Determinants of Cigarettes Demand in Kenya: Time Series Analysis from 1970-2005

M.A. (Economics) Thesis

By

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DECLARATION

I declare that this is my original work and that it has not been presented for a degree in any university. Where work of others has been utilized, acknowledgement has been duly given. I am solely responsible for all errors here in.

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CERTIFICATE OF APPROVAL

This thesis is submitted with our approval.

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DEDICATION

To the women in my life: my grandmothers Eunice and Jennifer, my sister Grace, my mother late Monica and my lovely daughter late Monica Diana.

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ABSTRACT

This study focused on determinants of cigarettes demand in Kenya for the period 1970 to 2005. Myopic addiction model of cigarettes demand was used to capture the addictive nature of cigarettes demand. Ordinary Least Squares (OLS) and Maximum likelihood-ARCH (ML-ARCH) estimation methods were used to estimate the long run cointegrating myopic cigarettes demand model. Furthermore, short run myopic error correction cigarette demand model was also estimated using OLS. The estimated long-run results indicated that cigarette prices have a significant and negative effect on cigarette consumption per capita; this implies that the government can easily manipulate cigarette prices by increasing excise tax.

ML-ARCH estimation confirmed the existence of a positive and significant myopic relationship between past and current cigarette consumption per capita. Real income per capita was statistically significant and had negative effect on cigarette consumption per capita in the long run. Health warning labels were found to be effective in reducing cigarettes demand both in the short run and in the long run. Advertising also was found to have a significant effect in promoting the use of tobacco (cigarettes) in Kenya.

Generally increase in excise tax, which is transmitted through the price factor and prominent health warning labels on the cigarette packs are the major advocated policy reaction from the study in controlling cigarettes (tobacco) use in Kenya.

Key words: determinants, myopic, ML-ARCH, cointegrating.

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ABBREVIATIONS USED

AIDS	-Acquired Immune Defiency Syndrome
BAT	-British American Tobacco
BBC	-British Broadcasting Corporation
ECM	-Error Correction Model
FCTC	-The Framework Convention on Tobacco Control
HIV	-Human Immuno- Defiency Virus
LCU/Kg	-Local Currency Unit/ Kilogram
OLS	-Ordinary Least Squares
SUSTAINET	-Sustainable Agriculture Network
WHO	-World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

This study focuses on determinants of cigarettes demand in Kenya for the period 1970 to 2005.Myopic addiction model[1] pioneered by Houthakker and Taylor (1966, 1970) is applied to the study to capture the addictive nature of cigarette consumption. Cigarettes are demanded by consumers and forms part of the social custom of many societies all over the world. Cigarettes are known to be extensively traded and highly profitable commodities, whose production and consumption have an impact on social and economic resources of both developed and developing countries alike (World Bank, 1999).

Although cigarettes use has declined in many high-income countries, there has been a sharp rise in its use, especially among men, in low and middle-income countries in recent decades (Guindon et al., 2003). From the period 1970 to 2000, cigarette per capita consumption reduced by about 24% in high-income countries while in the same period it increased by 46% in low income countries (Guindon and Boisclair, 2003) .These increases have been fuelled by falling real prices and rising incomes that have made cigarettes increasingly affordable, and by aggressive and sophisticated tobacco advertising. Close to 60% of 5,700 billion cigarettes smoked each year and 75% of tobacco users are in developing countries (World Bank 1999; WHO, 2002).

Smoking already kills one in 10 adults worldwide and by 2030 it is projected that the proportion will be one in six, or 10 million deaths per year more than any other single cause. Whereas until recently the epidemic of chronic disease[2] and premature death arising from cigarette smoking mainly affected high income countries, it is now rapidly shifting to the developing world. It is further predicted that by 2020, seven of every 10 people killed by smoking will be in low-and middle-income nations (World Bank, 1999). Ezzati et al. (2004) found that these tobacco-related deaths occurred among the people aged 30 to 69 years, resulting in a large number of premature deaths, accounting for a

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[1] This model implies that an individual recognizes the dependence of the current addictive consumption decisions on past choices on future consumption decisions when making current choices.
[2] See appendix D.

larger loss of life from premature mortality in developing countries relative to developed countries.

Regulatory effect of prices in control of cigarette consumption has been captured by most cigarettes demand studies[3] using different models and increase in cigarette prices have been found to reduce the cigarette consumption significantly. Cigarette taxes for instance, excise taxes, have been found to be effective tool in manipulating prices in a way that they affect the cigarette consumption negatively (Bishop and Yoo, 1985; Licari and Meier, 1997). The World Bank (1999) reiterated that on average, a price rise of 10% on a pack of cigarettes would be expected to reduce demand for cigarettes by about 4% in high income countries and about 8% in low and middle income countries.

The models for the report further showed that tax increases that would raise the real prices of cigarettes by 10% worldwide would cause 40 million smokers alive in 1995 to quit, and prevent a minimum of 10 million tobacco related deaths. The price rise would also deter others from taking up smoking in the first place. Currently, in the high-income countries, taxes average about two -thirds or more of the retail price of a pack of cigarettes. In lower income countries taxes amount to not more than half the retail price of a pack of cigarettes (World Bank, 1999).

Other control measures applied to cigarettes consumption include comprehensive bans on advertising and promotion of tobacco; information measures such as mass media counter advertising, prominent health warning labels, the publication and dissemination of research findings on the health consequences of smoking as well as restrictions on smoking in work and public places (World Bank, 1999). In the majority of countries[4], the health warning is basic, for example "smoking is harmful to your health" or "smoking is dangerous for health". In at least nine countries[5] the warning is prefaced with the words "Government warning:" or "Ministry of Health warning:" or "Surgeon General's warning:" A few countries cite specific health consequences of smoking and use rotating

[3] Bishop and Yoo, 1985 using a conventional demand model; Mullahy, 1985 using myopic addiction model and Grossman et al., 1991 using a rational addiction model

[4] Bangladesh, Cameroon, Congo, Czech Republic, Georgia, India, Indonesia, Kenya, Laos, Pakistan, Papua New Guinea, Romania, Uganda, Ukraine, Uruguay, Yugoslavia, Zambia, Zimbabwe

[5] Bangladesh, Congo, Czech Republic, Kenya, Pakistan, Papua New Guinea, Uganda, Ukraine, USA

warnings. Canada and Thailand have the strongest warning labels, which include information on addiction, sexual impotence, and smoking's harm to love ones (FCA[6], 2005).

The World Bank (1999) report further says that if these non-price measures are employed as a package globally they could persuade about 23 million smokers alive in 1995 to quit and avert the tobacco attributable deaths of 5 million of them. Another intervention is high accessibility and availability of nicotine replacement therapies for those who wish to cease smoking. The report also concluded that tobacco control measures were highly cost-effective compared to other health interventions.

1.1.1 Cigarette Consumption, Smoking Prevalence and Control Measures in Kenya

Kenya is classified as a low income country with Gross National Income per capita of about $1,170 and a population of about 34.2 million in 2005 (WHS[7], 2007). Currently the economy is enjoying a remarkably steady growth, where in 2005 it was reported to be 5.7% and in 2006 it realized 6.1% indicating an improvement of about 0.4%. (Economic Survey, 2007). The main economic activities are agriculture, tourism and manufacturing sectors. Agriculture employs about 75% of the working population most of them living in the rural areas (SUSTAINET online).

Life expectancy at birth in the country is about 51 years (2005) for both males and females while the healthy life expectancy at birth for both males and females was about 44 and 45 years respectively based on the year 2002 statistics (WHS, 2007). The total government health expenditure per capita was $85 in 2004 and the total expenditure on health as a percentage of GDP in 2001 was 4.1% (ibid.). Kenyan population is affected by health concerns such as HIV and AIDS, malaria and tuberculosis and, currently reeling under the threat of tobacco related epidemic.

Total consumption of cigarettes in Kenya shows an up and down trend. In the period between 1970 and 1990 the consumption increased by 153% and between the periods 1990 and 1996 it decreased by 26% (Guindon and Boisclair, 2003). Statistical Abstract

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[6] Framework Convention Alliance for Tobacco Control.
[7] World Health Statistics, 2007.

(2006) further reported that between 1997 and 2005 the total cigarette consumption decreased by about 54% and this might have been due to the stoppage of cigarette advertising by British American Tobacco (BAT) in the year 2000 in its all international outlets. By 2000 BAT owned about 92.3% of the market share of cigarette manufacturing in Kenya with the rest being shared by Mastermind (6%), Japan Tobacco (0.4%) and others (1.3%) (WHO, 2002). Additionally, per capita consumption of cigarettes rose by 32% (from 429 to 565) between the period 1970 and 1980 and gradually reduced by 44% (from 565 to 316) between the period 1980 and 1995 (Guindon and Boisclair, 2003). Wangai et al. (2000)[8] reported that the tobacco smoking prevalence rate was 66.8% and 31.9% for males and females respectively with an overall prevalence rate of 54.6% for the population at the age of 12+ years.

Statistical Abstract (2006) report on outpatient morbidity statistics showed that the diseases of respiratory system increased[9] from about 4.6 million cases in 2000 to 8 million cases in 2005. Similarly rheumatism diseases increased from about 232,000 cases in 2000 to 569,000 cases in the year 2005. Specifically, Farley et al (2001) reported that the rate of trachea, lung and bronchus cancer death was 9.3% for male and 3.8% for female from the age 45+ years. Deaths from lip, oral cavity and pharynx cancer were at the rate of 24.5% and 19.5% for male and female respectively at the age of 45+ years (ibid.).

The effects of health on development are clear. Countries with weak health and education conditions find it harder to achieve sustained growth. Economic evidence confirms that a 10% improvement in life expectancy at birth is associated with a rise in economic growth of some 0.3 to 0.4-percentage points a year (OECD Observer, Online). Disease hinders institutional performance too and lower life expectancy discourages adult training and damages productivity tremendously. The high prevalence of smoking cigarettes (tobacco) in Kenya is a very big cause for an alarm both in the health sector and the economy in general.

[8] Reported in WHO Global InfoBase (infobase.who.int)
[9] There is no tangible evidence that they are all cases resulting from tobacco or cigarettes smoking.

First issue of concern is the possible increase in government health expenditure thus diverting resources, which could be used in other development sectors to improve economic growth due to illnesses arising from tobacco or cigarette consumption. Secondly, tobacco kills people at the height of their productivity, depriving nations of a healthy workforce and furthering the cycle of ill health, poverty and death. The premature death of a breadwinner increases the vulnerability of the family hence compromising the livelihood of the household. This has a substantial effect on their children education and nutrition thus enhancing the poverty vicious cycle.

Thirdly, most smokers spend their income on cigarettes and deprive their families of basic necessities such as education and nutrition because of slavery of addiction stopping the habit is not always easy. Finally, the biggest problem arises from the negative externalities propagated by the smokers to those around him or her. The second hand smokers are also vulnerable to suffer from tobacco related illness. Therefore there is a dire need to protect present and future generations from the devastating health, social, environmental and economic consequences of tobacco (cigarette) consumption and exposure.

1.1.2 The Framework Convention on Tobacco Control (FCTC)

The dramatic changes in global patterns of tobacco (cigarette) use and tobacco-attributable deaths and diseases[10], and a relentless rise in the number of deaths from tobacco(cigarette) use provided impetus for the World Health Organisation (WHO) to take the unprecedented step of a global treaty. The Framework Convention on Tobacco Control (FCTC) is the first international treaty ever negotiated by the member states of WHO. The WHO Framework Convention on Tobacco Control entered into force and became legally binding for the first 40 countries in 2005. There are 39 out of 46 countries in WHO African region who signed the treaty and nine countries[11] ratified it in the same year. (WHO Africa Region, 2005)

[10] See Appendix D.
[11] Botswana, Ghana, Kenya, Lesotho, Madagascar, Mauritius, Senegal, Seychelles and South Africa.

The role of the convention is to stem the high prevalence of tobacco use in Africa and other WHO regions[12]. The tobacco (cigarette) smoking prevalence in Africa was about 29% and 7%, for males, and females respectively in the year 2000. The main objective of the convention is to protect the present and future generations from the damaging health, social, environmental and economic consequences of tobacco consumption and exposure (Ibid.).

It provides guidelines for tobacco control measures to be implemented by parties at the national, regional and international levels inorder to substantially and continually reduce the prevalence of tobacco smoke. The final draft of the FCTC addresses a wide range of issues including price and tax measures, protection from exposure to secondhand smoke, regulation and disclosure of the contents of tobacco products, packaging and labelling, education, communication, training and public awareness, advertising, promotion and sponsorship, tobacco dependence and cessation measures, illicit trade, and sales to and by minors and liability (WHO, 2003).

The major challenges for FCTC in African region include: a) protecting public health policies from commercial interests of the tobacco industry and ensuring effective interventions to counter the social effects of persuasive and misleading advertising; b) strengthening capacity of health personnel to prevent and reduce tobacco consumption; improving financial and human resources to support comprehensive tobacco control programmes; and encouraging the involvement of non-health sectors in tobacco control; c) ensuring that tobacco control is included on national development agendas and investing in feasible and sustainable alternative sources of economic income for countries heavily dependent on tobacco revenues (WHO African Region, 2005).

Some of opportunities arising from implementation of FCTC in participating countries are: i) implementation may begin with application of strategies that have already been adopted by the Region to foster action towards tobacco control. Integration of tobacco control into established national HIV and AIDS, malaria and tuberculosis programmes is necessary as tobacco is an important risk factor in tuberculosis and also interferes with

[12] America, Eastern Mediterranean, European, South-East Asia and Western Pacific.

the immune system. ii) The strong stand of the donor community, notably the World Bank (WB) and the European Union (EU), on tobacco control offer further opportunities for countries to accept the challenge of tobacco control as well as enhance their capacity to achieve the millennium development goals pertaining to poverty reduction and better health (ibid.).

Increased activity to reduce this burden is a priority for both the WHO and the World Bank as part of their mission to improve health and reduce poverty. These two institutions partnering with various governments including Kenya have a strong mandate to enable efforts which identify and implement effective tobacco control policies, particularly to reduce the suffering and costs of the smoking epidemic (World Bank, 1999).

1.2 Problem Statement and Significance of the Study

The tobacco control policies such as higher excise taxes, health warning labels and ban on advertising in Kenya have been effected not from local studies but studies done elsewhere in the developed countries. The Framework Convention on Tobacco Control (FCTC) treaty which Kenya signed and ratified in the year 2005 promoted a lot of actions on tobacco control efforts in Kenya.

The first intervention was in 2006 where the Kenyan Parliament passed The Tobacco Control Bill through the second reading which aimed at establishing a legal entity to regulate the growing, manufacture, sale, distribution, use and advertising of tobacco and its products (The Nation [Nairobi], 2006). In the same year ministerial directive from the Ministry of Health on smoking ban in public places was thwarted by a court of law after both smokers and the cigarette manufacturers sued the government. The ban affected office blocks, working areas, court buildings, education institutions, residential areas, places of worship, police stations, prisons, markets, malls, cinema and theatre, children's homes and playing fields (BBC, Online). Though the smoking ban legislation is not effective yet, most public buildings especially government premises hold big signboards which prohibit both occupants and visitors from smoking within that area.

The government has annually raised excise tax on cigarettes not as a result of tobacco control efforts but for revenue optimization purposes thus the reason for a lot of studies on revenue optimization for example, Njuguna et al. (2002) and Obwona et al. (2005) rather than control attribute of excises taxes which are transmitted to prices of cigarettes. Various Statistical Abstracts have reported that excise tax revenue from cigarettes has been growing steadily from $ 1.3 million in 1970 to $7.2 million in 1980 and from $ 31 million in 1990 to $ 63 million in the year 2005 which vividly implies that increase in the rate of excise taxes overtime does not result into decrease in revenues collected from cigarette taxes (excise tax). Specifically, Yurekli and Beyer (2001)[13] reported that the excise tax charged on cigarettes was as high as 160%, sales tax (Ad Valorem tax) 18% and import duty was 30% (min 300 LCU/kg[14]) in Kenya.

Recently in 2007-2008 budget reading the Minister of Finance imposed additional excise tax of between $0.02 and $0.09 cents on individual cigarette packs (East Standard Online). The tax burden is expected to be transferred to smokers by the cigarette manufacturers by increasing cigarette prices. Another measure used to control cigarette consumption in Kenya has been health-warning labels. The warning label is quoted, as 'Cigarette Smoking is Harmful to Your Health' on all cigarette packs, introduced by the Ministry of Health in 1985 under the Public Health Act, Section 169. The health-warning message was ratified under Public Health (warning on cigarette smoking) Rules, Section 2-5.

The study is important because of the need to build literature and give a vivid result on effects of regulatory policies such as higher prices and prominent health warning labels on cigarettes demand in Kenya. The study will fill the knowledge gap by finding out if higher prices and prominent health warning labels have been effective in controlling per capita cigarette consumption in Kenya. Diversion from the cigarette excise revenue optimization studies, will give a clear direction on curbing negative effects of cigarette smoking in order to avoid catastrophic illness and human capital loss, which has adverse effect on productivity of labour and economic development.

[13] World Bank Country Profile on Kenya on tobacco prevalence and use. The information for the excise tax, sales tax and import duty was adapted from Economic Intelligence Unit (EIU) by the authors.
[14] Local Currency Unit/ kilogram

1.3 Objectives of the study

The general objective of the study is to evaluate the determinants of cigarettes in Kenya.

Specific objectives:

i) To investigate the impact of cigarette prices on per capita consumption of cigarettes.

ii) To determine the influence of past cigarette consumption per capita on the current per capita cigarette consumption.

iii) To analyze the influence of advertising on cigarette consumption per capita.

iv) To evaluate the effectiveness of health warnings labels on per capita cigarette consumption.

1.4 Study Hypotheses

i) Cigarette prices have no impact on per capita consumption of cigarettes.

ii) Past per capita consumption of cigarettes does not influence per capita consumption of cigarettes.

iii) Advertising does not influence cigarette consumption per capita.

iv) Health warning labels have no effect on per capita cigarettes consumption.

1.5 Organization of the Study

The study is organized in 5 chapters. Chapter 1, introduces of the scope of the study. Chapter 2 presents a review of existing literature both theoretical and empirical. Chapter 3 looks at the methodology of the study. Chapter 4 presents and discusses an analysis of the results. Finally, chapter 5 consists of summary of findings, conclusions and policy implications.

CHAPTER 2

LITERATURE REVIEW

There is a wide range of both theoretical and empirical literature on cigarettes demand. Generally most literature presents behaviour of cigarette demand in relation to its addictiveness, prices, income and information variables such as advertising and health warning or scare about adverse of cigarette consumption. In this chapter the study presents both theoretical and empirical literature on cigarette demand starting with theoretical in section 2.1 and empirical in section 2.2.

2.1 Theoretical Review

Introduction

Modelling the demand for cigarettes has long been an interest of economists. Many studies for long, have viewed cigarette smoking and other addictive behaviours as irrational requiring no conventional economic analysis (Schelling, 1984). The belief was that demand for cigarettes did not follow the basic law of economics including the downward-sloping demand curve. This view has gradually changed as a large body of economic research demonstrates that demand for cigarettes clearly responds to changes in prices and other factors. Several types of economic models with different types of data and various estimation techniques have been applied to studies on demand for cigarettes. Generally, two types of economic models are used: the conventional demand models and the addictive demand models.

2.1.1 Conventional Demand Models[15]

Conventional demand models are based on standard, constrained lifetime utility-maximizing framework in economics. They are modelled as follows:

$$U_t = f\left[C_t, X_t\right] \qquad [2.1]$$

Where C_t is the consumption of the addictive substance at time t, X_t is the consumption of other composite good at time t. This utility is maximized subject to income constraints.

[15] Adapted from Chaloupka, F.J. and Tauras, J.A. (2001)

The demand function is derived as follows:

$$C_t = g[P_t, Y_t, Z_t] \qquad [2.2]$$

where P_t is the current price of the addictive substance, Y_t is the income and Z_t is the vector of the other variable influencing cigarette demand such as tobacco control policies, variety of socioeconomic and demographic factors.

In conventional models, current consumption of addictive substance (cigarettes) depends only on current factors. Increase in current price will reduce current consumption, where price is defined broadly to include monetary price, time costs, expected legal costs, and anticipated health consequences. Increase in past price and/or anticipated increase in future price will have no impact on current consumption. Convention demand models do not reflect the dependence of current consumption decisions on the past behaviours that characterizes the use of the addictive substances Chaloupka and Tauras (2001).

2.1.2 Addictive Demand Models

Marshall (1920) discussed the effects of addiction on demand, where he observed that whether a commodity conforms to the law of diminishing or increasing returns, the increase in consumption arising from a fall in price is gradual; and, further, habits which have once grown up around the use of a commodity while its price is low are not quickly abandoned when its prices rise again. Moreover, Phlips (1983) noted that Marshall's statement introduced the three basic dimensions of addiction; gradual adaptations (tolerance), irreversibility (withdrawal) and positive effects of habits (reinforcement) that are used in many of the recent formal models of addictive behaviour.

Tolerance suggests that a given level of consumption leads to less satisfaction as past consumption of the cigarettes is higher. Reinforcement implies a learned response to past consumption and can be either positive or negative. Finally, withdrawal refers to a negative physical reactions and other reductions in utility associated with cessation of consumption (Chaloupka, 1990).

Recent economic models of habitual behaviour can be divided into distinct classes based on their approaches to key factors. The first distinction comes from the treatment of tastes as either endogenous or constant over the life cycle. Endogenous tastes models incorporate addiction by making present tastes dependent on the past consumption (Gorman, 1967). Alternatively, models with constant tastes, developed in the framework of household production theory, embody the addictive nature of consumption by letting the ability to produce the addictive commodity (using the addictive good) depend on the past consumption.

The second key distinction concerns the rationality of the addict (Stigler and Becker, 1977 and Becker and Murphy, 1988). Some treat the addict as behaving myopically that is the addict takes into account the dependence of current addictive consumption on past consumption but ignore the dependence of future consumption on current and past consumption when making current consumption decision. Others choose to treat the addict as fully rationally. In these models, the addict is assumed to be aware of and accounts for the interdependence of past, current and future consumption when making current consumption decisions.

At any moment in time, the individual's utility is assumed to be a function of three factors H, K, and M.

$$U_t = u[H_t, K_t, M_t]. \qquad [2.3]$$

H_t is the individual's health at time t, K_t is the "comfort" produced by the consumption of the addictive commodity at time t, and M_t is a vector of other consumption commodities. The assumption is made that u is a concave function and has negative second derivatives with respect to each of the arguments:

$$u_i > 0, \quad \text{and} \quad u_{ii} < 0, \qquad i = H, K, M \qquad [2.4]$$

The arguments in the utility function are produced as follows:

$$H_t = H[N_t, S_t] \text{ with } H_N > 0, H_{NN} < 0, H_S < 0, \text{ and } H_{SS} < 0 \qquad [2.5]$$

$$K_t = K[C_t, S_t], \text{ with } K_C > 0, K_{CC} < 0, K_S < 0, K_{SS} < 0, \text{ and } K_{CS} > 0 \qquad [2.6]$$

and:

$M_t = M[X_t]$, with $M_X > 0$, and $M_{XX} < 0$. [2.7]

H_t, is assumed to be a function of market goods, such as medical care, and the individual's own time spent for example, on exercise denoted by the vector N_t, which enter into the production of health. These inputs have positive but diminishing effects on health. Health at time t is also affected by the level of the addictive stock at time t, (S_t). The higher the level of the addictive stock (the larger the degree of addiction), the lower the level of health, all else constant.

'Comfort', K_t is produced by the consumption of the addictive good (cigarette), C_t and the addictive stock. Comfort can be thought of as the physiological and psychological benefits resulting from the addictive substance. For instance, Ashton and Stepney (1982) associated the short-term psychological and physiological effects of smoking cigarettes to relieving stress or boredom. Increased cigarette consumption has a positive effect on the production of comfort. Greater past consumption, however, is assumed to have a negative effect on the production of comfort. This assumption incorporates the notion of tolerance into the model. To capture reinforcement effects in consumption, the marginal productivity of cigarette consumption at time t in the production of comfort is assumed to be higher and higher as the level of addictive stock increases at time t.

The vector of consumption goods M_t is produced using inputs X_t, which include market goods and the individual's own time. All inputs are assumed to have positive but diminishing marginal productivity in the production of M.

Based on these assumptions, a derived instantaneous utility function is obtained as:

$U_t = U[C_t, S_t, G_t]$ [2.8]

Where C and S are as above, and G_t is a vector including all inputs into the production of consumption goods and health.

At any time t, the following will be true:

$$U_C = u_K K_C > 0 \quad [2.9]$$

$$U_S = u_K K_S + u_H H_S < 0 \quad [2.10]$$

$$U_G = u_H H_G + u_M M_G > 0 \quad [2.11]$$

$$U_{CS} = u_{KK} K_C K_S + u_K K_{CS} > 0 \text{, and} \quad [2.12]$$

$$U_{ii} < 0, \quad i = C, S, G \quad [2.13]$$

Equations 2.9 to 2.12 can be used to further explain the three characteristics of addictive consumption. Equation 2.9 illustrates withdrawal, since the total utility falls if cigarette consumption is reduced. Tolerance is captured by the negative marginal utility of the addictive stock shown in [2.10], which shows that the greater the level of the past consumption, the lower the current level of utility, ceteris paribus. Finally, reinforcement is shown by [2.12] which state that the marginal utility of current consumption is larger than the level of past consumption, or that past consumption reinforces current consumption (Chaloupka, 1990).

There are several versions of the addictive models that have been used for studying the demand for cigarettes. These are: the imperfectly rational addiction models, myopic addiction models and rational addiction models.

2.1.2.1 The Imperfectly Rational Addictive Models

These models generally assume stable but inconsistent short- run and long-run preferences. Schelling (1978) described a smoker who tries to quit smoking as having two personalities contesting for control of ones behaviour. He reiterates that one needs clean lungs and long life and the other adores tobacco. The latter needs only occasional control to spoil the resistance of the former, who enjoys clean lungs and long life.

Thus, the farsighted personality may enrol in a smoking cessation program, only to be undone by the shortsighted personality's relapse in a weak moment. Winston (1980) formally modelled this behaviour and described how this contest between personalities lead to evolution of what is called 'anti-markets', which he defined as firms or institutions that individuals will pay to help them stop consuming.

Strotz (1956) developed a model on such behaviour, describing the constrained utility maximization process as one which an individual chooses a future consumption path that maximizes current utility, but later in life changes this plan 'even though his original expectations of future desires and means of consumption are verified'. This inconsistency between current and future preferences only arises when a non-exponential discount function is used. Strotz further suggested that rational persons will recognize this inconsistency and plan accordingly, by pre-committing their future behaviour or by modifying consumption plans to be consistent with the future preferences when unable to pre-commit.

Pollak (1968) further reiterated the concept by arguing that an individual may behave naively even when using an exponential discount. Thaler and Shefrin (1981) looked at the problem similarly, referring to the individual at any point in time as both a 'farsighted planner and a myopic doer', with the two in continual conflict. While these models present interesting discussions of some aspects of addictive behaviour, they have not been applied empirically to cigarette smoking and other addictions.

2.1.2.2 Myopic Addiction Models

The naive behaviour described in some of the imperfectly rational models of addiction is the basis for many of the myopic models of addictive behaviour. Pollak (1975) observed that behaviour is naive in the sense that an individual recognizes the dependence of current addictive consumption decisions on past consumption, but then ignores the impact of current and past choices on future consumption decisions when making current choices. Many of these models treat preferences as endogenous, allowing tastes to change overtime in response to past consumption. Gorman (1967) model tastes endogenously as follows:

Consider consumer whose utility function

$$u = f(x,\alpha) = f(x_1,...,x_n,\alpha_1,...,\alpha_t) \qquad t < n \qquad [2.14]$$

Depends on a set of parameters $\alpha_1,...,\alpha_t$. He further assumes that in any given state of taste $\alpha \in A$, then, any $x \in X$ (addictive good) is chosen at prices p and income m defined by

$$p_i = \mu f_i(x,\alpha) \qquad \Sigma p_i x_i = m \quad f_i = \partial f / \partial x_i \qquad [2.15]$$

and only at *(p, m)* or *(Kp, Km)* in general.

In the long run, tastes depends on past behaviour so that.

$$\alpha_r = a_r(x) \qquad r=1,\ldots, t. \qquad [2.16]$$

Where *a*'s are habits[16].

The long run equlibria are defined by 2.15 and 2.16 or succinctly by

$$p_i = \mu f_i(x, a(x)),\ \Sigma p_i x_i = m \qquad [2.17]$$

The earliest theoretical models of demand in the context of myopic addiction can be traced to the irreversible demand model by Farrell (1952), where he described an irreversible demand function as one in which current demand depends on past prices and income combinations. As a result, price and income elasticities are constant, but may differ for increases and decreases in prices and income. See Houthakker and Taylor (1966, 1970) modelling of myopic addiction.

2.1.2.3 Rational Addiction Models

Rationality as implied here refers to a situation whereby individuals incorporate the interdependence between past, current and future consumption into their utility maximization process. This is in contrast to the assumption, implicit in myopic models of addictive behaviour, that future implications are ignored when making current decisions (that is myopic behaviour implies an infinite discounting of the future), while rational addictive behaviour implies that future implications are considered, while not ruling out a relatively high discount rate. Several of rational addiction models, including that of Lluch

[16] Habits are formed due to past consumption of the addictive good x.

(1974) assume that tastes are endogenous. This model builds on significant contributions of Ryder and Heal (1973) and others in the optimal growth literatures that have developed endogenous taste models with rational behaviour.

Spinnewyn (1981) and Phlips and Spinnewyn (1982) argued that incorporating rational decision making into models of habit formation results in models that are 'formally equivalent to models without habit formation'. Thus they argued that assuming rationality only leads to unnecessary complications. Pashardes (1986) challenged the assertion when he derived demand equations for a rational consumer in which current consumption was determined by past consumption and current preferences with full knowledge about the impact of current decisions on the future costs of consumption.

Becker and Murphy (1988) also rejected the notion that myopic behaviour is empirically indistinguishable from rational behaviour in their theory of rational addiction. They proposed the following simple model for consumption of addictive commodities, which is characterized by linear dynamics for an addictive stock variable and rational forward looking behaviour by utility maximizing agent.

The consumer's instantaneous utility is $U_t = U\left(C_t, S_t, G_t\right)$ where C_t current consumption of the addictive good is. S_t is a stock variable measuring the degree of addiction and G_t is a composite non-addictive consumption good. S_t enters utility function as a proxy for the health effects induced by the addictive consumption history and is assumed to evolve over time according to a simple investment equation:

$$S_{t+1} = \left(1-\delta\right) S_t + C_t \qquad [2.18]$$

Where δ is the rate at which the addiction depreciates over time. Using the non-addictive composite commodity as the numeraire, and denoting the price of the addictive good as P_t, the consumer is subject to a lifetime budget constraint

$$\sum_{t=1}^{\infty} \beta^{t-1}\left(G_t + P_t C_t\right) = W_t \qquad [2.19]$$

Where β is the discount factor. The individual's problem is to choose $\{C_t\}_1^\infty, \{S_t\}_1^\infty$ and $\{G_t\}_1^\infty$ to maximize the discounted stream of current and future utilities

$$\sum_{t=1}^{\infty} \beta^{t-1} U(C_t, S_t, G_t) \qquad [2.20]$$

subject to the budget constraint and the dynamics of the addictive stock.

Following Becker and Murphy the utility function is approximated by a quadratic in order to linearize the estimating question and write

$$U_t = \alpha_G G_t + \alpha_C C_t + \alpha_s S_t + \frac{U_{GG}}{2} G_t^2 + \frac{U_{CC}}{2} C_t^2 + \frac{U_{ss}}{2} S_t^2 + U_{GS}(G_t S_t) + U_{CS}(C_t S_t) + U_{GC}(G_t C_t) \qquad [2.21]$$

The marginal utilities with respect to the addictive good and the addictive stock are:

$$U_C = \alpha_C + U_{CC} C_t + U_{CS} S_t + U_{GC} G_t \qquad [2.22]$$

$$U_S = \alpha_S + U_{SS} S_t + U_{GS} G_t + U_{CS} C_t \qquad [2.23]$$

If we assume that current and past consumption of the addictive good have no effect on the marginal utility derived from consuming the composite good, this equation imply:

$$C_t = \vartheta_0 + \vartheta_1 C_{t-1} + \beta \vartheta_1 C_{t+1} + \vartheta_2 P_t + \vartheta_3 P_{t-1} + \beta \vartheta_3 P_{t+1} \qquad [2.24]$$

Where $\vartheta_1 > 0, \vartheta_2 < 0$ and $\vartheta_3 > 0$.

The positive sign for ϑ_1 follows from the reinforcement effect of addictive consumption $(U_{cS} > 0)$. Positively signed coefficients on past and future prices are less intuitive given the complementarity of consumption across periods. The explanation is that ϑ_3 measures the marginal effect of past and future prices on current consumption holding consumption in period's t-1 and t+1 constant. This implies that other factors must be operating to offset the effects of past and future price changes on past and future consumption respectively. The relevant complementarity therefore relates to these offsetting effects, and gives rise to the positive value for ϑ_3.

The equation [2.24] nests a number of different behaviours. A non-addicted consumer responds only to current price and perhaps to other exogenous factors such as income, advertising and health warning messages. An addicted but myopic consumer ignores the implications for his future consumption of current decisions and only responds systematically to current and past information. An individual who is addicted and rational takes these implications into account. As an example, consider an individual who expects consumption of cigarettes and tobacco to be relatively lower in the next period because of an anticipated price increase. This would have no implications for the current behaviour of a non-addicted or a myopic addicted individual. However, an addicted and rational individual will recognize that the price increase will raise the future cost of current consumption and will make the appropriate adjustments to current consumption. A rational consumer will also take notice of new information about future health effects (Bardsley and Olekalns, 1998).

Becker and Murphy (1988) reiterated further that the long-run effect of a permanent change in price will exceed the short-run effect[17] and the ratio of long run to short-run price effects rises as the degree of addiction rises. They then predicted that the effect of an anticipated price change will be greater than the impact of a comparable unanticipated price change, while a permanent price change will have a larger impact on demand than the temporary price change. Finally, price responsiveness varies with time preferences: addicts with higher discount rates will be relatively more responsive to changes in money price than those with lower discount rates.

The opposite will be true with respect to the effects of information concerning the future consequences of addictive consumption. Thus, the model suggests that younger, less educated, and lower income people will be relatively more responsive to changes in money prices of cigarettes, while older, more educated and higher income people will be relatively more responsive to new information on the health consequences of cigarette smoking.

[17] Myopic addiction models also predict that long-run price elasticity of demand will be larger than the short run elasticity.

Strong adjacent complementarity, reflecting strong addiction, can lead to unstable steady states in the Becker and Murphy model. This is the key feature of their rational addiction theory helping to explain the binge behaviour and 'cold turkey' quit behaviour observed in addicts. Furthermore, these unstable steady states imply that there will be a bimodal distribution of consumption, again something observed for many addictive goods. In addiction, Becker and Murphy model implies that temporary events, including price reductions, peer pressure, or stressful events, can lead to permanent addictions.

2.2 Empirical Literature Review

Introduction

Studies on demand for cigarettes have applied different economic models to two different types of data, aggregated and individual level. Analyzing each of the two data-types has some advantages and disadvantages. The aggregate data are either time-series data or pooled cross-sectional and time-series data. High correlation among many of the key independent variables and prices can be a problem with time-series data. Consequently, estimates of the impact, which prices and other factors have on demand, can be sensitive to the inclusion and exclusion of the other variables. The problem with using the pooled data is the measurement of cigarette consumption. Using these data, smoking is normally measured by annual state-level tax-paid cigarette sales. Both cross-border shopping between the neighbour states or countries and the long-distance smuggling from low-tax to high-tax states or countries can occur due to differences in taxes on cigarettes. Failure to account for this will produce upward-biased estimates of the impact of price on cigarettes demand.

Finally, with aggregate data the demand and supply of cigarettes need to be modelled simultaneously since cigarette price, sale and consumption are simultaneously determined. In contrast, the use of individual-level data can ease some of the problems associated with aggregate data such as simultaneous biases resulting from the price and consumption, and multicollinearity between cigarette prices and other factors affecting the demand. In addition, using individual-level data can allow researchers to study the price responsiveness of different sub-population groups such as those based on income, education, and age. The problem with individual-level data is the accuracy with which consumption of cigarettes is measured. Self-reported consumption is typically under reported.

The use of a rational addiction model for modelling the demand for cigarettes has been controversial. Critics of the model argue that nobody would sit down at an initial period, survey future income, production technology, investment/addictive function, and consumption preference for a lifetime, maximize the discounted value of his expected utility and decide to become an addicted smoker. Empirical work for testing the rational addictive behaviours has also yielded mixed results.

Empirical Studies Using Conventional Demand Models

Hamilton (1972) using time series data found that in the US health scare was more effective tool to control cigarette consumption than advertising ban. He further argued that advertising elasticity was positive but quite small implying that advertising ban had a little effect on cigarette consumption and it did not reduce as such. Bishop and Yoo (1985) also using time series data found that in the US price elasticity of demand was -0.459, income elasticity of demand to be 0.904 and tax elasticity to be 0.011. Furthermore they concluded that advertising ban and health scare had little effect in reducing cigarettes demand.

Baltagi and Levin (1986) used panel data for 48 states of the United States to estimate dynamic demand for cigarettes and emphasizing on the effects of taxation and advertising. They found that price elasticity was -0.2 and income elasticity to be insignificant. They also found that cigarette taxation was effective tool for generating revenue and mildly supported the notion that subsidized anti-smoking messages were effective in reducing cigarette consumption. There was no support for the thesis that the ban on advertising helps to decrease per capita cigarette consumption.

Goel and Morey (1995) using pooled time series cross-section data set on United States cigarette consumption, measured the effects of antismoking messages and ban on all broadcast advertising of cigarettes. They concluded that effect of current advertising on consumption was negative although the results also showed that advertising had a lagged effect of increasing consumption for cigarettes. They further reiterated that counter-intuitive effect of anti-smoking messages accompanying advertisement made sobering immediate effects, which tended to wear off as time passed. Additionally, repetitive nature of the anti-smoking messages could fail to get consumer attention over time and advertising could also be first redistributing consumption among firms by inducing brand switching without increasing aggregate demand.

Galbraith and Kaiserman (1997), employed national time series on legal[18] cigarette sales and prices and found that short run elasticities of legal cigarettes to be -1.01.Although their model never controlled for linear time trend in smoking demand that might have been correlated with but not caused by price changes. Tauras et al. (2001) examined the impact of cigarette prices (which can be manipulated by excise taxation), youth access laws, and other socio-demographic factors have on youth's decision to start smoking in the United States. Using longitudinal data they found that the real prices of cigarettes had a negative and significant effect on level of smoking initiation among the youth.

Gruber et al. (2002) noted that the central determinant of the optimal of tobacco (cigarettes) taxation was the price sensitivity of demand for cigarettes. In their study they found that for every $1 rise in the (real) prices there were 49.95 reductions in cigarette consumption per capita and the implied elasticity was -1. The price was instrumented by tax based on the legal sales excluding smuggling. Liang and Tauras (2003) using cross-sectional data from the United States found that the real prices of cigarettes have negative and statistically significant impacts on the average number of cigarettes smoked by smokers. They estimated price elasticities for conditional cigarette demand to be –0.142 and –0.112 for two separate models. The estimates implied that 10% increase in real price of cigarettes would decrease the average amount of cigarettes consumed by adult smokers by 1.1% and 1.4%.

Chaloupka and Wechsler (1997) using cross-sectional data showed that substantial long run improvements in health could be achieved by raising cigarette excise taxes

[18] Not including smuggled cigarettes.

significantly. They concluded that if the federal excise tax were raised by 75 cents around 1.8 million premature death of young population in the United States would be saved. Chaloupka et al. (1999), using cross sectional data from the United States investigated the impact of cigarette prices, tobacco control policies, marijuana policies and alcohol prices on youth cigarettes smoking and Marijuana use. They found that cigarette prices had negative effects on cigarette consumption and policies that would be effective in reducing youth smoking would also lead to reduction in youth drinking, marijuana use and other illicit drug use.

Reinhardt and Giles (2001) in Canada using time series national level data found that the price elasticity of cigarette demand was -0.62. This result was questioned by Gruber et al. 2002 because they relied solely on national time series variation; any other contemporaneous trends in the demand for cigarettes could have biased their estimates.

Empirical Studies Using Myopic Addiction Models

Mullahy (1985), used myopic addiction model and micro- data in the US. He found that the stock of past cigarette consumption had a negative impact on the production of commodities such as health and the satisfaction received from the current smoking. He further applied a two-part model to estimate cigarettes demand, as well as instrumental variables method to account for unobservable individual heterogeneity likely to be correlated with the stock of past consumption. He proved the hypothesis that cigarette smoking is addictive was very true. Finally, he reiterated that more addicted smokers were less responsive to prices than their less addicted counterparts.

Licari and Meier (1997) in United States using panel data and applying myopic addiction model found that real tax increase by one cent per pack reduced consumption of cigarettes by 0.813 packs per person for state taxes and 0.824 packs per person for federal taxes. They also found that health-warning labels on cigarette packs led to the decline of cigarette consumption per capita.

Grossman (2004) noted that economics of substance use and abuse deals with consumption of goods that are addictive and are harmful to the user and others. This arouses interest from policy, legal and public health perspectives on the substances use. He found that prices have a negative and significant impact on cigarette consumption reduction. Further more previous consumption had a profound impact on current cigarette consumption hence reinforcing the myopic addiction models.

Empirical Studies Using Rational Addiction Models

Chaloupka (1990) supported Becker- Murphy rational addiction theory while using micro-data from the United States. He found that current cigarette consumption was significant and negatively related to the current price of cigarettes. Similarly, when past and future prices were included they had an anticipated positive effect on current consumption. They also found that past and future consumption both had significant and positive effect on current consumption.

Bardsley and Olekalns (1998) using survey data from Australia, applied rational addiction model to estimate impact of anti-smoking policies (advertising ban, health-warning and smoking ban at work place) on cigarettes and tobacco consumption. They strongly supported the Becker Murphy rational addiction model of aggregate consumption, finding that current consumption is affected by past and anticipated future consumption, and price and income were both significant. The price elasticity and income elasticity of demand were both -0.088 and 0.007 respectively. They also found that health warning and smoking ban at workplace had reduced the cigarettes and tobacco consumption significantly.

Gruber and Koszegi (2000) in their study on relevance of rational addiction theory on addictive substances citing cigarette addiction reiterated that there was a significant impact of linear time trend on price elasticity estimates and therefore it would be necessary to include time trend in any price elasticity estimation on cigarettes demand.

Coppejan et al. (2006) in the United States, analysed consumer demand in markets with large price uncertainty with emphasis on cigarette consumption. Their analysis differed from the most consumer demand studies, which either assumed that individuals face little uncertainty about future prices or the uncertainty has a neglible impact on demand. They developed a demand model for goods that are subject to habit formation and showed that consumption plan for forward looking individuals (rational addiction theory) depended not only on preferences and current period prices but also on individual belief about the evolution of future prices. Additionally, they commented that tax policies do not only affect prices in the period that they are announced or enacted but they also affect belief about future prices and finally announced that policy changes can have large immediate effects if they are perceived to be credible.

2.3 Summary of Literature Review

The study has discussed various theoretical models, which have been involved in the studies of cigarette demand. We have also seen that demand for cigarettes follows the law of demand and that idea of rationality of consumers has been reinforced. One of the theoretical models discussed were conventional demand models, which specify demand equation in such a way that the quantity of cigarettes demanded is a function of price, income, tobacco control policies and a variety of socioeconomic and demographic factors.

Secondly, we have come across addictive demand models, which consist of imperfectly rational addictive models, myopic addictive models and rational addictive models. Imperfectly rational addictive models assume stable but inconsistent short-run and long-run preferences (Strotz, 1956; Pollak, 1968; Schelling, 1978; Winston, 1980;Thaler and Shefrin, 1981) on the other hand myopic addiction models assumes that an individual recognizes the dependence of current addictive consumption decisions on the past consumption, but then ignores the impact of current and past choices on future consumption decisions when making current decisions (Farrell, 1952; Gorman, 1967; Pollak, 1975 , Houthakker and Taylor, 1966,1970).

Moreover, rational addiction models assume that individuals incorporates the interdependence between past, current and future consumption into their utility maximization process (Ryder and Heal, 1973; Lluch, 1974; Spinnewyn, 1981; Phlips and Spinnewyn, 1982; Pashardes, 1986; Becker and Murphy, 1988). These models have all been tested empirically except for imperfectly rational addictive models.

Various empirical literatures have used different kind of data to evaluate cigarettes demand generally. They have included individual level, time series, longitudinal, panel and cross sectional data types. Most of the studies discussed have concluded that prices or cigarette taxes (excise taxes) have a negative and significant influence impact on total or even per capita cigarettes consumption. Tobacco control policies such as health scare, advertising have also been studies and they have been found to be effective tool although with mixed perspectives.

In conclusion, relevant to the objective of this study increase in prices has been confirmed to be the most effective mechanism to control cigarettes consumption. Tobacco control policies such as advertising ban and health warning labels on cigarette packs will only be able to complement the effectiveness of high prices in regulating tobacco (cigarettes) use.

CHAPTER 3

METHODOLOGY

In this chapter the study focuses on four main areas. Firstly we present the model specification using myopic addiction theory adapted from Houthakker and Taylor (1966, 1970) pioneering empirical work on effects of stock of habits (or past consumption) to the current consumption. Secondly the variables used in the study are defined and their expected outcomes are also explained. In section 3.3 we define the kind and sources of data used in the empirical analysis. Section 3.4 discusses the underlying OLS and ML-ARCH assumptions and diagnostic tests used to check the compatibility of the data with the assumptions.

It is important to note that although the theoretical literature on the addictive demand models is embedded on microeconomic theory, the study used a macroeconomic myopic addiction model instead. The following variables in aggregated form, cigarette consumption per capita and the real gross domestic product per capita were included in the model. Cigarette consumption per capita was used as a proxy for individual cigarette consumption and real gross domestic product per capita was used to represent an individual's income. The use of these variables was justified because of the time series analysis rather than use of individual or survey data in the study.

3.1 Model Specification

Empirical applications of myopic addiction models are mostly based on pioneering work of Houthakker and Taylor (1966, 1970). They introduced the dependence of current assumption of an addictive good on its past consumption. This was done by modelling the current demand of the addictive good as a function of a 'stock of habits':

$$C_t = \alpha + \beta S_t + G_t \Pi \qquad [3.1]$$

Where C_t is the consumption of the addictive good at time t, G_t is a vector of factors influencing demand for cigarettes, and S_t is the stock of habits at time t, defined as:

$$S_t = C_{t-1} + (1-\rho)S_{t-1} \qquad [3.2]$$

Where ρ is the rate of depreciation. The stock of habits, or the 'addictive stock', represents the depreciated sum of all past consumption of the addictive good and explicitly captures the dependence of current consumption on past consumption. Making substitution Houthakker and Taylor made the following demand equation:

$$C_t = \lambda + \phi C_{t-1} + [G_t - G_{t-1}]\gamma + G_t\omega \qquad [3.3]$$

After simplification, the addictive nature of demand is captured by making current consumption dependent on past consumption. Houthakker and Taylor predicted that ϕ will be positive for addictive or habit forming goods like tobacco products. Mullahy (1985) found a strong support for the hypothesis that cigarette smoking is an addictive behaviour and concluded that more addicted smokers (defined as those with a larger addictive stock) were less responsive to price than their less addicted counterparts.

Adapting work by Houthakker and Taylor (1966, 1970) and Mullahy (1985) the following model was used in the study.

$$CCPC_t = f(TIME, CIGPRI, RGDP, CCPC_{t-1}, ADVDUM, WARNDUM) \qquad [3.4]$$

The model was transformed in a natural logarithmic function as shown below in equation [3.5]

$$\begin{aligned} \ln CCPC_t = {} & \varphi_0 + \varphi_{1t} TIME + \varphi_{2t} \ln CIGPRI_t + \varphi_{3t} \ln RGDP_t \\ & + \varphi_{4t} \ln CCPC_{t-1} + \varphi_5 ADVDUM + \varphi_6 WARNDUM + \varepsilon_t \end{aligned} \qquad [3.5]$$

Where:

TIME - Linear time trend

$\ln CCPC_t$ - Natural logarithm of current cigarette consumption per capita.

$\ln CIGPRI_t$	- Natural logarithm of real cigarette prices.
$\ln RGDP_t$	- Natural logarithm of real income per capita. (Base year = 1997)
$\ln CCPC_{t-1}$	- Natural logarithm of lagged cigarette consumption per capita.
$ADVDUM$	- Advertising dummy variable. Takes the value of 1=1970-1999, and 0=2000-2005.
$WARNDUM$	- Health Warning label dummy variable. Takes the value of 0= 1970 – 1985 and 1= 1986-2005.
ε_t	- Error term

3.2 Definition of Variables

This section provides definition of variables used in the study and their expected outcomes.

Cigarette consumption per capita (CCPC)

This is the per capita consumption of sticks of cigarettes in a given year. It is defined as total cigarettes consumption divided by the population (15+ years) in a given year. The per capita cigarettes consumption is calculated as follows:

$$CCPC = \frac{DPC + IC - EC}{Pop} \qquad [3.6]$$

Where: - CCPC - Cigarettes Consumption Per Capita.

- *DPC - Domestically Produced Cigarettes.*
- *IC - Imported Cigarettes.*
- *EC - Exported Cigarettes.*
- *Pop - Population 15+ years.*

Time (Trend)

Time trend captures the characteristics of addiction such as reinforcement, tolerance and withdrawal behaviours. Gruber and Koszegi (2000) found that linear trend was necessary for studies on price elasticity of demand.

Real Cigarette Prices (CIGPRI)

This represents the real prices of cigarettes in Kenya. The study uses the price of Sportsman's[19] as a proxy for all other brands. Prices are fundamental in any demand relationship therefore if there is a price increase our expectation is that consumption of that commodity will eventually go down whether in short run or long run. Although there have been propositions that cigarettes are price inelastic, several studies in the developed world have confirmed that increase in prices tend to have negative effects to cigarette consumption per capita.

Lagged Cigarette Consumption Per Capita (CCPC (-1))

This is the lagged dependent variable, which accounts for the per capita consumption of cigarettes in the previous year. It is included in the model to account for addiction**.** These coefficients are positive because of the addictive nature of cigarettes due to nicotine. Previous consumption will definitely have a positive impact on current consumption. This is a result of high-level dependency of current level of consumption on prior consumption level.

Real Income per Capita (RGDP)

This variable show the income earned by individuals in a country in a given year in terms of wages and salaries, gifts and other tokens. The study expects that with rise in income cigarette consumption per capita will rise too.

Advertising Dummy Variable (ADVDUM)

In 2000 BAT decreed that it would stop intensive advertising in all its countries of operation, this was brought about by efforts of anti-smoking lobbyists. Therefore the advertising dummy variable takes the value of 1 from year 1970 to 1999 and value of 0 from the period 2000 to 2005.General expectation is that advertising increases cigarette consumption per capita.

[19] This is because of the popularity of the brand in the Kenyan cigarette market. The price of Sportsman's provides a leverage between the less expensive (Such as Rooster brand) and the most expensive brands (Embassy , Benson and Hedges, and Malboro).

Health Warning Dummy Variable (WARNDUM)

This dummy variable represents health-warning labels on cigarette packs. From the period 1970 to 1985 the dummy variable will take the value of 0 and from 1986-2005 it will take the value of 1. Health warning will eventually reduce cigarette smoking because the smokers will be conscious about adverse effects of cigarettes consumption to their health.

3.3 Data

The data used in the study mainly comprised of secondary sources such as the government of Kenya publications from Central Bureau of statistics (CBS) which included Statistical Abstracts and Economic Surveys. The Ministry of Economic Planning and National Development publishes these annually. Annual data from the period 1970 to 2005 was used.

Firstly, data for cigarette consumption per capita was extracted from Guindon and Boisclair (2003) and various Kenya Statistical abstracts. Secondly, real gross domestic product per capita data was taken from various Statistical Abstracts and Economic Surveys. Finally, Real cigarette prices were extracted from various Statistical Abstracts.

3.4 Estimation Methods

The estimation methods used in the study are both OLS and Maximum Likelihood-ARCH. OLS method is used where there is no violation of classical linear regression model assumptions while Maximum Likelihood-ARCH is used where there is presence of Autoregressive Conditional Heteroscedasticity (ARCH). In the presence of ARCH effects as in the case of the long run cointegrating equation [3.5] Maximum Likelihood -ARCH was used to compare the results with OLS estimation method as shown in section 4.2.

3.4.1 Ordinary Least Squares Estimation Method.

The assumptions of the classical linear regression model consider the following characteristics of the model to be ideal (Gujarati, 2003):

i) linearity of the dependent and independent variables,

ii) the error term should be random,

iii) the error term should have a zero mean,

iv) the error term is also assumed to be homoscedastic or having a constant variance,

v) the error term has to be normally distributed with mean value of zero,

vi) the error term is also assumed not to be serially correlated with other error terms in the study.

The assumptions iv, v, and vi are tested in section 3.4.3.

3.4.2 Maximum Likelihood Estimation of ARCH Models[20]

The Likelihood function can be represented as follows:

$$L(\theta) = f_\theta(x_1, ..., x_n | \theta). \quad [3.7]$$

Where $x_1, ..., x_n$ are observations drawn from an n sample.

The method of maximum likelihood estimates θ by finding the value of θ that maximizes $L(\theta)$. This is the maximum likelihood estimator (MLE) of θ.

Maximum likelihood estimator has the following properties:

Functional invariance: The MLE of a parameter θ can be used to calculate the MLE of a function of the parameter. Specifically, if $\hat{\theta}$ is the MLE for θ, and if $g(\theta)$ is a one to one function, then the MLE for $\alpha = g(\theta)$ is

$$\hat{\alpha} = g(\hat{\theta}). \quad [3.8]$$

[20] Adapted from Robinson and Zaffaroni (2006)

If $g\ (\theta)$ is not one to one then $g(\hat{\theta})$ is the MLE of $\alpha = g(\theta)$ only if the likelihood function is to be modified to be

$$\bar{L}(\alpha) = \sup_{\theta:\alpha=g(\theta)} L(\theta) \qquad [3.9]$$

Asymptotics: The MLE is asymptotically unbiased, efficient and normal. The efficiency and bias are as a result of Gaussian distribution.

ARCH processes comprise a wide class of models for conditional heteroscedasticity in time series. Consider, for $t \in$ **à** $= \{0, \pm, \ldots\}$, the equations

$$x_t = \sigma_t \varepsilon_t, \qquad [3.10]$$

$$\sigma_t^2 = \omega_0 + \sum_{j=1}^{\infty} \psi_{0j} x_{t-j}^2 \qquad [3.11]$$

Where

$$\omega_0 > 0, \qquad \psi_{0j} > 0 \quad (j \geq 1), \qquad \sum_{j=1}^{\infty} \psi_{0j} < \infty, \qquad [3.12]$$

and $\{\varepsilon_t\}$ is a sequence of independent identically distributed (i.i.d.) unobservable real-valued random variables. Assume that a strictly stationary solution x_t to (3.13) and (3.14) exists almost surely (a.s.) under (3.15), and call it ARCH (∞) process.

Consider a parametric version, in which we know functions $\psi_j(\zeta)$ of the $r \times 1$ vector ζ, for $r > \infty$, such that, for some unknown ζ_0,

$$\psi_j(\zeta_0) = \psi_{0j}, \quad j \geq 1. \qquad [3.13]$$

$$y_t = \mu_0 + x_t \qquad [3.14]$$

for some unknown μ_0.

ARCH (∞) processes, extending the ARCH (m), $m < \infty$, process of Engle (1982) and the GARCH (n,m) process of Bollerslev (1986) are considered as class of parametric alternatives in testing for serial independence of y_t (Robinson and Zaffaroni, 2006).

For Gaussian ε_t, a widely used approximate likelihood estimate is defined as follows. Denote by $\theta = (\omega, \mu, \zeta)'$ any admissible value of θ_0 and define

$$x_t(\mu) = y_t - \mu,$$

$$\sigma_t^2(\theta) = \omega + \sum_{j=1}^{t-1} \psi_j(\zeta) x_{t-j}^2(\mu)$$

for $t \in \mathbf{Z}$, and

$$\bar{\sigma}_t^2(\theta) = \omega + \sum_{j=1}^{t-1} \psi_j(\zeta) x_{t-j}^2(\mu) 1(t \geq 2)$$

for $t \geq 1$, where $1(.)$ denotes the indicator function.

The diagnostic tests on the maximum likelihood estimation were normality and ARCH LM test for heteroscedasticity.

3.4.3 Diagnostic Tests

Model Specification Test

It is very important to find out whether the model has omitted certain variables, has incorrect functional form or there is correlation between explanatory variables and the residuals. Fitting two lags of the residuals, Ramsey reset test was used to test for the presence of model misspefication.

Normality of the Random Variable

OLS assumes that the random variable or error term is normally distributed around a zero mean and has a constant variance. Absence of this implies that OLS estimates are still BLUE but we cannot assess their statistical reliability by the classical tests of significance. The Jarque-Bera test was employed to test the null hypothesis of normality.

Autocorrelation of the Disturbance Term

The classical linear assumption on autocorrelation is that the residuals ε_i are mutually independent. OLS estimates, in the presence of autocorrelation are unbiased but not efficient. They do have minimum variance among all linear unbiased estimators. The

Breusch- Godfrey serial correlation LM test was used to test for the null hypothesis of no serial correlation of orders one.

Heteroscedasticity

Auto-Regressive Conditional Heteroscedasticity (ARCH)

ARCH occurs when the error term variance is auto correlated to the squared error term in the previous period. ARCH in itself does not invalidate standard OLS inference, however ignoring ARCH effects may result in loss of efficiency. The ARCH LM test was utilized to test for the presence of ARCH effects.

White's Heteroscedasticity Test

The assumption of homoscedasticity may imply that the residuals have a common variance σ^2. The violation of this assumption is known as heteroscedasticity. The consequences of heteroscedasticity are two fold. The estimates of the regression parameters are still unbiased but inefficient; and the estimates of the variances are biased. The White test was applied on the series to evaluate the presence of heteroscedasticity.

Stability of the Model

To ensure that model was stable the following tests were applied: the Cumulative Sum (CUSUM) Test for stability of the model, Cumulative Sum of Squares (CUSUMSQ) was used to test stability of variances, Recursive residuals for the residuals stability. It was also necessary to understand whether coefficients of the variables were stable so Recursive coefficient tests are used. The above tests were applied on short run OLS regression.

Unit Root Test

Time series data are usually associated with stationarity problems. A stochastic process is said to be stationary if its mean and variance are constant overtime and the value of the covariance between the two time periods is not dependent on the actual time at which the covariance is computed i.e. weak stationarity (Gujarati, 2003). Hence the test for unit root is important for elimination of spurious results. Augmented Dickey-Fuller (ADF) test was used in the study to test for unit root.

The Dickey-Fuller test is a test against the null hypothesis that there is a unit root series integrated of order one {i.e. I (1)}. The test equation is of the form:

$$\Delta X_t = \alpha_0 + \beta X_{t-1} + \alpha(t) + \varepsilon_t \qquad [3.15]$$

The DF test is the test of the coefficient β in equation [3.15], where X_t is any of the variables to be used in the model. The ADF test is the same as the DF except that augmentation in terms of lags of ΔX_t are incorporated. The test equation is of the form:

$$\Delta X_t = \alpha_0 + \beta X_{t-1} + \alpha_1(t) + \sum_{i=1}^{k} \beta \Delta X_{t-i} + \varepsilon_t \qquad [3.16]$$

Where the optimal lag length i is set so as to ensure that any autocorrelation in ΔX_t is absorbed and the error term is distributed as white noise. It is for this reason that it is considered to be a better test than the former. This test is therefore used in the data analysis. The test runs a regression of each variable against itself lagged once and the lagged differenced terms of the same. Eviews gives an option whether to include a constant, α_0 in the equation, or to include both constant α_0 and linear time trend t or none.

The Phillip-Perron (PP) test is the same as DF except that there is no requirement that the error term be serially uncorrelated. The restrictive assumption of independency and homogeneity of the error term under DF are relaxed under the PP test. The PP test is however more appropriate if the variable in consideration has some structural breaks, (Perron, 1989). All the tests were run at 5% significance level. The PP tests were run on three truncation lags as suggested by Newey-West (1998).

Cointegration Test

Regression in levels of non-stationary variables is generally considered spurious; this might not be the case if the variables are synchronized or trend together over time. Such synchrony suggests that a linear combination of the non-stationary variables is itself stationary, and the regression in levels represents long-run equilibrium relationship. Such variables are said to be cointegrated and their regression in levels is termed as cointegrating equation Gujarati (2003). The Augmented Engle-Granger test was used to test for cointegration as it facilitates the error correction mechanism.

3.5 Summary of Methodology

The study used a myopic addiction model by Houthakker and Taylor (1966, 1970) to measure the cigarette per capita consumption given the effects of time, cigarette prices, real income per capita, lagged cigarette consumption per capita and health warning and advertising dummy variables. Annual time series data from 1970 to 2005 was used. The data was sourced from a number of Economic Surveys and Statistical Abstracts published by the government of Kenya annually. Relevant diagnostic tests such as Ramsey RESET test for specification, Jarque-Bera test for Normality, Breusch- Godfrey test for autocorrelation, ARCH LM test for Autoregressive Conditional Heteroscedasticity, and White's test for heteroscedasticity were applied to the study to satisfy the classical linear regression model conditions and Maximum likelihood conditions. Assumptions underlying the two methods of estimation were also discussed.

CHAPTER 4

EMPIRICAL ANALYSIS

This chapter presents empirical analysis that was undertaken in the study. Specifically section 4.1 present unit root and cointegration tests and, section 4.2 reports regression results and their respective interpretations. Results for respective diagnostic tests are shown alongside the regression results.

4.1 Unit Root and Cointegration Analysis

This section reports the unit root test done by applying both Augmented Dickey- Fuller test and Philip-Peron tests on the individual variables both in their levels and first-differences. Secondly, cointegration analysis is also done to find if the variables in the regression equation are cointegrated using Engle-Granger two step procedure.

4.1.1 Unit Root Test for Stationarity

Individual unit root tests using Augmented Dickey- Fuller and Philip-Peron tests were taken for the dependent variable CCPC and the independent variables (CIGPRI and RGDP). The following results were realized as represented in the Table 1 and 2 below shown in both their levels and first differences.

Table 1: Augmented Dickey-Fuller and Philip-Perron Unit Root Test Statistics in Absolute Values for Individual Variables with a Constant Only

Variable	ADF in levels	CV-5%	P.P in levels	CV-5%	ADF in 1st Diff.	CV-5%	P.P in 1st Diff.	CV-5%	Order of Integration
lnCCPC	0.895	2.949	0.967	2.947	5.247	2.953	7.476	2.949	I (1)
lnCIGPRI	1.292	2.949	0.941	2.947	4.594	2.953	3.602	2.949	I (1)
lnRGDP	0.129	2.949	0.061	2.947	3.987	2.953	5.313	2.949	I (1)

The graph of the variables CCPC, CIGPRI, RGDP showed the presence of an intercept and plotting them against time indicated a presence of trend in the variables as shown in figures 1 to 3 in Appendix A. Therefore a constant and a trend were included in the unit root test for model [3.5]

Table 2: Augmented Dickey-Fuller and Philip-Perron Unit Root Test Statistics in Absolute Values for Individual Variables with a Constant and a Trend.

Variable	ADF in levels	CV-5%	P.P in levels	CV-5%	ADF in 1st Diff.	CV-5%	P.P in 1st Diff.	CV-5%	Order of Integration
lnCCPC	2.402	3.547	2.669	3.543	5.343	3.551	7.731	3.547	I (1)
lnCIGPRI	1.791	3.547	1.218	3.543	4.899	3.551	3.697	3.547	I (1)
lnRGDP	1.297	3.547	1.379	3.543	4.322	3.551	5.484	3.547	I (1)

Tables (1) and (2) show the evidence that all the variables are integrated of order one that is I (1) and were found to be I (0) after differencing once. The graphical representation of the variables in their first difference shows stochastic movements around the zero mean as shown in the figures 1 to 3 in appendix A, confirming that the variables are indeed stationary in first difference.

The confirmation that the variables are integrated of order I (1) makes its necessary to proceed with the cointegration test.

4.1.2 Cointegration Test

Most of the time when the economic variables may be individually non-stationary, it is likely that cointegration may occur. Non-stationary series are said to be cointegrated if a linear combination of these variables is stationary that is I (0). The existence of a cointegration relationship implies that the regression of non-stationary series in their levels yield meaningful and not spurious results. However Cointegration to exist the non-stationary series must be integrated of the same order. In the study all the variables were integrated of order one I (1).

Engle- Granger (1987) two-step procedure was used in the study to test for cointegration. The peculiarity of this method is that there is some adjustment process that prevents errors in the long-run relationship from becoming larger indefinitely i.e. the error correction mechanism -ECM. In this case, a static (long-run) model for [3.5] was estimated using OLS and Maximum Likelihood- ARCH (this was done due to presence of ARCH effects). Secondly, the residuals were generated and then their order of integration was generated using the ADF (AEG[21]) unit root test. It is of importance to note that in this test the usual ADF critical values are not appropriate hence Engle and Granger (1987) calculated the appropriate values against which this test can be resolved. These figures can be found from several sources including Charemza and Deadman (1997). Graph of the errors are as shown in Figure 4 and 5 in appendix A and they do not have intercepts.

The results showed that the residuals were stationary in levels i.e. I (0) which supports the existence of co-integrating relationship in the estimated equation. The results are shown in Table (3) below.

Table 3: Engle- Granger Two Step Co-integration Test Statistic in Absolute Values

Residual	**AEG test Statistic**	**5% critical value**	**Inference**
ECT - OLS	4.8567	3.63 to 3.71	I (0)
ECT -ML	4.1543	3.63 to 3.71	I (0)

In order to derive the short run coefficients of the per capita cigarette consumption model an overparametised Error Correction Model (ECM)[22] version of the equation [3.5] was estimated. A general –to- specific procedure of parsimonious model specification was followed. Using the Akaike information Criterion (AIC) as a guide; some of the variables that were statistically insignificant were systematically eliminated from the model to come up with a more preferred specification. A variable, though statistically insignificantly, could be dropped only if dropping it resulted into a smaller AIC and if dropping it could not result in misspecification of the model. Ramsey RESET test was used to diagnose the process of formulating the short run function cigarette demand. The error correction term ECT (-1) was derived as the lagged residuals generated from the estimated static long-run co-integrating equation

Finally the cigarette consumption per capita model [3.5] was estimated using OLS and Maximum Likelihood –ARCH method to correct for ARCH effects. The data was also taken through diagnostic tests to satisfy the classical assumptions of OLS. In order to

[21] Augmented Engle-Granger Test
[22] see appendix B

determine both short run and long run behaviour of per capita cigarette consumption with regard to explanatory variables, cigarette consumption per capita function was developed and estimated at levels to determine the long-run behaviour and, then re-estimated on differenced terms to determine the short run behaviour and the adjustment mechanism by which short run dynamics adjust towards the equilibrium. The Econometric Views package (Eviews 3.1) was used to generate the results of the study.

4.2 Regression Results and Interpretations

This section reports regression results for both long run static cointegrating equations and short run dynamics (Error Correction Model) for the cigarette demand model [3.5].

4.2.1 Long Run Regression Results

The long run estimated results for both OLS and Maximum Likelihood – ARCH are shown in this section in Tables 4 and 5.

Table 4: Long Run Determinants of Cigarette Demand Using OLS Method

Dependent Variable: lnCCPC

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	7.606	1.236	6.156***	0.000
Time	0.146	0.047	3.091***	0.005
lnCIGPRI	-1.098	0.332	-3.305***	0.003
lnRGDP	-0.489	0.097	-5.042***	0.000
lnCCPC-1	-0.254	0.200	-1.269	0.216
ADVDUM	1.444	0.347	4.159***	0.000
WARNDUM	-0.255	0.129	-1.969*	0.060
AR ^{a} (2)	-0.624	0.319	-1.955*	0.062
Normality J-B	2.091[0.352]	Autocorrelation B-G		1.453[0.255]
Heteroscedasticity - ARCH	0.142[0.709]	Stability Ramsey RESET		2.869[0.077]
- White	2.476[0.037]			

Note: ***, **, * imply significance at 1%, 5% and 10% respectively.
a- Autoregressive error correction of order 2.

Tables (4) and (5) report regression results with OLS and ML-ARCH estimation methods for a long-run relationship between per capita cigarette consumption (CCPC) and time, cigarette prices (CIGPRI), real income per capita (RGDP), lagged cigarette consumption per capita (CCPC(-1)), advertising dummy variable (ADVDUM) and health warning dummy variable (WARNDUM).

Table 5: Long Run Determinants of Cigarettes Demand Using Maximum Likelihood- ARCH Method

Dependent Variable: lnCCPC

	Coefficient	**Std. Error**	**z-Statistic**	**Prob.**
C	3.974	1.481	2.683***	0.007
Time	0.079	0.021	3.735***	0.000
lnCIGPRI	-0.659	0.171	-3.854***	0.000
lnRGDP	-0.246	0.055	-4.494***	0.000
lnCCPC-1	0.246	0.123	2.000**	0.046
ADVDUM	1.135	0.129	8.826***	0.000
WARNDUM	-0.073	0.017	-4.264***	0.000
	Variance Equation			
C	0.001	0.000	2.411	0.016
ARCH (1)	2.278	0.610	3.733	0.000
Normality J-B	2.261[0.323]		Heteroscedasticity-ARCH	0.884[0.354]

Note: ***, **, * imply significance at 1%, 5% and 10% respectively.

The regressions performed well in terms of goodness of fit and overall significance with an adjusted R^2 of 84% and 71% respectively. F-statistics for both the estimations were significant at 1% level respectively. The F-statistic implies that these variables are bound together or jointly significant in the long run. This confirms results obtained with the Engle-Granger two-step cointegration test approach.

For Table (4) diagnostic tests statistics showed that residuals are normally distributed and the functional model is well specified. However, the ARCH LM test indicated that there was presence of ARCH effects; correlogram Q statistic showed that there was higher order serial correlation of AR (2) and White's test highlighted the presence of heteroscedasticity. Breusch- Godfrey test also showed a presence of autocorrelation. This problem was solved using the Newey-West Heteroscedasticity and Autocorrelation Consistent Standard Errors and Covariance estimation and Autoregressive error correction of order two AR (2) was included in the regression to solve for higher order serial correlation.

In Table (5) Maximum Likelihood – Auto Regressive Conditional Heteroscedaticity estimation method was used to account for the multiple problems, which the study assumed, were due to ARCH effects. Convergence of the results was achieved after 83 iterations. Further more, Bollerslev-Wooldrige Robust Standard errors and Covariance was applied to whiten the residuals and to improve the probability values of the regressors.

The results indicate that cigarette prices have a negative effect on cigarette consumption per capita and it is statistically significant at 1%. This implies that controlling for other variables if you increase the cigarette prices by about 10% cigarette consumption per capita will reduce by about 11% and 7% in both estimations respectively. In the OLS estimation the study find the relationship to be unit elastic that is the changes in cigarette consumption per capita respond in equal proportion as change in cigarette prices.

These results indicate that cigarette smokers in Kenya are rational and therefore they will respond by reducing their cigarette consumption due to the price increase. Several studies have supported the notion that price increases over time definitely reduces cigarette demand significantly (Bishop and Yoo, 1985; Baltagi and Levin, 1986; Chaloupka, 1990; Galbraith and Kaiserman, 1997; Bardsley and Olekalns, 1998, Gruber et al., 2002; Liang and Tauras, 2003; Coppejan et al., 2006). This vividly shows how effective the cigarette prices are in controlling cigarettes consumption per capita.

Real income capita is statistically significant but has a negative effect on cigarettes consumption. This implies that holding all other variables constant 10% rise in income per capita reduces cigarette consumption per capita by about 5% and 2.5% in both estimation respectively. This contradicts the study expectation that, increase in income definitely increased cigarettes consumption capita. Bishop and Yoo (1985) and, Bardsley and Olekaln (1998) found that income had a positive relationship with cigarettes demand. On the other hand Baltagi and Levin (1986) found that income was insignificant in determining cigarettes demand. In this perspective, cigarette behaves as an inferior good that is as income rises less of it is consumed (Engel effect) this may be due to the smoker's immediate awareness of negative effects of cigarettes consumption to their health he or she may invest in cessation program or switch to nicotine replacement therapies. Becker and Murphy (1988) showed that the low income addicted, non addicted and myopic smokers would respond to money price increase on cigarettes and will consume less of it while the high income addicted, non addicted and myopic smoker will reduce their consumption due to the negative effects of health messages which are directed on cigarettes.

Myopic addiction models say that current consumption is only affected by past consumption and future consumption is not thought about at any point in time of an addicted consumer of cigarettes. The OLS results do not support the notion of myopic addiction theory where lagged cigarettes consumption is not significant while on the other hand ML-ARCH results show that lagged or previous cigarette consumption per capita is statistically significant and has a positive effect on current cigarettes consumption per capita hence supporting the myopic addiction theory. This implies that holding all other variables constant if the smoker had previously increased his cigarette consumption by about 10% his current consumption will go up by about 2.5%. This shows the characteristics of reinforcement behaviour. Studies done by Mullahy (1985) and Licari and Meier (1997) also showed that past consumption had a positive effect on current cigarette consumption.

The time variable is statistically significant showing that as time increases by a year the percentage of cigarettes consumed per person increased considerably by about 0.15% and 0.08% for each estimation respectively. This reinforces the addiction theory that with time, addictive substances such as nicotine in cigarettes tends to increase their consumption considerably. Marshall (1920) discussed the effects of addiction on demand saying that habits, which have, once grown up (with time) around the use of a commodity (cigarettes) are not quickly abandoned and may consequently increase the consumption overtime. This also brings about the concept of positive reinforcement because the individual has a positive learned response to past consumption (Chaloupka 1990). Gruber and Koszegi (2000) also reiterated that there was a significant impact of the linear time trend on any price elasticity estimate in cigarettes demand studies.

The advertising dummy variable is statistically significant showing that holding other variables constant from the year 1970 to 1999 the percentage of cigarettes consumed per capita increased by about 1.4% and 1.1% for each of the estimations respectively. This shows that advertising is a strong tool in making people to consume public bads like cigarettes, which have detrimental effects to their health. The health warning dummy variable is also statistically significant showing that from 1986 to 2005 the cigarettes consumption per capita reduced significantly by about 0.3% and 0.1% for both the estimations respectively, after controlling for the other variables. These figures may look minimal but in the real sense they have a significant and considerable impact on controlling cigarette consumption in Kenya.

Goel and Morey (1995) reiterates that counter-intuitive effect of anti-smoking messages accompanying advertisement made sobering immediate effects, which tended to wear off as time passed. Additionally, repetitive nature of the anti-smoking messages could fail to get consumer attention over time and advertising could also be first redistributing consumption among firms by inducing brand switching without increasing aggregate demand. Studies which have supported effectiveness of advertising in increasing cigarette demand and health warning dummy variables are Hamilton (1972); Bishop and Yoo (1985); Licari and Meier (1997) and Bardsley and Olekaln (1998). On the other hand Baltagi and Levin (1986) did not support the notion that advertising increased cigarette consumption.

The two estimation methods were used to verify the existence of myopic addiction model. The ML-ARCH estimation has supported the theory that past consumption has positive and significant effect on current consumption.

4.2.2 Short Run Regression Results

This section shows the short run error correction model results using OLS method.

Table 6: Short Run Determinants of Cigarettes Demand Using OLS Method

Dependent Variable: ∆ lnCCPC

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.089	0.098	-0.912	0.372
∆ lnCIGPRI-3	1.461	0.484	3.018***	0.006
∆ lnRGDP	-0.420	0.248	-1.691	0.105
∆ lnRGDP-5	0.443	0.279	1.584	0.128
∆ lnCCPC-4	-0.758	0.227	-3.338***	0.003
∆ lnCCPC-5	0.582	0.194	3.004***	0.007
WARNDUM	-0.179	0.098	-1.819*	0.083
ECT (-1)	-1.525	0.258	-5.907***	0.000
Normality J-B	0.937[0.626]	Autocorrelation B-G		0.672[0.522]
Heteroscedasticity-ARCH	0.192[0.665]	Ramsey RESET		3.483[0.076]
- White	1.468[0.231]			

Note: ***, **, * imply significance at 1%, 5% and 10% respectively.

Table (6) reports the short run cigarette consumption per capita regression results on differenced lagged of the independent variables. The diagnostic tests have shown that the residuals are normally distributed, there is no autocorrelation, and the Ramsey RESET test shows that the functional form of the model is well specified. Furthermore there is no presence of both ARCH effects and heteroscedasticity.

The F-statistic is significant level at 1 % showing that in the short run all the variables are jointly significant. The third lag of cigarette prices show a positive and significant impact on short run cigarette consumption per capita. This implies that holding other variables constant if the cigarette prices at lag three say in the year 2002 had been increased by about 10% the current cigarette consumption per capita that is 2005 is increased by about 15%.This shows that previous prices are have no deterrent effect on current cigarette consumption capita. This coincides with the addictive theory that subsequent lags of prices both in the future and past always have a positive impact on cigarette consumption per capita (Chaloupka, 1990).

Previous or lagged cigarette consumption per capita at lags four and five are significantly related to current cigarette consumption per capita in the short-run. Lag five is positively related to the current cigarette consumption per capita at 1% showing reinforcement characteristics of addiction. At lag four it is significant at 1% supporting the withdrawal characteristics of addiction which is shown by the negative relationship they have with current cigarette consumption per capita in the short run controlling for other variables.

Current and the fifth lag of real income per capita are insignificant in the short run. Health warning dummy variable is statistically significant and has a negative influence on cigarette consumption capita in the short run. The one period lag error term is negative and statistically significant at 1% level. Its coefficient which is -1.53 implies that about 15.3 % of the discrepancy between actual and equilibrium value of cigarettes consumption per capita is corrected each period. Thus there are economic forces, which operate to restore the long run equilibrium path of the cigarette consumption per capita following short run disturbances. Figure (5) in appendix B shows that recursive coefficients estimates of the short run regression are within the 5% boundary confirming that the model is stable.

4.3 Conclusion of Empirical Analysis

In conclusion, this chapter has shown empirical analysis in the following areas: unit root and cointegration tests, relevant diagnostic tests and regression results. A long run cointegration equation was estimated in section 4.2 using both OLS and ML-ARCH estimation methods. The long run cointegrating equation showed that cigarettes prices, real income per capita and health warning dummy variable had a negative and significant effect on cigarettes consumption per capita. Time, lagged cigarette consumption per capita and advertising dummy variable had positive and significant effect on cigarette consumption per capita.

Notably, the OLS estimation showed that lagged cigarette consumption per capita had no significant effect on current cigarette consumption per capita. On the other hand

Maximum Likelihood estimation contradicted the absence of lagged cigarette consumption effect on current cigarette consumption per capita. In the short run the result were quite different where cigarette prices in the third lag had a positive significant effect on CCPC supporting the addiction theory that subsequent lags of prices whether in the future or past have positive effect on current consumption.

The further lags of cigarette consumption in fourth and fifth lags had mixed result has one supported withdrawal and the other reinforcement characteristics of addiction. The current and the fifth lag of real income per capita proved to be insignificant. Health warning dummy variable had a negative and statistically significant effect on cigarette consumption per capita considerably.

The study has clearly shown that cigarette prices coupled with information disincentives such as health warning labels in cigarette packs have a remarkable regulatory effect on cigarette consumption.

CHAPTER 5

CONCLUSION

In this chapter the focus is on three main areas, which include: summary, policy implications and, limitations and further research avenues. The summary looks at the outcome of the study in general and the policy implications bring about the relevance of the output and measures that the government can take to control cigarette (tobacco) consumption in Kenya. Finally, the limitations and further research section discusses the problems which were encountered when carrying out the study and the areas which might be of interest to other researchers in this field.

5.1 Summary and Conclusion

The study focused on determinants of cigarettes demand in Kenya for the period 1970-2005. The long run and short run cigarette consumption per capita functions using myopic addiction model pioneered by Houthakker and Taylor (1966, 1970) have been estimated. Diagnostic tests, OLS and Maximum Likelihood-ARCH estimation methods were applied to the time series data for analysis purposes.

The study has found that in the long run cigarette consumption per capita (CCPC), cigarette prices (CIGPRI), previous or lagged cigarette consumption per capita CCPC (-1), real income per capita (RGDP), advertising (ADVDUM) and health warning (WARNDUM) dummy variables are jointly significant. Cigarette prices are negatively and significantly related to CCPC while the CCPC (-1) has a positive significant relationship with CCPC that is current cigarette consumption per capita. This study is in conformity with the myopic addiction theory that previous consumption has a positive effect on current consumption and old habits die-hard (Mullahy, 1985). Health warning and advertising dummy variable was found significant in the long run (see Goel and Morey, 1995). In the short run the variables in their respective lags were also significant except for the real income per capita variables which were insignificant.

The study has shown that the fight against cigarette (tobacco) smoking can only be won by higher taxes, which result in higher prices hence deterring the smoking habit in the young and the low-income earners. The World Bank estimated that tax increases that would raise real prices of cigarettes by 10% worldwide and a package of "non-price" measures such as advertising bans and smoke free policies would cause about 64 million of the smokers alive in 1995 to quit and would prevent at least 15 million tobacco-related deaths (Ranson et al, 2000). In China for example, conservative estimates suggest that a 10 % increase in cigarette tax would decrease consumption by 5 % , increase revenue by 5 % and that the increase would be sufficient to finance a package essential for health services for one-third of China's poorest 100 million citizens (World Bank, 1999).

In conclusion, the study has achieved its fundamental objectives in empirically measuring determinants of cigarettes demand in Kenya. Cigarette prices have proved to have negative influence on cigarette consumption per capita and can be effective control mechanism in tobacco (cigarettes) consumption overtime and can be manipulated easily by adjusting taxation on the product. Lagged cigarette consumption per capita has also proven to affect the current consumption hence reinforcing the concepts of addiction models. Advertising dummy variable showed that it has a positive and significant effect on cigarettes consumption per capita in the long run. Finally, health warning has also been confirmed to be a very effective tool in control of cigarette consumption in Kenya both in the short and long run.

5.2 Policy Implications

Globally war has been wedged against cigarettes (tobacco) use. Many nations of the world including Kenya are trying to find effective measures, which will control or even disband the tobacco use in their countries. The new government policy in Kenya, which is still in contention, is the collective ban of smoking cigarettes in public places because of hazardous effects of the smoke on the passive smokers. Although most government offices are displaying big signboards, which prohibit smoking of cigarettes, the battle is far from being won. There is dire need to formulate a policy framework, which will give sound regulation and eventually control cigarette smoking effectively.

The study has shown that, in Kenya the current effective tools are the increase in prices (through increase of excise tax) on consumption of cigarettes and health scare or prominent warnings labels on cigarette packs. Whatever the route the government of Kenya chooses, it appears that it is headed towards a future of much higher prices due to increase in excise taxes which will in turn lead to reduction in consumption of cigarettes.

The following steps can also help to ease the transition path to some positive results in anti-smoking campaigns in Kenya. The first step is to increase public spending for smoking cessation, such as subsidized or free provision of quitting aids. Secondly, increase of efforts to limit cigarettes smoking across all the population. Increases in the prices of cigarettes are still probably the most effective way to limit cigarette smoking. But there is also evidence that coordinated access restrictions across all forms of sale-enforcing age limits in stores, banning cigarette vending machines in public places, and so on- can significantly lower cigarette smoking. These effects would be magnified if a uniform national access policy were pursued.

Since the tobacco industry itself is likely to have information on how to best manipulate the use of its product, the government as part of any settlement (or legislation) could include financial incentives for the industry to reduce cigarette smoking. The fact that cigarette smokers appear to think that they will not be addicted to smoking suggests that standard information campaigns which emphasize the long-run costs of smoking are not likely to be effective. Rather, the government should highlight the short-run implications of smoking in terms of reduced physical performance, appearance and other costs directly salient to cigarette smokers.

Tobacco (cigarettes smoking) control is cost effective. Anti-smoking campaigns are the most cost-effective measures to improve health after child immunization. An anti-smoking campaign, costs between $ 20 to $40 per year of life gained, compared to $ 18000 per year gained from lung cancer treatment, this is world average according to Assunta (1999). By spending less on treatment that many poor countries cannot afford anyway, and more on anti-smoking efforts, more years of life can be changed by the limited resources available.

Finally, all in all the most effective tools to curb cigarette and other tobacco products use is the increase in taxes and enforcing prominent health warning labels on cigarette packs.

WHO Director- General Dr Gro Harlem Brundtland (2000) reaffirmed that tobacco control was and will be a major focus at the WHO. He further elaborated that the biggest cost of tobacco (cigarettes) use is the disease and suffering it brings to millions. Also adding that moderate action, such as higher tobacco taxes would ensure tremendous health gains to the populations in both developed and the developing countries. He firmly recommended that governments whose wish is to halt the rising toll of tobacco related deaths should strongly consider increases in tobacco taxes (which are transmitted to prices) as a matter of priority.

5.3 Limitations and Directions for Further Research

The main limitation was the periodicity of data which resulted in a small sample size and hence limiting the number of lags in the Error Correction Model. The individual data on various cigarette prices were hard to come by therefore price of sportsman's brand was used as proxy for all the other brands.

Further studies can also be done with individual level data or even panel data by doing district analysis of cigarette consumption and the effectiveness of taxes and other controls such as health warnings. Inclusion of more socio-economic characteristics such as gender and age are also necessary. Another issue arising in the cigarettes demand studies is the bootlegging effects on estimation results. There has been complaints by the Kenya Revenue Authority that contraband cigarettes are being sold within the borders of Kenya, Uganda and Tanzania to evade taxes.

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Appendix A: Graph of variables in levels and differences

Figure 1: Graph of lnCCPC and Differenced lnCCPC

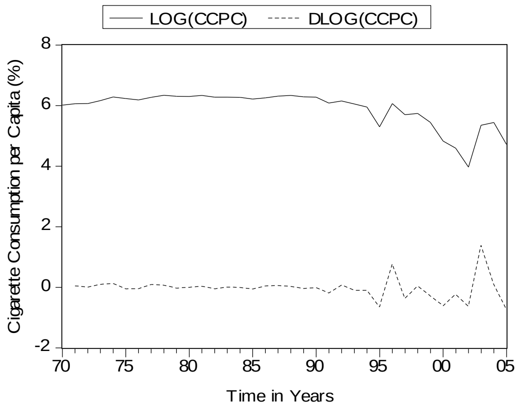


Figure 2; Graph of lnCIGPRI and Differenced lnCIGPRI

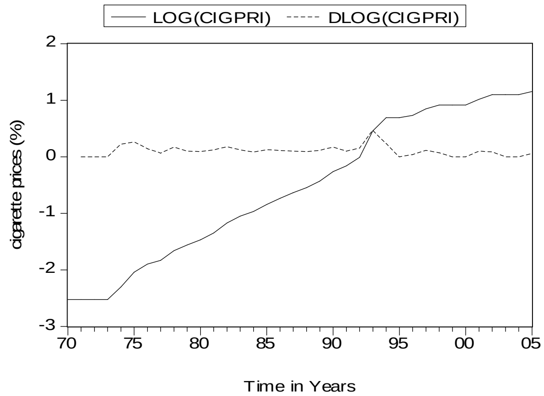


Figure 3: Graph of lnRGDP) and Differenced lnRGDP

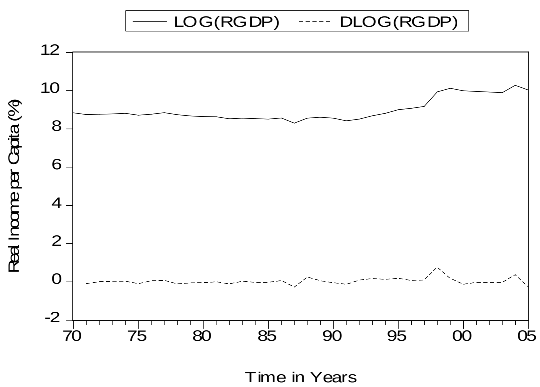


Figure 4: Graph of Long Run Residuals for ML-ARCH.

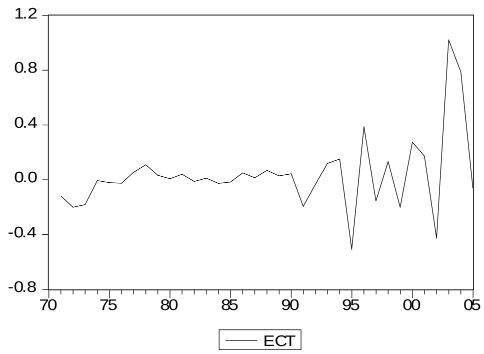
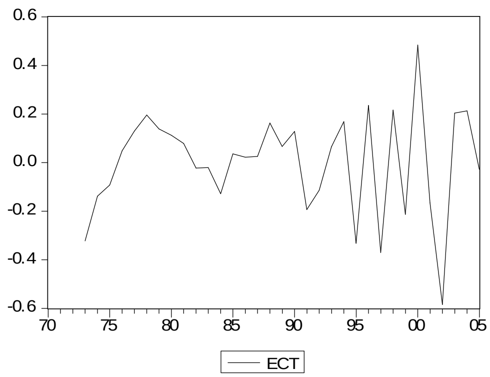


Figure 5: Graph of Long Run Residuals for OLS Estimation.



Appendix B: Other Regression Results

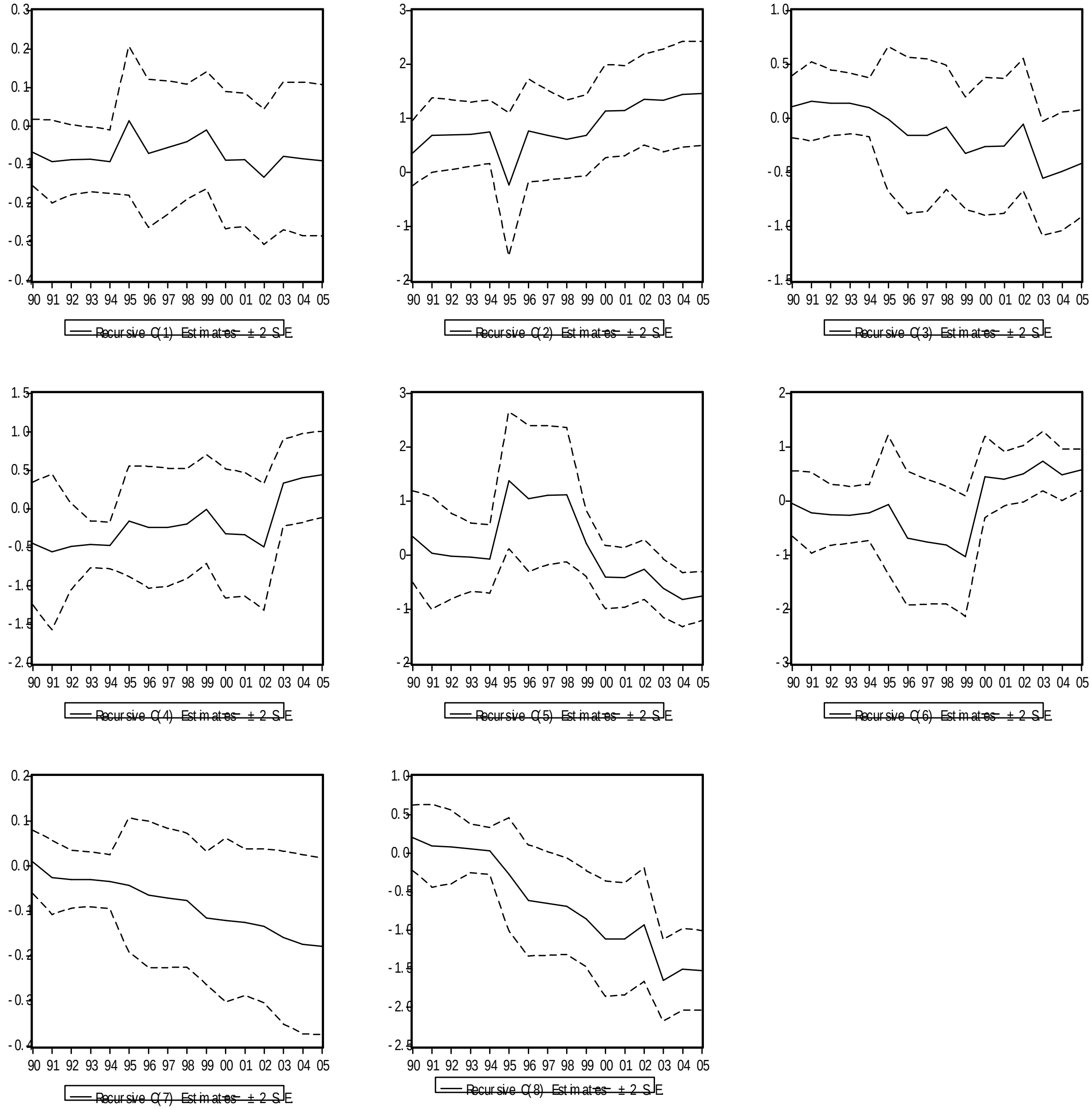
Table 7: Overparameterised Short Run Regression Model

Dependent Variable: ∆ lnCCPC

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.038984	0.553197	-0.070471	0.9454
∆ lnCIGPRI	-0.977632	0.911017	-1.073121	0.3111
∆ lnCIGPRI-1	-0.346811	1.190406	-0.291338	0.7774
∆ lnCIGPRI-2	-1.621706	0.931325	-1.741290	0.1156
∆ lnCIGPRI-3	1.429449	1.324945	1.078874	0.3087
∆ lnCIGPRI-4	-1.667879	1.758146	-0.948658	0.3676
∆ lnCIGPRI-5	-0.102532	1.352747	-0.075795	0.9412
∆ lnRGDP	-0.253082	0.487268	-0.519390	0.6160
∆ lnRGDP-1	0.073367	0.552779	0.132724	0.8973
∆ lnRGDP-2	-0.036796	0.642223	-0.057295	0.9556
∆ lnRGDP-3	-0.592033	0.591447	-1.000991	0.3430
∆ lnRGDP-4	-0.619666	0.575073	-1.077544	0.3093
∆ lnRGDP-5	0.047480	0.574732	0.082613	0.9360
∆ lnCCPC-1	-0.351091	0.580658	-0.604643	0.5603
∆ lnCCPC-2	-0.487069	0.613879	-0.793429	0.4479
∆ lnCCPC-3	-0.933534	1.334063	-0.699767	0.5018
∆ lnCCPC -4	-0.791308	0.776107	-1.019586	0.3345
∆ lnCCPC -5	0.601675	0.883320	0.681152	0.5129
ADVDUM	0.543407	1.001356	0.542671	0.6005
WARNDUM	-0.149532	0.182069	-0.821289	0.4327
ECT(-1)	-0.870429	0.891756	-0.976084	0.3545
Adjusted R-squared	0.636040	Akaike info criterion		0.166121
S.E. of regression	0.238379	F-statistic		3.533955
Durbin-Watson stat	1.883690	Prob(F-statistic)		0.028163

Figure 6: Recursive Coefficients Tests for Short Run Regression.



C(1) - Constant   C(2) - d (bg) CIGPRI-3   C(3) - d(bg) RGDP

C(4) - d(bg) RGDP(-5)   C(5) - d(bg) CCPC-4   C(6) - d(bg) CCPC-5   C(7) - WARNDUM

Appendix C: Data used in the study

Table 8: Data

YEAR	CCPC	ADVDUM	WARNDUM	CIGPRI	RGDP
1970	410	1	0	0.08	6897.28
1971	429	1	0	0.08	6322.33
1972	431	1	0	0.08	6386.35
1973	474	1	0	0.08	6534.57
1974	536	1	0	0.1	6752.31
1975	508	1	0	0.13	6094.65
1976	485	1	0	0.15	6425.34
1977	529	1	0	0.16	6937.25
1978	566	1	0	0.19	6242.16
1979	548	1	0	0.21	5875.15
1980	546	1	0	0.23	5648.25
1981	563	1	0	0.26	5630.76
1982	533	1	0	0.31	5049.80
1983	534	1	0	0.35	5217.88
1984	530	1	0	0.38	5088.71
1985	499	1	1	0.43	4956.24
1986	521	1	1	0.48	5275.08
1987	550	1	1	0.53	4037.56
1988	564	1	1	0.58	5205.94
1989	540	1	1	0.65	5487.70
1990	532	1	1	0.77	5209.07
1991	438	1	1	0.85	4550.85
1992	470	1	1	0.99	4979.99
1993	425	1	1	1.58	5896.36
1994	384	1	1	2	6723.72
1995	200	1	1	2	8135.47
1996	432	1	1	2.08	8737.09
1997	298	1	1	2.33	9616.60
1998	310	1	1	2.5	20713.20
1999	232	1	1	2.5	24896.20
2000	125	0	1	2.5	21774.75
2001	99	0	1	2.76	21208.67
2002	53	0	1	3	20459.93
2003	211	0	1	3	19894.44
2004	231	0	1	3	29041.60
2005	112	0	1	3.17	22794.92

Appendix D: Tobacco- Related Illnesses

Table 9: Tobacco-Related Illnesses

Type	**Specific**
Cancer	Lip, oral cavity and pharynx, oesophagus, pancreas, larynx, lung, trachea and bronchus, urinary bladder, kidney and other urinary organs
Cardiovascular Diseases	Rheumatic heart disease, hypertension, Ischaemic heart disease, pulmonary heart disease, other heart diseases, cerebrovascular diseases, atherosclerosis, aortic aneurysm and other arterial diseases
Respiratory Diseases	Tuberculosis, pneumonia and influenza, bronchitis and emphysema, asthma and chronic airway obstruction
Paediatric Diseases	Low birth weight, respiratory distress syndrome, newborn respiratory conditions, sudden infant death syndrome