could form a useful foundation on which future work could be based.

18.1. Methodology of Costing Long Term CVD Therapy.

Social workers, physiotherapists, occupational therapists, speech therapists and dieticians were identified as the paramedical professionals most likely to be involved in long-term CVD therapy. Clinical psychologists were also considered, but were disregarded owing to the difficulty of multiple diagnosis. [Repeat visits to doctors and physicians have been accounted for in Chapter 13.]

To determine the costs of CVD treatment carried out by the five professions above, the morbidity profiles of patients attended to by each would need to be available. Unfortunately, consultations with professionals in the field and office bearers of national bodies revealed that no such studies had been performed in South Africa.

Attempts at determining the number of paramedics employed by the state and private sectors respectively did not meet with success. The South African Medical and Dental Council has likewise not managed to obtain these figures despite persistent inquiry over the past two years.¹ The unavailability of this statistic put paid to the accurate calculation of a rehabilitation cost, the reasons being:

First, the mix of patients seen by paramedics at state hospitals differs markedly from that in the private sector. Many private physiotherapists for example, specialise to the extent of treating sports injuries exclusively. Second, costs of patients treated by paramedics in state hospitals have been included in Chapter 14 (state hospital costs). In order to avoid double counting, only the costs of private paramedics must be included here. This number is impossible to determine without knowledge of the numbers of professionals in the state and private sectors.

A large-scale study was not possible. Instead, a simple plan was devised which involved each of the five identified departments at Groote Schuur Hospital. They were asked to conduct surveys to determine the percentage of total patients treated who were referred owing to cardiovascular conditions. The earnings of a professional of five years standing in the public sector was then obtained, as was the number of practising professionals in the country. A simple calculation could then provide the answer (see Sections 18.2 to 18.6).

This method substantially underestimates this category of costs because the cost of specialist machinery (e.g. ultrasound in physiotherapy) is not included in the figures. Even if the numbers and cost of machines in the country were known, it is unlikely that the proportion of total running costs allocated to CVD would be accurate.

[A note on machinery charges in general: Private hospitals charge patients for use of equipment. State hospital budgets reflect the purchase of specialist machinery. To add these costs as a special entity would involve double counting.]

18.2 Preliminary Follow-up Figures for Follow-up Costs in 1991.

Sections 18.2.1. to 18.2.5. below give statistics obtained from five departments at GSH. If the statistic for the percentage of paramedics in private practice is known ($y\%$ for instance), then it becomes possible to allocate a figure to this category of CVD costs. It was decided not to assume figures for y in Sections 18.2.1 to 18.2.5. below. Calculations can however be easily performed when these figures become available.

18.2.1. Occupational Therapy:

Percentage of CV Attendances of Total Attendances: 13,7%²

Total number of registered occupational therapists in the RSA (1991): 1520.³

Percentage of private physiotherapists: $y\%$

Average salary, public sector, five years experience:
R29 208.⁴

Total CVD costs:

Percentage of time spent on CVD x No. private Occ.Th.s x salary.

Low figure = $10\% \times 1520 \times y\% \times R29\ 208.$

High Figure = $15\% \times 1520 \times y\% \times R29\ 208.$

18.2.2. Speech Therapy:

Percentage of CV Attendances of Total Attendances: 28%.⁵

Total number of registered speech therapists in the RSA (1991): 847.

Percentage of private speech therapists: y%.

Average salary, public sector, five years experience:
R29 208.

Total CVD costs =
percentage of time spent on CVD work x No. private STs x salary.

Low figure = $10\% \times 847 \times y\% \times R29\ 208$.

High figure = $25\% \times 847 \times y\% \times R29\ 208$.

Approximately 10% of all speech therapists are employed in hospitals, the rest in schools and the private sector.⁶ Speech therapists not working in hospital environments treat far fewer stroke patients, hence the figure of 10% for the low estimate.

18.2.3. Social Workers.

Percentage of CV Attendances of Total Attendances: 10,26%.⁷

Total number of registered social workers in the RSA (1991): 7198.

Average salary, public sector, five years experience:
R34 476.

Percentage of private social workers: y%.

The Social Work department at GSH did a study of the number of CVD patients it attended to. Although one staff member works exclusively on cardiac patients, the percentage of CVD contacts of the total was a mere 10,26%.

This figure would represent a gross overestimation of the total number of CVD contacts seen by the majority of social workers in the country, for they perform virtually no CVD work.⁸ Social workers focus on socioeconomic problems such as alcoholism and community health issues. This component of cost can thus be ignored with little consequence, but for the sake of completeness it can be calculated by the usual formula:

Total CVD costs =
percentage of time spent on CVD work x No. private STs x salary.

Low figure = 2% x 7 198 x y% x R34 476.

High figure = 3% x 7 198 x y% x R34 476.

18.2.4. Physiotherapists.

Percentage of CVD Attendances of Total Attendances: 17.6%.⁹

Total number of registered physiotherapists in the RSA, (1991): 3017.

Percentage of private physiotherapists: y%

Average salary, public sector, five years experience:
R29 208.

Total CVD costs = percentage of time spent on CVD work x Number private PTs x salary.

Low figure: 10% x 3017 x y% x R29 208.

High Figure: 15% x 3017 x y% x R29 208.

Note: Physiotherapists working in private practice would see a much lower percentage of CVD patients than those working in hospitals, hence the lower figures in the estimates. In fact, a small number of private physiotherapists specialise exclusively in cardiovascular work, but this figure is not available.

18.2.5. Dieticians.

Percentage CVD Attendances of Total Attendances: 17.3%.¹⁰

Total number of registered dieticians in the RSA, (1991): 631.

Percentage of private dieticians: y%.

Average salary, public sector, five years experience:
R29 208.

Total CVD costs = %CVD work x Number of Private Dieticians x salary.

Low figure: 12.5% x 631 x y% x R29 208.

High Figure: 17.0% x 631 x y% x R29 208.

18.3. Total Long-term Therapy Costs:

The total long term CVD costs can be assessed by adding the totals obtained in Sections 18.1 to 18.5. Because of the uncertainties associated with these costs, they are not included in the total CVD costs in Chapter 21.

** Caveats:*

1. The costs calculated above represent a gross underestimation and are unreliable for the following reasons:

- (i) the cost of specialist machinery has not been included,*
- (ii) the (usually higher) salaries of professionals in the private sector has not been assessed,*
- (iii) the cost of equipment used by patients such as pacemakers, wheelchairs, walking sticks, etc. has not been included,*
- (iv) the cost of home nursing and care has not been assessed, and*
- (iv) transportation and other sundry costs have been ignored.*

2. The patient profile at Groote Schuur may differ markedly from that seen by the private sector. Clearly, only an extensive investigation will reveal the extent to which this is the case.

Because of the level of inaccuracy in the figures above, they are not included in the final computations in Chapter 22.

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6. This is an approximate figure estimated by P. Clarkson of the GSH logopaedics unit and a colleague at the SA Speech-Language-Hearing Association.
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CHAPTER 19.

The Calculation of the Annual Value of Income Lost due to CVD Premature Mortality in South Africa.

The present value of future income lost due to premature mortality can be calculated by using various sets of statistics which vary in accuracy from the more precise age-, race- and sex-differentiated figures to the less precise national aggregates. Lack of precise figures have hampered accuracy. South African statistics are no longer collected on a racial basis, a move which is welcomed for its undisputable ethical propriety. However, from the perspective of this study, where incidence of CVD is linked to lifestyle which in turn has been linked to race in South Africa, a degree of statistical differentiation which could have been useful is no longer available in current records.

To impart a measure of accuracy to the figures, it was decided to use the Central Statistical Services' 1989 Reports on Death in which data is given on a racial basis.¹ However, this report was found to have a statistically lower number of deaths than usual, and the latest available accurate figures are for 1988.² These have been converted to 1991 figures by making use of the Central Statistical Services' index of average monthly salaries and wages.

Figures were computed as follows: The number of people who died of CVD in 1989 in each population, sex and age group was recorded, as was the labour force participation rate and the average income of each group. It was then assumed that nobody is employed before the age of 15 and that all people retire at the age of 65, after which they earn no income from their labour. The net present value (NPV) of foregone future income was calculated for a range of discount rates (0 to 10%) for each subgroup. Finally, the total sums for each group were added to derive a monetary value for each discount rate.

19.1. Three Statistics Relevant to the Calculation of CVD Cost of Mortality.

19.1.1. Annual Number of Cardiovascular Deaths.

The Central Statistical Service publishes an annual Report on Deaths, which since 1991 has not been differentiated according to race. It is widely acknowledged that figures for the black population are deficient due to under-registration and inadequate classification as to cause of death. Since the numbers of blacks swamp those of other groups in South Africa (70% of the population is black), it was decided to use 1989 figures where data was still recorded according to population group, as this would give more precise results.³

It also permits the further differentiation of income and employment rates into finer divisions.

19.1.2. Labour Force Participation Rates (LFPR).

The following information on SA LFPRs is available from the Central Statistical Services' Quarterly Bulletin of Statistics [2.1.].

Labour: Economically Active Population as a Percentage of the Total Population:

Year.	Total	Male	Female.
1980	34,7	46,2	22,8
1985	37,2	47,9	26,7
1991	37,5	45,5	29,5

Year	Whites	Coloureds	Asians	Blacks
1980	41,9	35,5	31,2	32,9
1985	43,2	39,6	35,6	35,0
1991	47,1	41,4	38,5	34,6

These figures are not very useful in that they do not exclude children, disabled or elderly people from the total population. Although a good approximation could be made by expressing this figure as a percentage of the population between the ages of 16 and 65 (which can be computed from the SA Census of 1991), minor adjustments for unemployed people and those not wishing to work would still be excluded.

The best figures available are those of the Institute for Futures Research, who do extensive work in this field.⁴ The figures of employment levels in the SA formal economy in 1990 (including the agricultural and domestic sectors) are given below, expressed as a percentage of those able to work between the ages of 15 and 65.

Whites	Coloureds	Asians	Blacks.
80,5	71,3	70,5	53,1

Finer differentiation of these figures into age and sex is not available. An earnings gradient could therefore not be obtained, and the figures had to be applied as such in NPV calculations. For the purposes of computation, it was assumed that the 1990 employment levels given above held in 1991, the base year of our study.

19.1.3. Personal Income.

The economy forfeits the pre-tax personal income of a worker who dies from CVD. According to the most recent Central Statistical Services publications, the last year for which an average wage is differentiated into race group is 1984. The 1984 annual figures [Rand] at constant 1990 prices are as follows:

Total:	Whites.	Coloureds.	Asians.	Blacks.
1612	40 262	13994	19512	10118

These figures are inaccurate since they do not reflect the redistribution of income that has taken place since 1984, nor the reduction in per capita income that has occurred over the corresponding period. The most recent year for which accurate figures are available is 1988, and these are as follows.⁵

*Per capita, pre-tax annual earnings [Rand] in the South African economy, 1988.
Employed persons only, including agricultural and domestic sectors.*

Whites	Coloureds	Asian	Blacks
29 990	9700	16100	7500

A summary of the monthly average salaries and wages in the SA economy over four years is given below.⁶

Year:	At current prices	At constant 1990 prices.
1986	875	1509
1987	1003	1475
1988	1156	1521
1989	1360	1563
1990	1594	1594
1991	1847	1606

This table makes the conversion of figures from one base year to another possible. Converting 1988 figures to 1991 figures (multiply by a factor of 1847/1156) gives

Whites	Coloureds	Asian	Blacks
47 917	15 498	25 723	11 983

which are the figures that are required to perform the present value calculations for 1991.

19.2. CVD Deaths, Labour Force Participation Rates and Incomes by Age, Sex and Race, South Africa 1989.

Tables 19.2.1 to 19.2.4 give a summary of the total number of CVD deaths, employment levels and income of the economically active population in South Africa for each sex and race. The employment and income figures are not further differentiated by sex or age. However, since average figures are used, eccentricities in the data tend to even out.

19.2.1. Whites.

Average Income 1991 [15-65y]: R47 917

LFPR: [15-65y] 80,5%.

Age Group (years)	<15	15-19	20-24	25-29	30-34	35-39
CVD deaths	5	6	16	25	46	90
Male/female	14	9	9	16	24	32
Age Group	40-44	45-49	50-54	55-59	60-64	65 and over
CVD deaths	194	238	417	586	779	4 452
male/female	71	123	165	269	366	5 073

19.2.2. Coloureds.

Average Income 1991 [15-65y]: R15 498

LFPR: [15-65y] 71,3%.

Age Group (years)	<15	15-19	20-24	25-29	30-34	35-39
CVD deaths	21	10	15	30	45	74
Male/Female	26	18	18	26	44	64
Age Group	40-44	45-49	50-54	55-59	60-64	65 and over
CVD deaths	110	185	255	358	361	1 130
Male/Female	127	162	210	280	321	1 602

19.2.3. Asians.

Average Income 1991 [15-65y]: R25 723

LFPR: [15-65y] 70,5%.

Age Group (years)	<15	15-19	20-24	25-29	30-34	35-39
CVD deaths	6	2	7	9	12	34
male/Female	8	0	2	4	6	7
Age Group	40-44	45-49	50-54	55-59	60-64	65 and over
CVD deaths	48	99	122	135	148	438
Male/Female	24	31	69	69	113	405

19.2.4. Blacks.

Average Income 1991 [15-65y]: R11 983

LFPR: [15-65y] 53,1%.

Age Group (years)	<15	15-19	20-24	25-29	30-34	35-39
CVD deaths	137	71	123	166	269	291
Male/Female	75	82	126	138	197	283
Age Group	40-44	45-49	50-54	55-59	60-64	65 and over
CVD deaths	483	574	715	686	832	2 610
Male/Female	326	447	549	650	850	3 250

Notes:

1. These figures exclude the TBVC countries.
2. Figures for the Black population are suspect due to under-registration and inadequate classification as to cause of death.
3. Only people employed in the formal sector are included. The informal economy and non-remunerative activities for which shadow prices can be calculated, such as housework, are not taken into account.

19.3. Computation of Results.

The NPV of foregone future earnings of each CVD death according to race, sex and age group was discounted at rates of between zero and ten percent per annum, from the age of

death to sixty-five. These figures were added separately, and multiplied by the LFPRs of each population group to afford the global 1991 costs of CVD mortality, which are given in Table 19.3.

Table 19.3. South African 1991 CVD Mortality Rates: NPV of Foregone Earnings, 1991 R100million:

Pop. Group.	Discount Rate. (%)					
	0	2	4	6	8	10
White M.	10,475	8,935	7,798	6,930	6,249	5,702
White F.	4,766	4,035	3,506	3,108	2,799	2,553
Col. M.	2,093	1,750	1,504	1,320	1,178	1,066
Col. F.	1,949	1,610	1,370	1,195	1,061	0,956
Asian M.	1,466	1,235	1,065	0,937	0,838	0,758
Asian F.	0,657	0,561	0,491	0,437	0,395	0,361
Black M.	4,502	3,616	3,009	2,574	2,225	2,003
Black F.	3,783	3,027	2,514	2,150	1,882	1,677
Totals	29,692	24,769	21,256	18,649	16,651	15,076

As can be seen, the discount rate seriously influences the monetary costs of mortality. There is much controversy as to which is the appropriate discount rate to use when discounting foregone future earnings. In the United Kingdom, a standard rate of 5% in real terms was promulgated for many years, but has recently been revised to 6%.⁷ The South African Department of Finance discounts public projects at a rate of eight percent.⁸ Canadian researchers have recently discounted health benefits at real rate of six percent, but allow for productivity gains of two percent; they therefore used an effective discount rate of four percent.⁹

The debate is very topical at present.^{10,11,12,13,14} Some of the relevant theoretical issues have been discussed in paragraph 4.5.6 of Section II. Readers unfamiliar with the concept of discounting are referred to a paper by Sheldon (1992) where the foundations of discounting, its application to health care and critiques thereof are discussed.¹⁵

In summary, there is thus a lack of consensus on the appropriate rate to use in human capital calculations. [In fact, some writers (e.g. Goodin) reject the discounting of a class of so-called "non-tradable goods", among which is included a person's life.¹⁶] Given this state of affairs, Hodgson and Meiners (1982) recommend that investigators employ three discount rates ranging from 2.5 to 10%.¹⁷ The sensitivity analysis provided in Table 19.3

gives an even broader range of values, which are derived from discount rates of between 0 and 10%.

Two figures had to be selected from Table 19.3 to be included in the final computations in Chapter 22. It was decided to make the six percent discount figure the high estimate and the eight percent discount figure the low estimate for mortality costs of CVD (see Table 21.1). No arguments will be advanced for this choice; this is a topic too broad to be discussed in any detail here and is not the main focus of this work. However, a discount rate of six percent is in line with that currently used in Britain, whereas eight percent is the rate recommended by South African economic advisors. Economists and policy makers who argue for different discount rates can implement the relevant figure in Table 19.3 in their final computations.

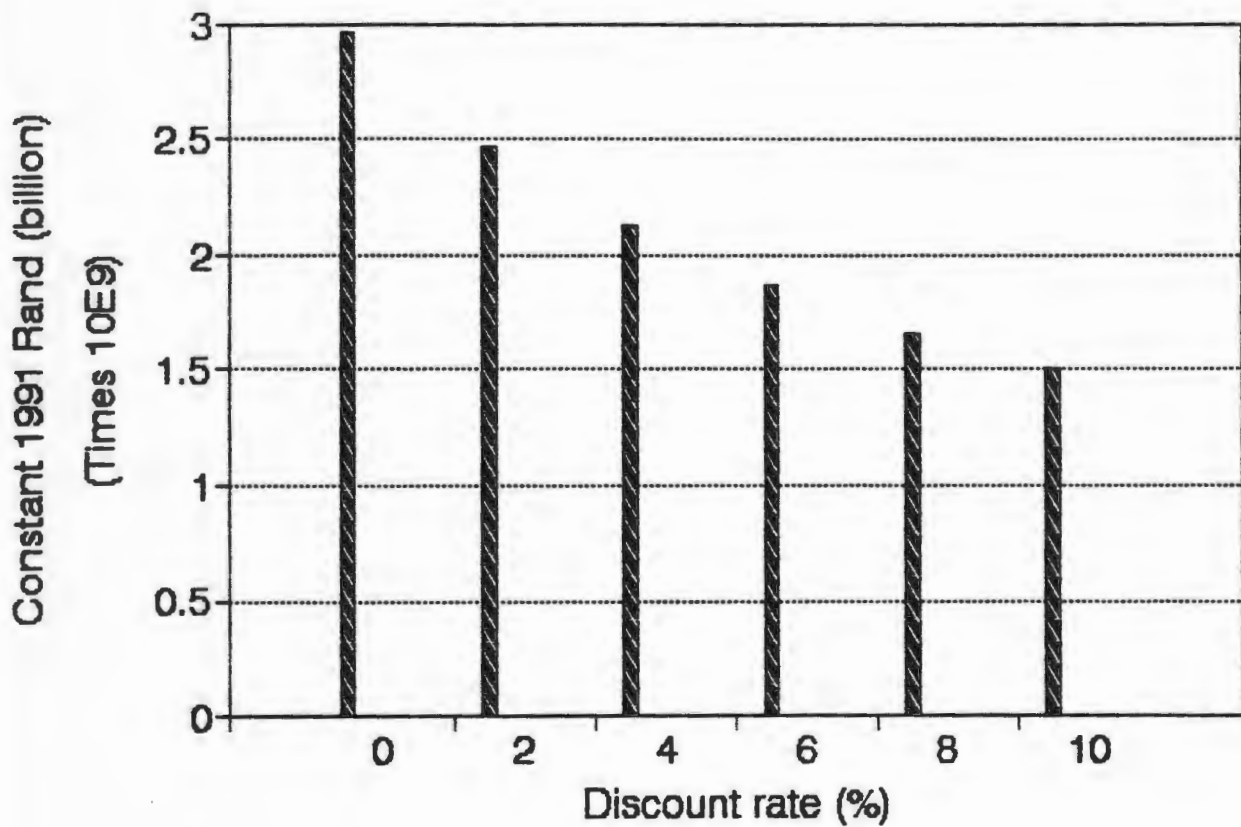
Estimates to determine the extent to which the national accounts reflect the true level of economic activity in South Africa suggest an under-estimation of between 8 and 20% [Leiman and Hartzenberg, 1990].¹⁸ Those wanting to include the contribution of the informal sector can adjust these figures accordingly.

Caveats:

South Africa is experiencing high levels of unemployment at present. As has been explained in paragraph 4.5.8 of Section 2, the impact of a loss of a worker on an economy with widespread unemployment is more closely approximated by the foregone consumption of an unemployed person than the foregone earnings of a worker. It could thus be argued that the figures calculated by the human capital method above overestimate the true indirect impact of CVD on the economy.

There are two counter arguments to this. The first is that the NPV of the future foregone consumption of an unemployed person grossly underestimates the value of a life. And second, unemployed persons could be put to productive use when the business cycle gains momentum. They should thus be seen as unproductive assets rather than a burden to the economy.

NPV of Foregone Y. CVD Mortality, SA 1989.



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CHAPTER 20.

The Estimation of the Annual Value of Productivity Lost Due to CVD Functional Disability, South Africa 1991.

The other major indirect cost of illness is the loss of productivity caused by disability or disease, whether long-term or short-term. These costs are collectively known as *morbidity* costs. The estimation of morbidity costs of CVD proved to be the most difficult undertaking of this study.

20.1. The Extent of CVD Morbidity in the United States (1980).

North American studies have shown that the impact of cardiovascular conditions on productivity is striking.^{1,2,3} Table 20.1 gives a clear indication of the productivity and activity measures of the US population in 1980.

It can be seen that persons in the US reporting hypertension alone (52.2% of all CVD patients) were less likely to be employed than persons in the general population. Persons in the other subcategories of cardiovascular disease were significantly more likely to be unable to work than those in the general population. They are about three times less active in terms of restricted-activity and mean-bed disability days than hypertensives or the general population.

No study which parallels the above has been conducted in South Africa; the extent of morbidity details of cardiovascular disease in South Africa is thus unknown. In default of such data, a fairly rough way to estimate these figures had to be devised. Various approaches differing in their degree of complexity were considered, and they are briefly discussed below. It was finally decided to forward a simple solution based on clear assumptions which could be adjusted in time.

Table 20.1. Annual Productivity and Activity Measures for Persons 17 Years of Age and over with Cardiovascular Conditions, by Condition: United States, 1980.⁴

Productivity Measures			
Condition	Percent employed	Percent Unable to Work.	Mean Work-loss days
All Persons	71.6	4.9	4.9
Persons with cardiovascular conditions			
Hypertension alone	52.2	7.9	6.5
Cardiovascular disease			
With hypertension	23.4	21.6	19.0
Alone	33.5	23.2	12.0
With complicating conditions	38.6	20.2	7.1
Activity Measures			
	Mean restricted-activity days.	Mean bed-disability days	
All Persons	15.6	5.6	
Persons with cardiovascular conditions			
Hypertension alone	20.1	6.0	
Cardiovascular disease			
With hypertension	46.1	16.7	
Alone	45.7	17.3	
With complicating conditions	41.0	16.7	

20.2. Possible but Unsuitable Approaches to the Determination of the Cost of CVD Morbidity in South Africa.

20.2.1. The Sample Technique.

This technique is the only accurate way of determining the extent of morbidity in a population. The data in Table 20.1 was obtained by following up a sample of 17 123 civilian non-institutionalised US individuals over a period of fourteen months.⁵ The results obtained from the sample were extrapolated to the total US population by making use of appropriate statistical techniques. Such a study is the ideal to which medical researchers in South Africa should strive if any semblance of accuracy is to be attained. However, it is unlikely that resources to realise such a comprehensive study will be available to South African medical researchers in the near future.

20.2.2. The Assumption that the Percentage of Work Days Lost in South Africa due to CVD is the same as that in the US.

US data for 1963 indicate that 13.9% of the total number of man-years lost to productivity and indirect costs for persons of all ages in the United States were due to diseases of the circulatory system.⁶ A more recent US study showed that approximately 98 million days of work were lost in the US during 1980 by persons with cardiovascular disease, accounting for 17.1% of the total work-loss days.⁷ A Canadian study estimates the annual value of time lost to chronic disability from cardiovascular disease to be 17.4% of the total value of time lost to all chronic health problems.

In principle therefore, if the total number of man-years lost to chronic health problems in South Africa is known, and parallels with North America data are assumed, then a percentage range of say 12.5 to 18% of this figure could be attributable to CVD. Useful data would be the number of days of work lost to illness in South Africa per year, and the percentage of attributed to CVD. These data are however not available.⁸

It must be realised that even if these figures were available, and even if adjustments were made to reflect the difference in the prevalence of CVD between South Africa and the US, the figures would still be skewed because of the disparity in quality of treatment available to the US and South African populations. The extent of the bias would be difficult to ascertain.

20.2.3. The Assumption that the Debility Profile of CVD Patients is the same in South Africa as in the US.

It is known that in 1980 approximately 28 million people in the US, or 17,3 percent of the total civilian non-institutionalised population 17 years and over, suffered from a cardiovascular condition. Of these 28 million, about one-half were hypertensives, the morbidity costs of which did not differ much from the rest of the population (6,5 vs. 4,9 work-loss days per year). The other half of the US CVD patients reported mean work-loss days ranging from 7 to 19 days. A large percentage of persons in this subcategory (20-23%) were also unable to work.

Likewise, if it is assumed that 17,3% of the total South African civilian non-institutionalised population 17 years and over have a similar disease profile, and if it can be assumed that the mean work-loss days is the same in both populations, then a set of facile calculations would easily reveal this category of cost.

These assumptions can, however, only be made on the grounds that human physiology and habits are the same all over the world. But epidemiological studies do not bear this out. Different populations are prone to different health threats according to the socioeconomic environment in which they are located. They are also endowed with differing levels of natural immunity and have access to disparate qualities of health care. These facts rendered this method unsuitable.

20.3. An Imperfect but Simple and Workable Approach to the Determination of the Cost of CVD Morbidity in South Africa.

It was ultimately realised that the best that could be done in the absence of a representative sample survey was to establish some sort of broad correlation between South African CVD mortality and morbidity costs. If an indication of a ratio could be found between these two categories of costs for a country not too dissimilar from South Africa, then at least some figure could be formulated. What was appealing about this approach was that the mortality costs calculated in chapter 19 took account of levels of unemployment in the economy, as well as the earnings of the different population groups. This in effect serves as a built-in adjustment when making comparison with foreign studies.

Ideally, the reference study had to be one conducted in a country of similar size, economy and population characteristics as South Africa. Studies from African countries of similar size were not available, and it is doubtful whether such studies have been carried out elsewhere on the continent. A country with which suitable comparisons could be made

was sought, and Canadian data were considered.⁹ Canada is not the perfect country to serve as a basis for extrapolation to South African data, and a number of serious reservations become apparent when doing such a projection. It is however possible to make some sort of tentative comparison based on considerations given below, but it is not well-grounded.

Canada had a population of 27m in 1991, which compares favourably with South Africa's population of 26,5m in 1992. (excluding the TBVC states).¹⁰ The Canadian annual income per capita of US\$16 760 (1988) was 6,81 times South Africa's at US\$2 460. Canada's population is not as racially heterogeneous as South Africa's, but as has been stated before, differences among the income levels of the South African population groups have been taken into account in the calculation of South African CVD mortality costs.

Table 20.3. CVD Mortality Rates per 100 000 of the Population, 1989.

	Male	Female.
Canada.	432,3	304,6
South Africa.		
Whites, Coloureds, Asians:	259,8	230,7
Blacks:	171,2	165,1
Number of Deaths:		
	Below 65	65+
Canada *	8354	39484
Ratio <65 deaths/total deaths:	0,17	
South Africa. (CVD deaths)		
Whites, Coloureds, Asians:	7265	13100
Ratio <65 deaths/total deaths:	0,36	
Blacks:	8116	5860
Ratio <65 deaths/total deaths:	0,58	

** Deaths due to IHD, cerebrovascular disease and hypertension only are included.*

Canada is a westernised, first world country, and is therefore not the ideal country with which to compare South Africa. Table 20.3 shows that Canadian CVD mortality figures are considerably higher than those of South Africa. However, the age-specific mortality rates indicate that the bulk (80%) of Canadian CVD deaths occur after the age of 65 when

most people have retired. In South Africa, a higher proportion of deaths from CVD occurs before the age of 65 (Table 20.3); CVD thus presents a comparatively higher burden to the economy. These figures also reflect the better health care and longevity that Canadians enjoy.

A disease will have a similar morbidity impact on two economies if its debilitating effect on the work force is of approximately the same order. *The crucial statistic to compare is the below 65, labour force participation rate adjusted CVD mortality figures.*

Canadian males(females) have a below-65 CVD mortality rate of 73,53(51,78) per 100 000 of the total population, whereas South African white, coloured and Asian males have a below-65 CVD death rate of 93,52(83,1). South African blacks have a below-65 CVD death rate of 99,29(95,75). South Africans therefore have a CVD mortality rate that ranges from between 1,27 to 1,84 higher than the corresponding Canadian rate.

Adjusting for labour force participation rates: The Canadian unemployment rate for August 1990 was 8,3%, while the South African LFPR ranges from between 70,5 and 80,5% for whites, coloureds and asians, whereas the black LFPR is 53,1%. Very roughly, the number of deaths per 100 000 working people can be calculated by multiplying the LFPR by the number of deaths per total 100 000 (Table 20.4).

Table 20.4. Number of CVD Deaths per 100 000 Employed Persons.

Canada:Male (Female)	67,43 (47,48)
SA	
Whites, Coloureds and Asians:	79,49 (66,90)
	to 66,93 (58,59)
Blacks:	52,70 (50,58)

These figures show that although the epidemiological profile of the two countries differ, a fair case can be made for equating the two countries in terms of the economic impact that CVD makes on the two economies as far as foregone earnings, due to mortality, is concerned. Because the LFPR adjusted under-65 CVD mortality figures for the two economies do not vary by much, and because there are many other factors which play a role (such as e.g. attitude of workers towards taking leave when ill), the disparity between the figures may be even smaller than it appears in Table 20.4.

If it is further assumed, as is common practice with chronic diseases, that mortality is a function of the level of morbidity for CVD, and that the levels of CVD morbidity in

Canada and South Africa approximate each other to the extent that their CVD mortalities do, then it is feasible to accord a CVD morbidity impact to South Africa which comprises the same ratio of mortality costs as does Canadian CVD morbidity.

Naturally, these are tenuous assumptions; in the country with a superior health service, better management of disease accelerates the patient's return to work, enhancing productivity and reducing morbidity costs. On the other hand, where health services are rudimentary people are less likely to survive an acute cardiovascular attack, resulting in increased mortality costs and reduced morbidity costs.

20.4. The Calculation of South African CVD Morbidity Costs (1991).

Canadian data of 1986 gives the present value of future income lost due to CVD premature mortality as 8 167 737 000 Canadian Dollars.¹¹ This was calculated making adjustments for future productivity gains of 2% per year, and discounted future earnings of 6% per year; i.e. using an effective discount rate of 4% per year. This figure represents 31.9% of the amount lost due to premature mortality by the Canadian population in 1986.

The annual value of time lost due to chronic disability of cardiovascular patients was calculated by the same study to be 3 305 750 000 Canadian dollars, while the annual value of short term disability was 162 632 000 Canadian dollars. This gives a combined morbidity figure of 3 468 383 000 Canadian dollars, which is approximately 42% the size of mortality costs.

The cost of South African CVD mortality in 1991 at a discount rate of 4% p.a. came to R2,126 billion (see Table 19.3). Since Canadian CVD morbidity costs are 42% the size of its CVD mortality costs discounted at 4% p.a., it can be guardedly assumed that South Africa's morbidity costs would fall in a range that is between 37 and 47% of its mortality costs, or between R786,6m and R999,2m in 1991.

Caveats:

It should be remembered that this range of figures is based on an extrapolation from a study which was performed in a country with a dissimilar population composition to South Africa. Although they probably represent the best figures that could be computed under the circumstances, there is a degree of arbitrariness present which will only be removed when a proper South African survey is conducted.

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 7. "Health Care Utilization and Costs of Adult Cardiovascular Conditions, United States 1980", op.cit. p.8.
 8. The National Productivity Institute could not provide this data, but could supply US data! The Human Resources Group of ESKOM, the giant South African electricity provider, reported that from 1986 to 1991, 261 out of 1223 (21,34%) of its employees who retired owing to ill-health cited circulatory problems as the reason. [Report by C.P. Roos, Human Resources Group, ESKOM, Megawatt Park, Sandton.]
- Other promising leads proved fruitless.
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11. *"Chronic Diseases in Canada: Economic Burden of Illness in Canada, 1986"*. op.cit. p. 21.

CHAPTER 21.

The Summation of Total Costs of CVD, South Africa 1991.

This Chapter integrates the results of the preceding chapters. Table 22.1 summarises each CVD cost category for the base year 1991. The total costs of CVD to the South African economy in 1991 amounted to between R4 135m and R5 035m.

22.1. The Composition of the Costs of CVD.

The total direct costs of CVD in South Africa (1991) amounted to between R1 684m and R2 171m. The composition of the estimate of direct costs is as follows:

<i>Cost Category.</i>	<i>% of Total Direct Costs</i>	
	<i>Low Estimate</i>	<i>High Estimate</i>
Minor costs (Research etc.)	0.45	0.35
Transport.	1.06	0.83
Private Hospitals.	5.01	5.83
General Practitioners.	9.95	17.26
Public hospitals.	27.40	21.25
Drugs.	27.92	21.66
Physicians.	28.21	32.82
Total.	100.00	100.00

Some of the cost categories above are not neat. For example, the figure for state hospital costs is an amalgamation of costs of drugs, interventions, ward costs and salaries of medical personnel in the public health sector. This has arisen from the way in which costs have been computed.

The total indirect costs of CVD in South Africa in the same year amounted to between R2 452m and R2 864m.

<i>Cost Category.</i>	<i>% of Total Indirect Costs</i>	
	<i>Low Estimate</i>	<i>High Estimate</i>
Morbidity.	32.08	34.89
Mortality.	67.92	65.11
Total.	100.00	100.00

The ratio of direct to indirect costs of CVD is as follows:

<i>Cost Category.</i>	<i>% of Total Costs</i>	
	<i>Low Estimate</i>	<i>High Estimate</i>
<i>Direct Costs.</i>	40.72	43.12
<i>Indirect Costs.</i>	59.28	56.88
<i>Total.</i>	100.00	100.00

One of the features of the economic cost of CVD is the high ratio of indirect costs to total costs. Rice estimated this ratio as 88.12% for the US in 1963.¹ A recent Canadian study estimated this ratio to be 69.05%.² In countries of lower income and higher unemployment with a well developed health service (e.g. South Africa), the burden of indirect costs can be expected to be lower. This occurs because earnings lost through loss of productivity is comparatively lower than the proportion of the national budget allocated to health.

22.2. Total Cost of CVD.

The total costs of CVD to the South African economy in 1991, excluding rehabilitation costs, amounted to between R4 135m and R5 035m. Where data has not been concrete, care has been taken to forward conservative figures. The methodology followed by this study allows for the easy accommodation of more accurate data as it becomes available.

The figures above represent the extremes of a range; the actual cost is closer to midway between the two values.

22.3. Broad Policy Implications Arising from this Study.

The major value of this study is that a workable methodology for the costing of disease in South Africa has been developed. The results highlight an earnest need for programmes that will induce changes to a healthier lifestyle among members of the population, especially those at high risk of contracting CVD.

However, in isolation, the study does not have any implications for health budget allocation. Efficiency can only be obtained across disease categories once a comprehensive picture of the burden of all diseases has been established. This requires the costing of each broad category of disease, preferably according to the methodology of this study. Efficiency criteria will only be applicable once this has been performed; researchers will then be in a position to determine the cost-effectiveness of various health programmes at the margin.

22.4. Recommendations for Health in Developing Countries: World Bank Report, 1993.

The World Development Bank advocates a three-pronged approach to government policies for improving health in developing countries.³

First, governments need to foster an economic environment that enables households to improve their own health. Growth policies that ensure income gains for the poor are essential. Second, government spending on health should be directed to more cost-effective programmes that do more to help the poor. A greater proportion of developing nations' health budgets must be channeled into low-cost, highly effective programmes such as control and treatment of infectious diseases. Third, governments need to promote greater diversity and competition in the financing and delivery of health services.

The World Bank Report on Health stresses that in health, as elsewhere, good information facilitates sound decision making. It recognises that although governments are already heavily involved in data collection, the data are often irrelevant to policy and program design (this project proved no exception). Revamping health information systems is an attractive investment, both because it is relatively inexpensive and because poor decisions can be very costly. It is argued that investments in research have been the source of enormous improvements in health in this century.

The need to monitor health expenditure and equity of allocation is strongly recommended by the World Bank, as is the role of government in promoting national health research programmes. Special emphasis is placed on public policy making and programme design. The following excerpt from the Report illustrates the World Bank's recommendations on health research in developing countries:

"Governments have a role in supporting the research necessary for understanding specific local health problems and for guiding public policymaking and design. This 'essential national health research', which is also undertaken by the private sector, examines health strategy in more ways than is done with day-to-day budgetary and management information. The international community can help both in gathering data for international comparisons and in assisting local institutions build up capacity in epidemiology, health economics, health policy and management. Research priorities in this area include cost-effectiveness analysis of health interventions, evaluations of medical practice and of variations in practice, and studies of drug utilisation, equity, consumer satisfaction and women's health."⁴

Table 21.1. Direct and Indirect Costs of CVD: South Africa. 1991.

	Cardiovascular Cost Category	Cost. 1991 R million	
		Low	High.
1.	Transportation Costs.	17,97	18,08
2.	GP costs	167,64	374,75
3.	Physicians' Costs.(?)	475,0	712,5
4.	Public Hospitals' Cost.	461,3	461,3
5.	Private Hospitals' Cost. Fee-for-service.	84,3	126,5
6.	Drug Costs.	470,2	470,2
7.	Minor costs:	7,6	7,6
	SUBTOTAL: Direct Costs.	1 684,01	2 170,93
8.	Mortality Costs. (6% and 8% discount rates)	1 665,1	1 864,9
9.	Morbidity Costs.(1991).	786,6	999,2
	SUBTOTAL: Indirect costs.	2 451,7	2 864.1
	TOTAL: SA CVD Costs, 1991.	4 135,71	5 035.03

* Rehabilitation and follow-up costs of CVD have been excluded. It was also not possible to include the CVD costs incurred in industrial hospitals.

22.5. Conclusion.

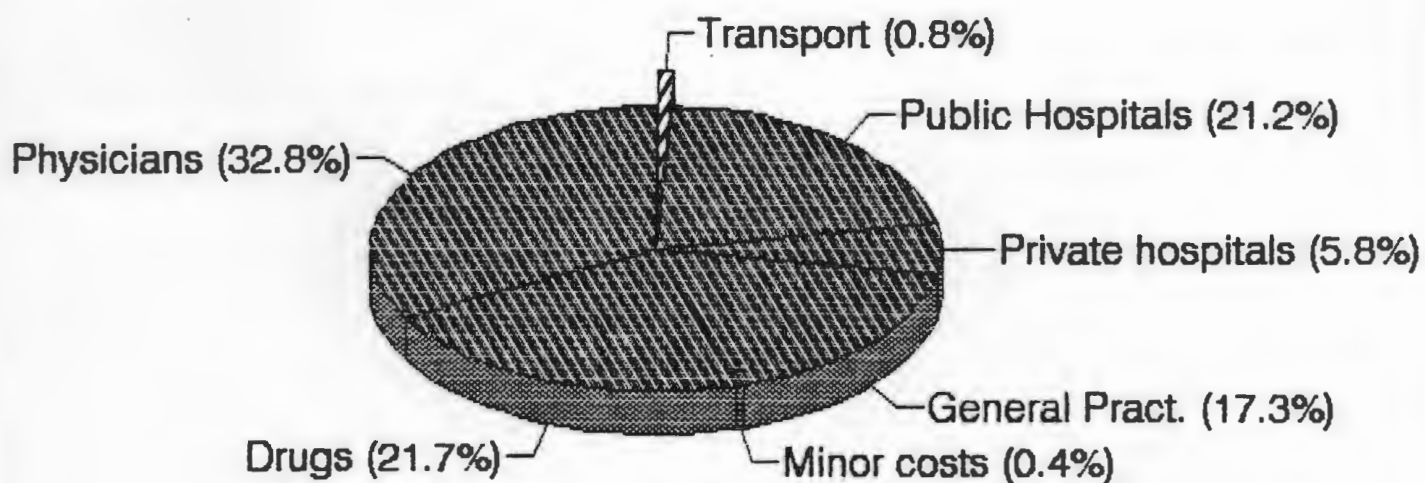
The need for research into health economics has begun to dawn on South African health policy makers. This thesis is a timeous response to this need. The recommendations of the World Bank Report on research into health call for the development of health economics; this thesis represents a start in this direction.

Ideally, the work presented here should have two consequences: first, it is hoped that a wider range of policy makers will be made aware of the importance of health economics, second, it is hoped that a South African university will be induced to offer post-graduate courses in health economics in due course. Ideally, these courses should be run for students and health personnel in administrative positions alike. It is particularly important that training be provided for the latter, for it is they who manage health budgets and are in the best position to optimise them.

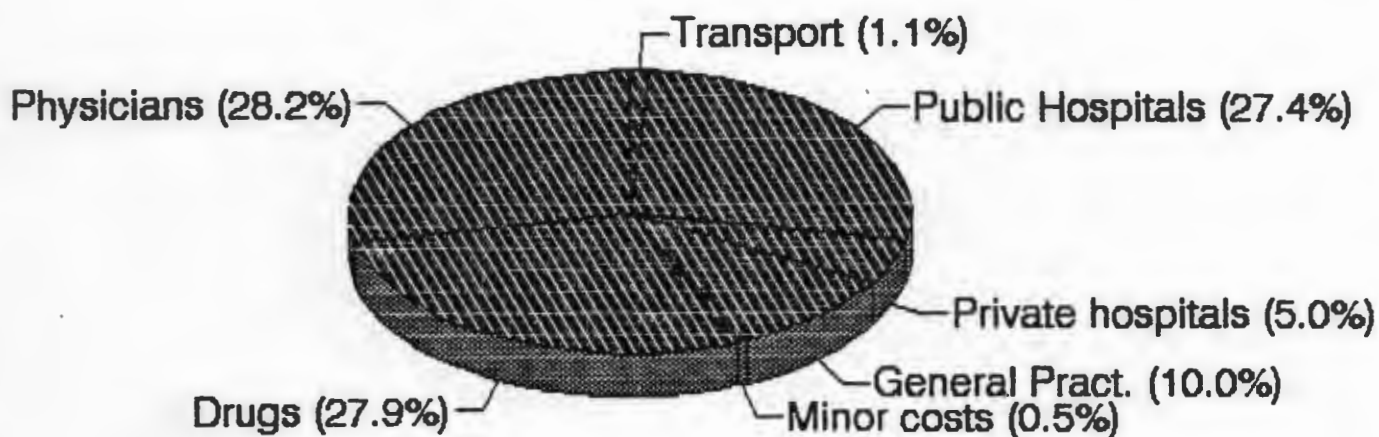
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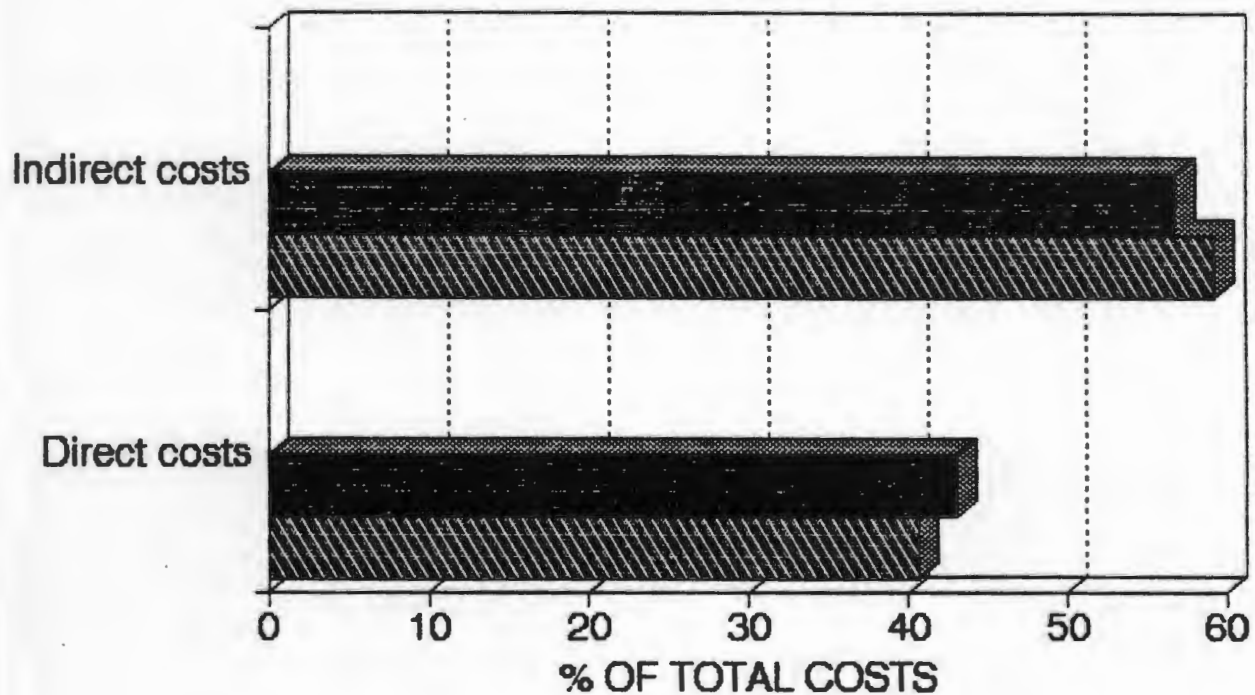
DIRECT CVD COSTS - COMPOSITION
High estimate 1991 Rm





DIRECT CVD COSTS - COMPOSITION
Low estimate 1991 Rm



DIRECT AND INDIRECT COSTS COMPOSITION OF TOTAL COSTS



 Low estimate  High estimate

INDIRECT CVD COSTS - COMPOSITION (LOW)

