TAX AND NON-COMMUNICABLE DISEASES ATTRIBUTABLE TO TOBACCO AND ALCOHOL CONSUMPTION IN 5 SUB-SAHARAN AFRICAN COUNTRIES

MASTER OF ARTS (ECONOMICS) THESIS

MACHIRU MOYO

UNIVERSITY OF MALAWI

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MASTER OF ARTS (ECONOMICS) THESIS

By

Machiru Moyo
B.Soc. Sc. (Economics)-CUNIMA

Submitted to the Department of Economics, Faculty of Social Science, School of Law, Economics and Government in partial fulfillment of the requirements for a Master of Arts Degree (Economics)

University of Malawi

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DECLARATION

I, the undersigned, hereby declare that this thesis is my original work and it has never been submitted for similar purposes to this or any other university or institution of higher learning. Where other people's work has been used acknowledgements have been made. All errors contained herein are the author's sole responsibility.

MACHIRU MOYO

_____

Full Legal Name

_____

Signature

22nd December 2024

_____

Date

CERTIFICATE OF APPROVAL

The undersigned certifies that this thesis represents the student's work effort, and it makes acknowledgments where other sources of information are used. The thesis is submitted with my approval.

Signature: _____ Date: _____

Gowokani Chijere Chirwa, PhD. (Associate Professor)

Supervisor

DEDICATION

Amid trials, I stand here, dedicating this work to myself. It symbolizes the unwavering spirit that refused to yield, even when faced with adversity. To my late father, whose absence is deeply felt, I wish he could witness this moment. His memory fuels my determination.

My late friend, who lost to non-communicable diseases (NCDs), remains a sad reminder of the urgency of our fight. This thesis carries their legacy, a beacon of hope for prevention and healing.

Dr. Thomas Nyirenda, my uncle, ignited the spark that birthed this journey. His wisdom and encouragement echo through these pages. To all those living with NCDs, your resilience inspires me. And to those who've lost loved ones, this work stands as a tribute.

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My gratitude also extends to my family and friends, whose support has been a constant source of strength. Together, we have navigated challenges and celebrated achievements.
And lastly, to my classmates, thank you for sharing both the difficult moments and the joyous ones. Our collective experiences have enriched our academic path.

May this thesis stand as a testament to the collaborative efforts and unwavering support that have fuelled my journey.

ABSTRACT

Increased taxation on alcohol and tobacco is among the cost-effective measures used to deal with fighting the burden of non-communicable diseases (NCDs) globally. Despite adopting such efforts, its actual impacts are yet to be fully understood. Our study had two key questions: can heavy taxation breathe new hope into countries' efforts to combat NCDs as we approach the World Health Organization target of a 25% global reduction in NCD mortality rates by 2025? Can the approach recoup economic losses that have been brought by these conditions? Little is known about the answers to these questions, especially in low-income countries where NCDs are on the rise. The study's objective is to address these key questions and find empirical evidence regarding changes in the NCD mortality rate associated with changes in the tax rates of tobacco and alcohol. The study adopted the System Generalized Method of Moments (SGMM) to explore the relationship between levels of taxes and NCD mortality rates. The SGMM allowed the inclusion of the dependent variable as an explanatory variable assuming there is reverse causality. There seems to be a negative relationship between increased taxes and rates of NCDs. These results suggest that to reduce NCDs, tax increases on the major risk factors must be implemented. Doing so will likely enable the achievement of Sustainable Development Goal 3.4 of reducing NCD mortality by one-third by 2030.

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ABBREVIATIONS

FCTC	Framework Convention on Tobacco Control
GMM	Generalized Method of Moments
NCDs	Non-communicable Disease Mortality
SDGs	Sustainable Development Goals
WHO	World Health Organisation

CHAPTER 1

INTRODUCTION

1.1 Background

Classical production theory postulates that labor and capital are vital to production(Todaro 2020). Of much significance is the fact that labor uses capital for production processes. Non-communicable diseases (NCDs) may affect production as they affect one factor of production -labor (Chakraborty et al., 2023; Lawana et al., 2020). NCDs have negative health implications and are significant contributors to reduced economic progress and productivity. NCDs result in long-term health issues as they lead to reduced quality of life, require long-term treatment and care among sufferers, introduce lifestyle changes, or, in some extreme conditions, necessitate palliative care, which also has negative implications on careers. This is a threat to economic progress as human productivity is negatively affected, due to lost income that consequently temporarily or permanently cripples the labor force of the economy (Folland et al., 2024).

Global statistics show that non-communicable diseases (NCDs) are the leading cause of death and disability worldwide(World Health Organization, 2023). NCDs are responsible for 74% of global deaths, claiming the lives of 15 million people prematurely between the ages of 30 and 70 (World Health Organization, 2023). Since each death results in a loss of income, there is a significant economic cost associated with NCDs (Lawana et al., 2023). Without effective interventions, the World Health Organization predicts that the number of NCD-related deaths will sharply increase to 55 million by 2030 (World Health Organization, 2023).

Regarding their effect on productivity, NCDs have surpassed infectious diseases in the African region, making up about 37% of the total disease burden (World Health Organization, 2019). The sub-Saharan region is seeing an epidemiological change in the disease burden, with a sharp 67% increase between 1990 and 2017 (African Center for Disease Control, 2022). Unlike communicable diseases that arise due to a germ (viral, bacterial, or fungal) infection, few NCDs are genetically inherited while most of them

occur due to lifestyle or environmental factors (Hambleton et al., 2023) Among lifestyle factors long-term use of tobacco and alcohol is identified as one of the main risk factors that are associated with the burden of NCDs (World Health Organization, 2023).

The World Health Organization (WHO) has implemented a comprehensive Global Action Plan for the Prevention and Control of Noncommunicable Diseases (NCDs) that runs from 2013 to 2030, aiming to ease the burden of NCDs. Specifically, the third objective of this plan focuses on addressing risk factors and underlying social determinants. To achieve this, the plan emphasizes the reduction of tobacco and alcohol use, as they both significantly contribute to the prevalence of NCDs. The proposed plan aims to contribute to achieving global targets of a 30% reduction in tobacco use and a 10% reduction in harmful alcohol consumption. One of the effective measures to reduce the demand for these products is increased tax imposition to reduce affordability (World Health Organization, 2013).

1.2 Problem Statement

Global statistics indicate that more than half of the 3 million annual deaths attributable to alcohol use are from NCDs, including cancer. And tobacco accounts for over 8 million deaths every year. More than 7 million of those deaths are the result of direct tobacco use, while around 1.2 million are the result of non-smokers being exposed to passive or second-hand smoke(World Health Organization, 2023). The principle of heavily taxing tobacco products and alcohol is to reduce consumption, in turn lowering these risk factors that bring about NCDs(World Health Organization, 2017). The issue of taxing tobacco goes way back to the 17th century, when classical economist Adam Smith in his book “The Wealth of all Nations”, argued, as quoted: “Sugar, rum, and tobacco, are commodities which are nowhere necessaries of life, which have become objects of almost universal consumption, and which are, therefore, extremely proper subjects of taxation,”(Smith, 1776). The rationale for taxing tobacco in these primary days was to raise government revenue. The literature identifies other proposed reasons for taxing tobacco, of which one among the many is to promote public health by reducing morbidity and mortality effects associated with smoking. An interesting context that reflects on how the debate of tobacco taxation has evolved(US National Cancer Institute & World Health Organisation, 2016).

The WHO implemented the Framework Convention on Tobacco Control (FCTC) as a commitment to deal with the global tobacco epidemic and prioritize public health and well-being (World Health Organization, 2023). MPOWER which stands for; Monitor Tobacco Use and Prevention Policies; Protect People from Tobacco Smoke; Offer Help to quit tobacco use; Warn about the dangers of Tobacco; Enforce bans on tobacco advertising, promotion, and sponsorship and; Raising taxes on tobacco, has been introduced as a technical package designed to help countries implement demand-reduction measures for tobacco.

Now the nexus between NCDs and taxation is dynamic. According to the WHO Steps Surveillance(World Health Organization, 2017), tobacco use imposes a risk of developing cancer, especially lung cancer, heart disease, stroke, and diabetes. It becomes a threat to passive smokers, who are between 20% to 30% at risk of developing lung cancer and other chronic respiratory diseases. A recent study conducted on the "Global Burden of Cancer" reports that alcohol consumption accounts for 4% of specific cancers(Rumgay et al., 2021). Because these products are sold in a market governed by the forces of demand and supply, tampering with their prices through taxation reduces their purchase. This implies that the consumption of these products will be lowered, as will the risk of developing NCDs like lung cancer, diabetes, hypertension, and chronic respiratory diseases. Furthermore, lowered risk will be reflected in lower NCD mortality rates.

There has been an interest in this research nexus in the past. Most of it has been from not within the African region but the Western countries, with most of them concluding that the taxes are effective in reducing NCD mortality rates (Kilian et al 2021; Lawana et al 2024; Rumagay, 2021; Neufiled,2022; Manthey, 2024; Morris 2024). Immurana et al., (2021) researched the effects of increased tobacco taxation and pricing on the prevalence of smoking in Africa. The authors found that increased taxation and pricing have significant negative effects on the prevalence of smoking. The former had a negative effect on the prevalence of smoking by 0.25% to 0.36%, while the latter had a negative effect on the prevalence of smoking by 0.11 to 0.14% (Immurana et al., 2021). Similarly, Frank et al., 2013 undertook extensive research on cigarette excise tax structure and cigarette prices. The study demonstrates that simpler tax structures would be much more effective in reducing cigarette smoking than tax structures that are more complicated as there is a greater likelihood of switching to cheaper brands whenever a tax increase is

imposed. In addition to the aforementioned, it was found that alcohol taxation consistently shows that it reduces consumption. Alcohol prices and taxes are inversely related to drinking (Wagenaar et al., 2009).

Alcohol control strategies mirror those of tobacco control; however, there is little empirical evidence on the possible effects of increased alcohol taxation on preventing NCD deaths. This study brings forth both increased alcohol and tobacco taxation as a preventative measure against NCDs. We studied data from five sub-Saharan African countries to assess whether increased or heavy taxation breathe new hope into these countries' efforts to combat NCDs as we approach the Sustainable Development Goal (SDG) 2025 target of a 25% global reduction in NCD mortality rates and whether this approach helped the countries to recoup economic losses caused by the associated NCD conditions.

This study recognizes that non-communicable diseases (NCDs) not only pose significant health risks but also influence policy decisions. Consequently, it is essential to examine the persistence of NCDs, as this informs the development of effective control and preventative measures that governments can implement to address the burden of NCDs.

1.3 Objectives

1. Analyze how changes in NCD mortality rate relate to changes in tobacco tax.
2. Examine how changes in the mortality rate from NCDs relate to changes in alcohol tax.
3. Investigative if there is a persistence of past NCD mortality.

1.4 Justification of the Study

Undertaking the study is important. With the current statistics on NCDs, the current trends indicate a high possibility that the target to reduce NCD mortality by one-third by 2030 might not be achieved (SDG 3.4 target). Deaths related to NCDs affect SDG8 of economic growth in particular target 8.2 because of the long-term health effects that impede productivity. This has implications for the poverty levels in the economy and SDG1 of no poverty target 5. A failure in the reduction of poverty will likely bring about inequalities among communities that SDG10.2.

1.5 Study Hypotheses

Derived objectives from the objectives of this study, the following null hypothesis will be tested;

1) There is no significant relationship between changes in the tobacco tax rate and changes in the NCD mortality rate.
2) There is no significant relationship between changes in alcohol tax rates and changes in NCD mortality rate.
3) There is no persistence of previous NCDs.

1.6 Organization of the Paper

In Chapter One, the topic is introduced. Chapter Two provides an overview of WHO BEST BUYS, focusing on taxation for preventing and controlling non-communicable diseases (NCDs). Chapter Three reviews both theoretical and empirical literature related to tobacco and alcohol taxes for NCD prevention and control. Chapter Four describes the study's methodology, while Chapter Five discusses research findings from the analysis. Finally, Chapter Six is the conclusion of the study in addressing policy implications and suggesting directions for further research.

CHAPTER 2

OVERVIEW

2.1 Introduction

With an emphasis on Malawi, Mozambique, South Africa, Zambia, and Zimbabwe, this chapter gives an overview of the burden of NCDs, risk factors, and WHO Best-Buys interventions specifically, health taxes aimed at alcohol and tobacco reduction as means to reduce the burden of NCDs are also discussed in this chapter.

2.2 The Burden of Non-communicable Diseases

In African nations, the World Health Organization projects NCDs to exceed communicable diseases as the most common causes of death by 2030 if no intervention is implemented. Sub-Saharan African countries are experiencing a shift in the burden of diseases from communicable diseases to chronic non-communicable diseases(World Health Organisation, 2022). The surveillance of NCD risk factors in sub-Saharan Africa indicates that most adults are exposed to at least one risk factor of NCDs, including harmful use of tobacco and alcohol consumption(World Health Organization, 2020).

Evidence has shown that deaths from NCDs are happening prematurely before the ages of 30 and 70, as shown in Figure 1 below (World Health Organisation, 2022). In contrast, Malawi's risk of developing premature NCDs is already 23%, up from 16% in 2020 (World Health Organisation, 2022). This indicates that 23% of Malawians are susceptible to early NCD development. That puts nearly 4 million individuals in danger. A premature likelihood of NCDs stands at 24.1% in South Africa, 30.6% in Mozambique, 24.6% in Zambia, and 28.4% in Zimbabwe respectively. This is a cause for concern because people who fall within this age range are the most active in the economy's labor force.

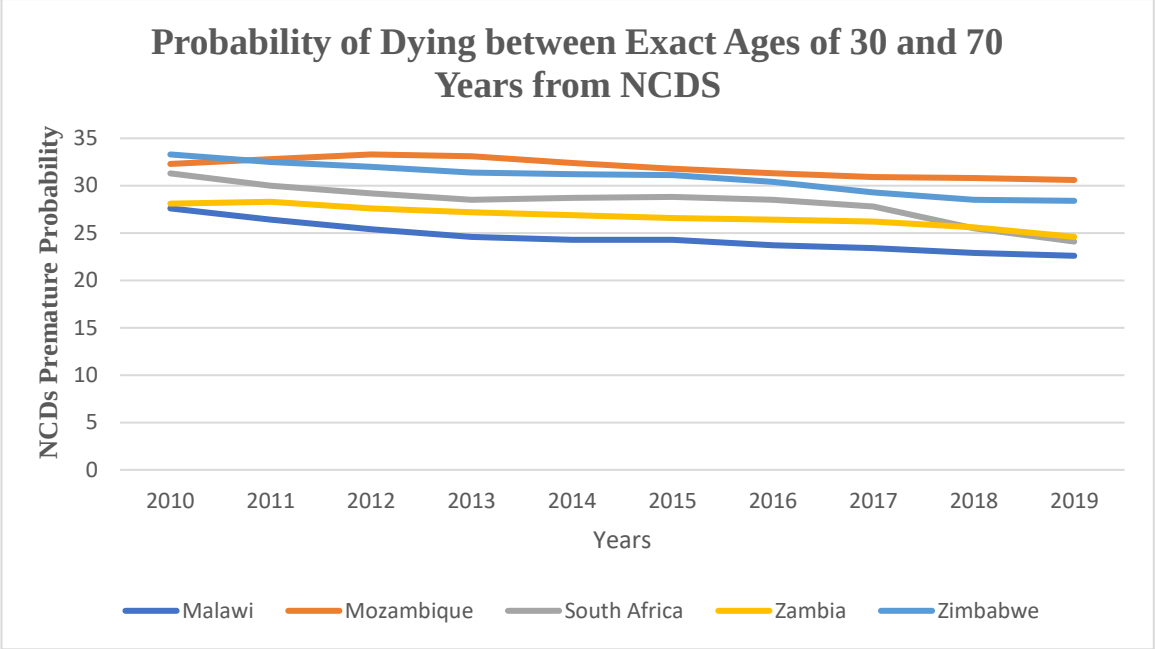


Figure 1: NCDs Premature Probability (Author's Computation Using WHO Data)

Countries have embarked on a journey to fight NCDs by implementing national strategies for the prevention and control of NCDs. Countries have taken the initiative in signing up for the WHO Framework Convention on Tobacco Control (FCTC) which has been enforced since 2005 to control the production and sale of tobacco to reduce its impact on public health. The FCTC also calls for an increase in taxes on tobacco products. Malawi took a bold step in 2023 to sign up for FCTC to control the tobacco pandemic (World Health Organisation, 2023). Likewise, Mozambique, South Africa, Zambia, and Zimbabwe are also members of FCTC. On the other hand, alcohol policies have been implemented to control the harmful consumption of alcohol. Malawi has implemented its first-ever national alcohol policy (Ministry of Health, Malawi, 2017).

2.3 Health Taxes

Noncommunicable diseases (NCDs) present several difficulties because of the length of time they take to treat and the high lifetime expenditures involved. In line with Sustainable Development Goal (SDG) 3.4, the World Health Organization (WHO) has advised the global implementation of the "WHO Best-Buys" intervention, which aims to reduce NCD mortality by one-third by 2030 and a 25% reduction by 2025.

Tobacco and alcohol products are subject to health charges as part of the World Health Organization's (WHO) Best-Buys plan. Since these products are major modifiable risk factors for noncommunicable diseases (NCDs), the goal of these levies is to make them less affordable(World Health Organization, 2017). Health taxes do two things at once: they provide money for the government and, by deterring alcohol and tobacco use, they improve public health. Excise taxes are thought to be the most successful of these since they have a direct impact on changes in prices.

The implementation of these levies by WHO Best-Buys is mostly the responsibility of governments across the globe. And the ability of the government to properly implement and oversee these levies is also a necessary condition for their efficacy. But, as is often the case, many nations find it difficult to implement these tariffs in cases where some of these goods are economically significant. Several sub-Saharan nations are significant producers and exporters of tobacco, accounting for 42.3% of Zimbabwe's exports, 24.8% of Malawi's exports, and 5% of Zambia's exports. South Africa exports 28.5% of its tobacco cigarettes while importing 10% of its tobacco. The challenge now is to fight the pandemic of tobacco use and alcohol consumption while remaining unaffected by the conditions that are souring these products.

The responsibility of governments goes beyond the implementation of such taxes but also the monitoring of macroeconomic variables such as inflation. Inflation erodes the value of currency reducing the real purchasing power. If the tax rate remains the same when inflation increases, its real value will decrease. A debate has risen over the years that if tobacco and alcohol taxes are to be effective, they must be indexed to inflation. These taxes should increase in line with an increment in inflation. This maintains the tax revenue's real value and intended tax incidence(World Health Organisation, 2023).

Regardless of several countries raising taxes on tobacco cigarettes, inflation has not been offset causing the tax value lower and ineffective in reducing consumption. Cigarette pack's total taxes are on the lower end in low- and middle-income countries. The average total tax as a proportion of price is reported to amount to 56.65% in low-income countries and 59.1% in middle-income countries. 66.9% is reported in high-income countries. A need for countries to increase taxes on tobacco products(World Health Organisation, 2023).

WHO reports indicate that 148 countries have implemented taxes on alcoholic beverages at a national level. On a global scale, the excise tax imposed on the most sold brand of beer stands at 17.2% while spirits accumulate a tax value of 26.5%(World Health Organisation, 2018). A 2017 study conducted by the World Health Organisation suggests that an increment in alcohol prices by 50% would assist in averting over 21 million deaths over 50 years. In addition, US$17 trillion will be generated as revenue. As much as health taxes (taxes on tobacco products and alcohol) are recommended worldwide, there are also rising concerns that these taxes are regressive.

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

This chapter combines the theoretical and empirical review. The theoretical review provides an economic understanding of taxes and public health. The empirical review gives evidence on the effectiveness of taxes to improve public health.

3.2 Theoretical Review

The theoretical review seeks to make references to an individual as a decision maker and focuses on the potential negative effects taxes have on individual demand through the pricing of tobacco products and alcohol, which are among the major risk factors for non-communicable diseases.

3.2.1 The Rational Choice Theory

Rational choice theory is a concept in behavior economics that postulates that individuals are guided by their self-interest when making decisions, and they actively seek to maximize their benefits in any situation while minimizing their losses. This theory assumes that actors are rational and are guided by an invisible hand, a metaphor that Adam Smith used to describe unforeseen influences. The theory suggests that individuals acting with their self-interest result in benefits to the economy at large. However, the theory is flawed as it does not explicitly take into account the costs to an individual that they do not consider when deciding to consume certain products, such as tobacco and alcohol. However, a critique of this theory has evolved to provide a comprehensive understanding of how individuals make sub-optimal decisions.

3.2.2 Internality Theory

Tobacco smokers and alcohol consumers may not take into account the full costs of their actions when making decisions to consume these products as they pursue present satisfaction at the expense of their future well-being. This is because of self-control problems and present biased preferences. Because of the time factor, health consequences are realized at a later date from the moment of consumption and the inception of the disease. A critique of the traditional economic theory that assumes individuals as rational thinkers. Under such circumstances, tax policies can be used to deter the consumption of goods that have negative effects on individuals' health, such as tobacco and alcohol. In addition, tobacco use and alcohol consumption pose negative externalities, a result of market failure. Under such circumstances, the government is justified to intervene with tax policies to reduce both internalities and externalities that contribute to the burden of non-communicable diseases, which are a leading cause of death worldwide, especially in low- and middle-income countries (World Health Organisation, 2023).

3.2.3 The Theory of Demand

When modeling the demand for tobacco products and alcohol to their prices, the key element is to understand the behavior of individuals under certain restrictions. Alfred Marshall, the great British economist (1842-1924) called this fundamental relationship the law of demand. Though the demand for these products is dependent on not only the price but also income, taste, and prices of other products, under all things being equal, the demand is inversely related to its price.

Changes in demand depend on the responsiveness of individuals to any changes in the prices of alcohol and tobacco products, a term known as elasticity. The more elastic these products are, the more the responsiveness of their demand. The World Health Organization reports that the own-price elasticity of alcohol ranges between -0.5 in the short term and -0.8 in the long term. The elasticity of tobacco products ranges from 5-8% in low- and middle-income countries, while in high-income countries, it is about 4%. Making these products elastic over a time horizon. But this. is only effective if there are no available close substitutes. A substitutional effect always compels individuals to switch from one brand to another. This also leads to the understanding of who bears the tax, in other words, tax incidence.

3.3 Empirical Review

Several studies recommend taxes on tobacco and alcohol to reduce consumption in alignment with WHO's best buys in preventing and controlling NCDs. However, little has been done to assess the direct effect of tobacco and alcohol taxes on NCD mortality rates.

Thow et al, (2018) conducted an evidence-based study on Fiscal policy to improve diets and prevent non-communicable diseases. The authors explain diet-related interventions regarding fiscal policies. The authors recommend taxes and subsidies to impact the purchase and consumption of targeted foods by influencing prices.

Mwagomba et al, (2018)conducted a qualitative study on Alcohol policies in Malawi specifically investigating the extent of inclusivity of alcohol-related Best Buy interventions in Malawi national policies. The findings are that there is inadequate inclusion of WHO “best buys” on the control of harmful use of alcohol in Malawi’s national legislation and policies.

Watkins et al, (2023) conducted a benefit-cost analysis study on best investments in chronic, non-communicable disease prevention and control in Low- and Lower-middle-income countries. The study included 30 interventions including six intersectoral policies (e.g., taxes) and 24 clinical services. The findings are that intersectoral policies provide great value for money, with benefit-cost ratios ranging from 40 to 100. However, the authors recommend that the impact of clinical interventions on the overall population over the 2023 to 2030 period is much higher than that of the intersectoral policies, as they would take longer to reach their peak effects.

In 2020, Summan et al., conducted a study on the potential global gains in health and revenue from increased taxation of tobacco, alcohol, and sugar-sweetened beverages: a modeling analysis. The study predicted that over 50 years, tax rates that raise the retail price of products such as tobacco and alcohol by 20%, could bring substantial health gains by reducing premature mortality while raising government revenues, which could be used to increase public health funding.

Chaiyasong et al., (2022) conducted a study on the estimated impacts of alcohol control policies on NCD premature deaths in Thailand. The study aimed to achieve a 10%

reduction in alcohol and other alcohol policy interventions between a period of 2010-2015. The authors estimated the impact of three main NCDs namely; cancers, cardiovascular diseases, and diabetes. Results indicated that a 50% price increase and other interventions, would lead to 3903-79997 avoidable NCD deaths. Such that the interventions proposed in this study would reduce NCD deaths by 13,286 among men and 4994 among women accounting for 46% of the NCD mortality target.

It is to the author's knowledge that the taxes recommended by WHO on alcohol and tobacco products are taxes imposed on the most sold brands. In such a scenario it is likely that if there are substitutes, people might switch to other brands, making any efforts to control the harmful use of alcohol and tobacco challenging. Apart from substitutes, real income as a purchasing power of individuals also affects the demand for alcohol and tobacco products. Though the real income is untaxed at the point of purchase of these products, the ideal situation is to make their prices higher than the purchasing power. In a country where these products are very much affordable, for example, Malawi where there is a tendency to sell single sticks of tobacco cigarettes that are relatively cheaper, an increase in prices influenced by a tax will not have much effect on affordability.

The traditional demand theory alone in explaining the behavior of individuals under certain constraints is insufficient considering the possibility of addiction. Becker and Murphy (1988) came up with the rationality addiction theory attempting to understand what drives an individual to consume such products that are regarded as harmful.

The empirical studies complement the economic theory but less is known about the true impact of taxes on improving public health.

CHAPTER 4

METHODOLOGY

4.1 Introduction

The research model used in this study addresses the research objectives. The theoretical framework, conceptual framework, model specification, and source of the data are all presented. It also outlines the variables and their anticipated effects on NCD mortality rates. The estimation method and diagnostic tests are presented in this chapter.

4.2 Theoretical Framework

This study used the System Generalized Methods of Moments (SGMM) to estimate and assess the relationship between changes in the death rate from NCDs in five sub-Saharan countries relative to the changes in tax rates on alcohol and tobacco products, tobacco cigarette prices, and screening rates. Urban growth and income per capita have been used as instruments to control for potential endogeneity and the validity of the estimates. SGMM allows for the dependent variable to be included as an explanatory variable if there are any suspicions of reverse causality. Furthermore, GMM does not rely on assumptions about the normality of the data distribution. It can be applied to a wide range of models, both linear and nonlinear, without being limited by specific distributional assumptions (Pesaran, 2016).

Including a lagged dependent variable brings about endogeneity as it is correlated with an error term, this is what is known as the Nickell bias. As a result, panel data estimators like fixed effects, random effects, and first-different can be biased and inconsistent especially in an analysis with a short T and large N. In this case, the System GMM estimation addresses this by instrumenting endogenous variables with their lagged values(Nickell , 1981).

The data used in this study was sourced from the World Health Organization Database, World Bank Database, and WHO Health Observatory. The data spans from 2008 to 2022 and includes information on NCD mortality rate, income per capita, urban growth rate,

and health taxes. The NCD mortality rate, income per capita, and urban growth rate for each of the five nations are based on data from the World Bank, while the health tax information is extracted from the WHO database. The WHO Health Observatory Data Base (health taxes) contains information on alcohol and tobacco cigarette taxes and prices. The tax used in this study is the excise tax from the most sold brand of these products. While alcohol taxes only cover 2022, tobacco cigarette taxes and prices go from 2008, 2010, 2012, 2014, 2016, 2018, 2020, and 2022.

For analysis we assumed that the tobacco cigarettes tax data and prices will remain in effect for the other years for which there is no data, assuming they haven't been changed. Alcohol taxes have not been proposed because the data only covers a single period. A dummy variable representing screening rates was established to supplement the independent variables. The dummy variable is categorical, with values of 1 for lower screening rates, 2 for medium screening rates, and 3 for high screening rates.

NCD mortality data and income per capita span from 2008 to 2019. To fill in the missing data of the three years, the mean has been used to interpolate missing data as the data was relatively symmetric. For urban growth, the median was used to fill in the missing value of the year 2022 as the data was heavily skewed.

4.3 Conceptual Framework

The World Health Organization lists alcohol and tobacco use as the main modifiable risk factors that contribute to NCDs even though these conditions do not always have clear causes. Thus, it makes economic sense to tax these goods to lower modifiable risk factors, which will prevent and control the mortality from NCDs. In addition, previous research indicates that screening rates may also have an impact on the death rate from NCDs. At the same time, NCDs can also affect tax policy, screening rates, income per capita as well as urban growth. As seen in Figure 2 below, this is how the conceptual framework of this study has been arranged, including the instruments (urban growth rate and income per capita).

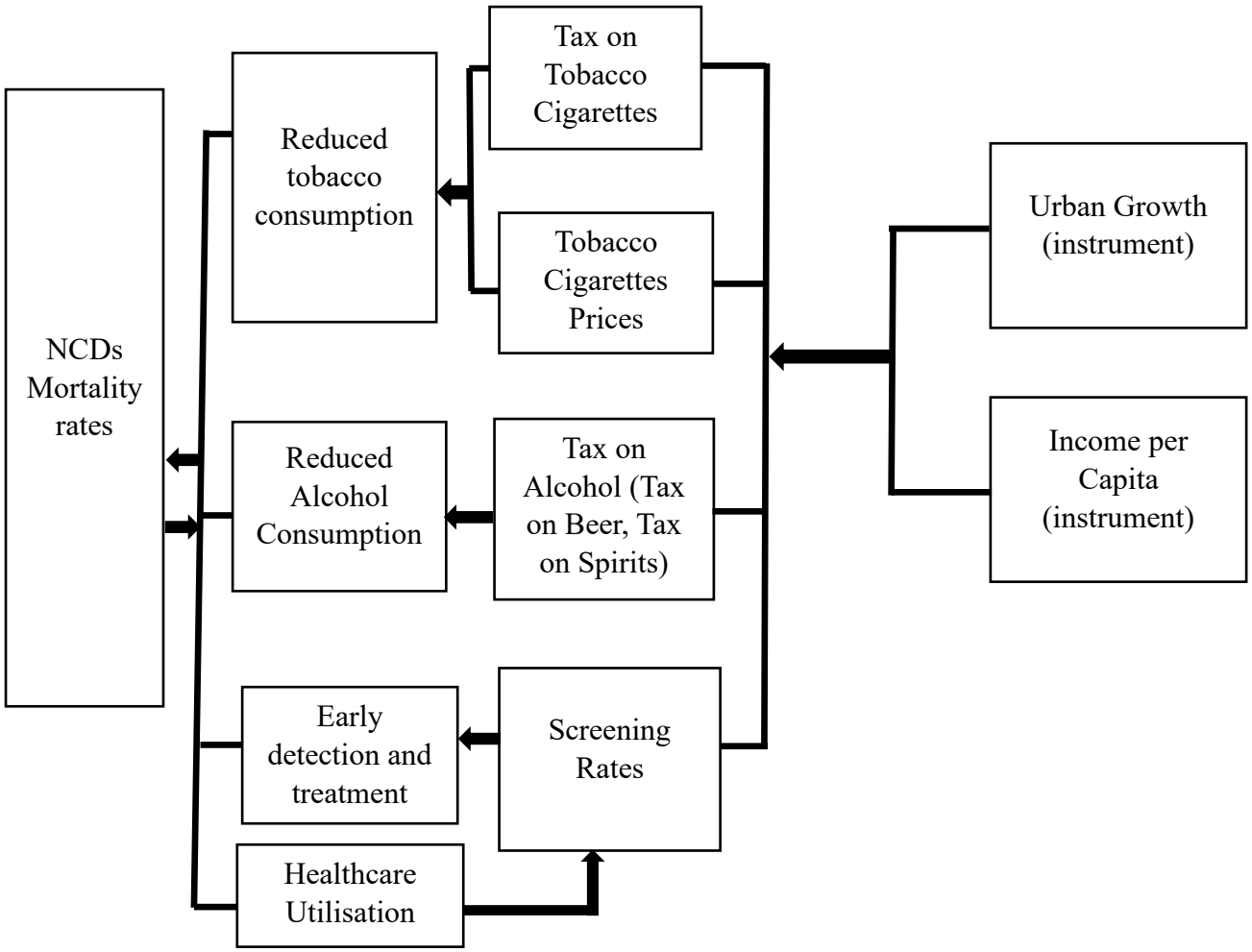


Figure 2: Conceptual Framework

In addition, urban growth rate and income per capita are exogenous which means they are not influenced by the dependent variable to avoid correlation with an error term. This makes them fit to capture the variation among the endegenous variables.

4.4 Model Specification

4.4.1 Arellano-Bover/Blundell and Bond Model

The study has employed System GMM as proposed by Arellano-Bover (1995) / Blundell and Bond (1998). The model holds assumptions that the first differences of instrument variables are uncorrelated with the fixed effects. Thereby allowing more instruments that may improve efficiency. The model is built on a system of equations. The System GMM holds the following assumptions about the data-generating process:

1) The process may be dynamic with current realizations of the dependent variable influenced by past ones.
2) There may be distributed fixed individual effects
3) Some regressors may be endogenous
4) The number of periods of available data, T may be small
5) The only available instruments are internal. However, the estimates do allow the inclusion of external instruments.

A related study conducted by Bowser Diana et al., (2014) on the impact of tobacco taxes on mortality in the USA, used a fixed effects approach to assess the changes in mortality rates relative to the changes in taxes. Another study conducted by Rado K Martha et al., (2022) on cigarette taxation and neonatal and infant mortality: a longitudinal analysis of 159 countries, employed both fixed and random effects models. This study has diverted by using a generalized method of moments by introducing instruments to improve efficiency.

The GMM model is specified as below

$$NCDM_{it} = \alpha_{it} + \beta_1 tobptax_{it-K} + \beta_2 alctax_{it-K} + \beta_3 y_t + d_t + \varepsilon_{it}$$

The dynamic panel data model has the following form;

$$y_{it} = \sum_{j=1}^{p} \alpha_j y_{i,t-j} + \beta_1 x_{it} + \beta_2 w_{it} + v_i + \varepsilon_t \text{ ....} \quad (1)$$

Where $i = 1, \ldots \ldots \ldots \ldots . N \quad and \quad t = 1, \ldots \ldots \ldots \ldots . . T$

- α_j are p parameters to be estimated.
- x_{it} are is a $1 \times K_1$ vector strictly exogenous covariates.
- β_1 is a $K_1 \times 1$ vector of predetermined and endogenous covariates.
- β_2 is a $K_2 \times 1$ vector of Parameters To be estimated.
- v_I are panel-level effects (which may be correlated with the covariates).
- ε_{it} is the error term.

4.4.2 Empirical Model

The study adopted a specification and functional form of Immurana et al., (2020) who conducted a study on the taxation of harmful products and its influence on the population health of Africa using a dynamic panel system GMM model.

$$NCDM_{it} = f(Tax_{it}, M_{it}, \varepsilon_{it})$$

$NCDM_{it} = \alpha_0 + \beta_1 NCDM_{it-1} + \beta_2 Tax_{it} + \beta_3 M_{it} + \varepsilon_{it}$

Where M_{it} is the vector of the controlled variable, and α_0 is the intercept.

$NCDM_{it}$ is the mortality rate of non-communicable diseases

Tax_{it} is the excise tax on the most sold brands of tobacco cigarettes, and alcohol specifically beer and spirits.

M_{it} is the vector of control variables including; tobacco cigarette prices, screening rates, urban growth rate, and income per capita.

$\beta_1 - \beta_3$ are coefficients of explanatory variables.

ε_{it} is the error term.

4.4.3 Apriori Expectation

- **Taxes:** Holding onto the theory of taxation. The expected sign is negative because of the inverse relationship price has with demand, as taxes are associated with higher prices. It is expected that there will be a reduction in consumption which will have a negative effect on NCD mortality as risk factors would be lowered by then.
- **Tobacco Cigarette prices:** The expected sign is negative because price and demand work inversely. So higher tobacco prices might result in lower demand for cigarettes reducing consumption in turn lowering risk factors that bring about NCDs.
- **Screening rates dummy variables:** This generally refer to the percentage of people who have undergone a screening test for a particular disease or condition. The expected sign of these categorical dummy variables is either negative or positive depending on the categories. Because at lower and medium screening rates there might be under diagnosis which would reflect lower death rates of NCDs than compared to high screening rates.

4.4.4. Choice of Variables

The choice of variables has been guided by literature. The economics of taxing tobacco and alcohol links tax to higher prices that reduce consumption, lowering risk factors that bring about NCDs. This also extends to epidemiology studies that emphasize the need for screening NCDs.

4.5 Data Analysis

The study has used Microsoft Excel for data compilation and statistical packages such as STATA for data analysis.

4.6 Diagnostic Tests

4.6.1 Sargan Test for Over-identification Restrictions

The Sargan test was proposed by John Denis Sargan in 1958 to assess whether the parameters of the model are correctly identified about prior restrictions on coefficients. The test checks the validity of instruments in the model to avoid overidentification. Overidentifying restrictions assesses the validity of instruments used in a model The test statistic follows a chi-square distribution with the following null;

$$H_0 = \text{over-identification restrictions are valid}$$

If the chi-square p-value is lesser than the 5% significance level, then the null hypothesis of valid over-identification restriction is rejected indicating the invalidity of the instruments. Otherwise, a high p-value fails to reject the null concluding that the instruments are valid.

4.6.2 Arellano Bond Test for Autocorrelation

When error terms in a regression correlate, there is the presence of autocorrelation. This has implications for estimators as they are biased with large variances. If the variances are not minimal, it might affect hypothesis testing and confidence intervals resulting in a type I or type II error. , it is assumed that the error term is not correlated. A p-value below the 0.05 significance level will result in the rejection of the null hypothesis of no autocorrelation. This study has employed the Arellano Bond test to check for the presence of autocorrelation.

4.6.3 Multicollinearity

When explanatory variables are correlated, it is difficult to isolate individual influences on the dependent variable. This can lead to unstable and unreliable estimates of the coefficients of the independent variables in the regression model resulting in a spurious regression. Therefore, this study needs to detect and address multicollinearity before estimating the regression model. The correlation matrix is employed to test the presence of multicollinearity. If multicollinearity is found, interaction terms will capture the joint effect of the two if the variables are relevant to the research question.

4.6.4 Heteroskedasticity test

The classical linear regression model assumes that the variance is equal across all observations. This follows that:

$$var(\mu_i|X_i) = E\big[\mu_i - E(\mu_i|X_j)\big]^2$$
$$= E(\mu_i{}^2|X_j)$$
$$= \sigma^2$$

Where σ^2 is the variance. If this assumption is violated then heteroscedasticity (unequal variance) is present. It follows that;

$$Var(\mu_i|X_i)$$
$$= \sigma_i{}^2$$

Estimation in the presence of heteroscedasticity means that estimators no longer have minimum variance, which implies the confidence intervals and hypothesis testing. To check for the presence of heteroscedasticity, this study has adopted a residual plot approach to identify any patterns that will give a hint of the presence of heteroscedasticity.

CHAPTER 5

EMPIRICAL RESULTS AND DISCUSSIONS

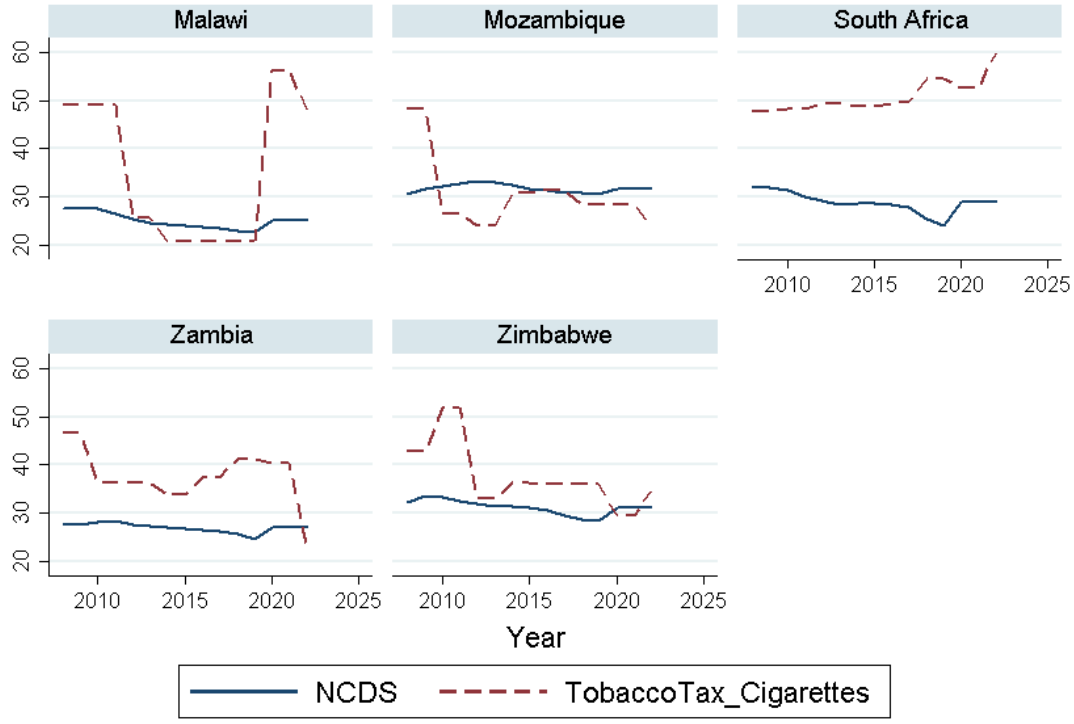
5.1 Introduction

This chapter presents results obtained after using the Blundell/Bond system GMM estimators as described in chapter four. It includes descriptive statistics, results, interpretation, and, a summary of the results. The section on results and interpretation also includes diagnostic tests as required for the panel estimated model.

5.2 Descriptive Statistics

The visual presentation of NCD mortality and taxes on tobacco cigarettes within the implementation period of the tax (2008-2022) in Figure 3 below, shows a rise and fall in NCD mortality and tax rates on tobacco cigarettes over the years. The taxation of tobacco might not have solely focused on reducing NCDs, such, Figure 3 should be interpreted as a descriptive visualization, rather than an inferential tool.

Malawi and Mozambique exhibit the same pattern; however, Malawi's graph indicates a drastic increase in tobacco cigarette tax around the period of 2020. Zambia and Zimbabwe show fluctuations in both NCDs and tax rates while South Africa depicts a stable tax rate but rising NCDs, suggesting consistency in tax policy implementation.



Author's computation using WHO and World Bank Data

Figure 3: NCDs Mortality rates and Tax on Tobacco Cigarette by Country for Years 2008 to 2022

As much as these countries are members of the WHO Framework Convention on Tobacco Control (FCTC) which aims to fight the tobacco pandemic, the fluctuations in the graph of tax on tobacco cigarettes may not solely be attributed to the desire to reduce the burden of NCDs mortality rates. Policy reforms are among the various factors that alter tax changes. The policy reforms that might have influenced cigarette taxation during the 2008 to 2022 period, are summarized in Table 1.

Table 1: Tax reforms by country within the period of 2008 to 2022

Country	Reform
Malawi	In 2008, the Malawi government introduced low taxes on cigarettes containing 70% of Malawi tobacco, tax stamps, and, a change from ad valorem to a specific tax. The rationale was to curb smuggling and develop a strong tobacco sector in Malawi. In 2022 value added tax on cigarettes was suspended.
Mozambique	In 2009, the excise tax was adopted. It introduced specific tax rates and ad valorem for cigarettes. In 2010, the tiered specific excises for cigarettes and mixed (ad valorem and specific) excises for other tobacco were put in place. In 2013-2015, there was an increase in excise tax on cigarettes for public health concerns and revenue generation.
South Africa	During the 2008 period, there was a 52% increase in the total excise tax aimed to control tobacco. In 2020-2021, there was an 8% increase in excise duty. The rationale was to grow government revenue after the COVID-19 crisis.
Zambia	In 2020, the tax on tobacco cigarettes declined because of the tiered tax structure which gives a preferential excise tax rate for domestically manufactured cigarettes.
Zimbabwe	In 2020, the Zimbabwe government increased excise duty on cigarettes to help the health sector.

Descriptive statistics reflect the distribution and diversity of variables. The statistics give insight into the average value, variability, and range of each variable. Table 2 below displays descriptive statistics for all variables.

The variation in NCD mortality rates across the five countries is minimal. There is higher variability in cigarette tax rates with a standard deviation of 10.859 indicating a higher dispersion around the mean. The minimum and maximum values show a wide range of tax rates for cigarettes with a minimum of 20.68 and a maximum of 60.9. Alcohol tax on beer shows a considerable variation in beer taxes. The standard deviation of alcohol tax on spirits suggests significant variation across countries. There are wide disparities in

income per capita across countries. Moderate variability in tobacco cigarette prices as well as urban growth rate.

Table 2: Summary Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
NCDS Mortality	75	28.748	2.951	22.6	33.5
TobaccoTax Cigarettes	75	38.476	10.859	20.68	60.09
AlcoholTax Beer	75	2.141	8.451	0	40.64
AlcoholTax Spirits	75	3.247	12.354	0	59.55
IncomePerCapita	75	1614.437	1999.285	19.129	7006.261
TobaccoCigarettes Prices	75	3.46	1.788	.96	7.04
UrbanGrowthRate	75	3.259	1.306	.254	4.856

5.3 Results and Interpretation

5.3.1 Diagnostics tests

5.3.1.1 Multicollinearity

One of the fundamental assumptions is that the explanatory variables must be independent of one another to isolate individual influence on the dependent variables. Such, a correlation matrix was computed to investigate the degree of correlation among independent variables. Though most of the variables have a weak correlation, the alcohol tax on beer and alcohol tax on spirits have a strong correlation of 0.974 indicating the presence of multicollinearity. To account for multicollinearity an interaction term has been created for alcohol tax on beer and alcohol tax on spirits to capture the joint effect of the two variables. The correlation matrix is presented in Appendix A.

5.3.1.2 Sargan Test of Overidentifying Restrictions

The Sargan test proposed by John Denis Sargan in 1958 assesses whether the parameters of the model are correctly identified about prior restrictions on coefficients. The test statistic of the test follows a chi-square distribution with the following null; $H_0 =$ over-identification restrictions are valid.

Table 3: Sargan test for identified restriction

Sargan test of over-identifying restrictions	
Chi-square Statistic	66.34
Chi-square DF	52
P>chi2	0.087

In reference to the results in the table above, at a 5% significance level, we fail to reject the null hypothesis of valid over-identification restrictions as the p-value is greater than the significance level (0.087). Such, there is no strong evidence to indicate the invalidity of the instruments hence the moments of conditions are correctly specified.

5.3.1.3 Arellano Bond Test for Autocorrelation

The results below show Arellano-Bond for autocorrelation. The test statistic follows a normal distribution. At order 1 and order 2, the p values are greater than the 0.05% significance level, as such we fail to reject the null hypothesis of no autocorrelation. Hence, there is no strong evidence to reject the null hypothesis, such as there is no autocorrelation.

Table 4: Arellano bond test for Autocorrelation

	Z statistic	**Pr>z**
Arellano-Bond test for AR (1) in first differences	-1.75	0.080
Arellano-Bond test for AR (2) in first differences	-1.16	0.247

5.3.1.4 Heteroskedasticity

The assumption of Homoscedasticity requires that the disturbance terms (μ_i) have all the same variance,(σ^2). If this assumption is not satisfied then there is the presence of heteroscedasticity or unequal variance. To check for heteroscedasticity, residuals were plotted, and the pattern was analyzed as most values centered around zero indicating homoscedasticity. The residual plot is displayed in the appendix B.

5.4 System GMM Results

After conducting all the necessary diagnostic tests, the analysis investigated the changes in NCD mortality rate relative to the changes in tax rates of alcohol and tobacco products using the system GMM estimator. The lagged dependent variable has been included as a regressor to account for any persistence correlation. Urban growth and income per capita have been used as instruments and are certified valid by the Sargan test. They help to account for endogeneity and improve the validity of estimates. The results are displayed in the Table 5.

Table 5: One -Step System GMM output

NCDS Mortality	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
TobaccoTax on Cigarettes	-.042	.007	-6.17	0.000	-.055	-.028	***
AlcoholTax on Beer	.115	.048	2.40	.016	.021	.209	**
AlcoholTax on Spirits	-.012	.004	-2.64	.008	-.02	-.003	***
Tobacco Cigarettes Prices	-.887	.051	-17.38	0.000	-.987	-.787	***
Interaction OF TobaccoTax om Cigarettes and Tobacco Cigarettes Prices	.018	.002	9.63	0.000	.014	.021	***
Medium screening rates	-.461	.219	-2.10	0.036	-.890	-.031	**
High screening rates	.164	.065	2.53	0.011	.037	.292	**
Interaction of Alcohol Tax on Beer and Spirits	-.002	.001	-2.20	0.028	-.0037	-.0002	**
Lagged NCDS	.766	.028	27.85	0.000	.712	.820	***
Constant	8.995	.928	9.69	0.000	7.175	10.814	***
Mean dependent var		28.651	SD dependent var			2.983	
Number of obs		70	Chi-square			434.186	

**** p<.01, ** p<.05, * p<.1*

5.5 Interpretation of the results

A one percent increase in tobacco-cigarette tax is associated with a decrease in NCD mortality rates by 0.0416% holding all other factors constant. The coefficient is statistically significant at 5%. This conforms with public health goals, as higher cigarette prices can discourage smoking and reduce health risks that are attributed to NCDs. The negative results may also reflect the issues of elasticity as WHO reports indicate that the elasticity of tobacco cigarettes ranges from 5-8% in low- and middle-income countries,

while in high-income countries, it is about 4%. A positive coefficient of alcohol tax on beer implies that a one percent increase in excise tax on beer is associated with an increase in NCD mortality by 0.1152%, holding all other factors constant.

The coefficient is statistically significant under the 5% level. This finding is intriguing and might warrant further investigation, as it could be due to other factors related to beer consumption. A negative coefficient of alcohol tax on spirits suggests that a one percent increase in excise tax on spirits is associated with lower NCDS mortality rates by 0,0116% all things being equal. The coefficient is statistically significant at the 5% level. The negative result may also imply that spirits tend to have higher alcohol content, so this result might reflect differences in alcohol consumption patterns. A negative coefficient of tobacco cigarette prices indicates that higher prices are associated with lower NCD mortality rates by 0.08868%. The coefficient is statistically significant.

The joint effect of alcohol tax on beer and spirits is associated with a decrease in NCD mortality rates by 0.002%. The coefficient is significant at a 5% level. The negative association might also be attributed to whether these products are complements. The combined effect of increasing both cigarette tax and prices is associated with an increase in the NCD mortality rate by 0.018%. The coefficient is significant at the 5% level. Medium screening rates are negatively associated with NCD mortality rates. Higher screening rates are positively associated with NCD mortality rates as opposed to lower and medium screening rates. The result is expected mainly in disease epidemiology; when screening tools are introduced, or the old ones are improved, there is an increment in the death rate of the disease. This increase is due to the introduction of new tools. This suggests that in the past, the diseases were present in their respective countries, but no one picked them up. Both screening rates for dummies are significant at a 5% level. Past NCDs have a positive association with current NCDs by 0.7664%. This suggests a prevalence in NCD mortality rates. They are significant at the 5% level. The constant value of 8.9948 represents the expected NCD mortality rates when all other variables are zero. It is statistically significant.

Urban growth rate and income per capita might influence tax policies and outcomes of NCDs though they have not been explicitly addressed by estimators. Rapid urbanization is usually associated with lifestyle changes and better health facilities which could

influence screening rates and other health outcomes. Higher income levels provide access to better healthcare facilities and healthy lifestyles which could alter the risk of developing NCDs.

5.6 Discussions

This study empirically investigated the relationship between NCD mortality rates relative to changes in tax rates on tobacco cigarettes and alcohol (beer and spirit) while controlling for tobacco cigarette prices, screening rates, income per capita, and urban growth rates. This was done by collecting data for five sampled sub-Saharan countries from 2008-2022. The tax data used is about the excise tax on the most sold brands extracted from the World Health Organization. We find that increased taxes on tobacco or alcohol or both seem to have a negative significant association with NCDs.

The empirical evidence of the negative association of alcohol and tobacco cigarette taxes on the mortality rates of NCDs. The results confirmed the propositions that have been advocated by the WHO (WHO, 2024). Also, the use of the fiscus in dealing with the NCDS scourge has been reported in several studies to be effective and a negative relationship has also been found (Elliot et al., 2022). Furthermore, the negative association was reported in the Carrebian (Foucade et al., 2018), Nepal (Acharya et al., 2023), Peru(Zuleta et al., 2023), and many developed countries such as those in Europe(Manthey et al., 2024). Despite these findings, given the actual data, there are concerns about whether economic theory accounts for reality, particularly the positive association between alcohol taxes on beer and the mortality rates of NCDs.

The interaction of alcohol tax on spirits and beer tax conforms to the principles of taxation and reflects a possibility of complementarity. On the other hand, the interaction of tobacco tax on cigarettes and tobacco cigarette prices is counterintuitive. One interesting finding of these results is the significance of the intercept, indicating the presence of additional factors that may have a significant association with NCD mortality.

We also noticed that increased tobacco cigarette prices have a negative association with NCD mortality rate. This finding also agrees with the finding of Bader et al., 2011, who conducted a study on the effects of tobacco taxation and pricing on smoking behavior in high-risk populations. Probably the effect may be coming from the substitution effect as

people may be switching to consuming healthy goods. Given that the household budget has effectively been reduced in relative terms due to the price increase (Ross et al., 2017). This supports rational choice theories, where people weigh the benefits of a decision and opt for the option that yields the most beneficial outcome that maximizes utility(Kauder E, 2015).

Related to NCD screening, the categorical screening rates dummy variables imply that high screening rates unravel some NCD mortality rates that have not been picked up due to potential underdiagnosis. The importance of NCD screening in similar scenarios was reported among healthcare workers in South Africa (Malau et al., 2024) as well as for hypertension in Malawi(Ciancio et al., 2021). The screening may be said to be an important preventive strategy in areas like the countries analyzed, given their low capacity to adopt a curative approach due to a lack of adequate facilities, and low budget (Qoko et al., 2024) except for South Africa which may finance a large part of its health budget(Ataguba, 2021). Furthermore, the study showed that the use of lagged NCD mortality rates as an explanatory variable hints that previous NCD mortality rates may influence present or future NCDs. This is likely to be influenced by policy interventions that would impact the outcome of NCDs' present or future mortality rates.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATIONS

6.1 Introduction

The introduction is followed by three main sections: a summary of the findings, policy implications, and problematic areas that require further research. This chapter summarizes the research findings of the study and goes on to make conclusions and policy implications. It also encourages direction for further research.

6.2 Summary Findings

This study served to empirically investigate the relationship in the changes in NCD mortality rates relative to changes in tax rates of tobacco cigarettes and alcohol (beer and spirit) while controlling for tobacco cigarette prices, screening rates, income per capita, and urban growth rates. This was done by collecting data for five sampled sub-Saharan countries from the period of 2008-2022. The tax data used is an excise tax on the most sold brands extracted from the World Health Organization. Taxes seem to have a significant association with NCDs though there is not enough evidence of causality. The use of lagged NCDs as explanatory variables provides hints that previous NCDs may influence present or future NCDs in terms of policy interventions and the like. Tobacco cigarette prices have a negative association with NCD mortality rate reflecting an inverse relationship between price and demand. This finding also agrees with the finding of Bader et al., (2011) who conducted a study on the effects of tobacco taxation and pricing on smoking behavior in high-risk populations. The categorical screening rates dummy variables imply that high screening rates unravel some of the NCD mortality rates that have not been picked up due to potential underdiagnosis. The interaction of alcohol tax on spirits and tax on beer conforms to the principles of taxation but also reflects a possibility of complementarity. On the other hand, the interaction of tax on tobacco cigarettes and tobacco cigarette prices is counterintuitive. One interesting finding of these results is the significance of the intercept, indicating the presence of additional factors that have a possible significant association with NCD mortality.

6.3 Policy Implications

Having said that, it is imperative to indicate that the success of the tax intervention depends on taking a holistic approach. Such is the case because people trade off, and there is a temporary or permanent coping mechanism as humans are rationing and responding to price incentives, a phenomenon that was already observed in Malawi where alcohol consumption overcrowded the consumption of other household commodities (Jolex et al. 2022). They reduce the consumption of other necessities (Bao et al., 2013). To model the demand for these products, addiction-related issues must be taken into consideration because addicts would rather modify their spending in other areas to make up for the decrease in their present consumption than alter their behavior in the face of higher taxation. Further, the perceptions of other stakeholders may matter as they may jeopardize the policy process- a finding that was established in Nepal (Elliot et al., 2022).

Since there is no one-size-fits-all solution, differential taxes that target particular populations may be considered. In nations such as South Africa, where a varied range of racial backgrounds predominate, it is customary for individuals to smoke and drink alcohol (Jafari et al., 2021;Morojele et al., 2021). Effective implementation of tax interventions requires consideration of all these factors. In addition, since these levies provide the government with income, there should be consideration that the tax revenue generated should be channeled toward funding health initiatives related to NCDs and the treatment of current NCDs.

There are possible solutions for improving the effectiveness of these interventions, but there are also potential blind spots. Alcohol and tobacco products are taxed in the formal sector but not in the unregulated informal sector, where government supervision is minimal. This poses a challenge in some countries analyzed here, which comprise a large informal sector. Furthermore, WHO proposes taxes on the most sold brands of tobacco products and alcohol. An intervention that might compel people to switch to local brands if a tax hike makes these products costly. It is important to bear in mind that the goal of tax interventions is to ensure that the consumption of these goods is reduced to the point where there are no viable substitutes while balancing the impact on household income for countries like Malawi where these products specifically tobacco has economic significance, without compromising public health goals. In addition, differences in tax

distribution across countries might also yield significant differences in the reduction of modifiable risk factors.

6.4 Direction for Further Research

The results of this study call for more research to address some problematic areas raised, such as variations in demand responsiveness to price changes. In addition, the intercept in the regression analysis of this study shows a strong association with the dependent variable, the research should assist policymakers in investigating other factors influencing NCDs, this also includes the reaction of tobacco and alcohol industries to increased taxation. This will be extremely important when creating interventions.

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APPENDICES

Appendix A: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)
(1) TobaccoTax on Cigarettes	1.000					
(2) AlcoholTax on Beer	0.012	1.000				
(3) AlcoholTax Spirits	0.024	0.974	1.000			
(4) IncomePerCapita	0.560	-0.026	-0.031	1.000		
(5) Tobacco Cigarettes Prices	0.189	0.055	0.027	0.556	1.000	
(6) UrbanGrowthRate	-0.426	0.014	-0.013	-0.485	-0.119	1.000

Appendix B: Residual Plots, Test of the Presence of Heteroscedasticity