

**Bindura University
of Science Education**



DEPARTMENT OF ECONOMICS

***Assessing the impact of Total Health Expenditure on Life expectancy in
Zimbabwe: An Instrumental variable approach.***

by

COURAGE ELIOT MUZONDO

B231616B

This Dissertation is Submitted in Partial Fulfilment of the
Requirements for Master of Science Degree in Health Economics

SUPERVISOR

DR DAMIYANO

NOVEMBER 2024

APPROVAL FORM

The undersigned certify that they have supervised, reviewed and recommend to Bindura University of Science Education the acceptance of the research project titled: Assessing the impact of Total Health Expenditure on Life expectancy in Zimbabwe: An Instrumental variable approach. Submitted by Courage Eliot Muzondo, in partial fulfilment of the requirements of the Master of Science Degree in Health Economics.

Signature of Student..... Date:.....//

Signature of Supervisor..... Date:.....//

Signature of Chairperson..... Date:.....//

Signature of Examiner..... Date:.....//

DEDICATION

To my loving wife, Keley Nyoni whose unwavering support and patience were my guiding forces throughout this journey. I also extent my heartfelt dedication to my daughter with which her presence inspires and motivates me, to my mother whose love and encouragement sustained me and to my entire family who have been my support system in numerous ways. This thesis is dedicated to you all with deepest gratitude and love.

ACKNOWLEDGEMENTS

"I express my deepest gratitude to the Almighty for granting me the wisdom and discernment to partake in this academic journey. I'm indebted to my academic supervisor, Doctor Damiano, for his invaluable guidance, mentorship, and unwavering support throughout this project and the research methodology module. To add on, I would like to extend my sincere appreciation to the entire Economics Department and my fellow Health Economics classmates of November twenty twenty-four for the encouragement and support. Lastly, I'm grateful for the love, support, and encouragement from my family, friends, and workmates, whose contributions made this achievement a reality."

ABSTRACT

This study assesses the impact of total health expenditure on life expectancy in Zimbabwe, utilizing a two-stage least squares regression model, an instrumental variable approach. Data were collected from the World Bank's Health Nutrition and Population Statistics database, spanning 1990-2024. The results reveal an inverse relationship between total health expenditure and life expectancy, contrary to theoretical expectations. This unexpected finding suggests that inefficient allocation of health resources, dominance of the private sector with profit-driven motives, insufficient healthcare infrastructure, and inequitable access to healthcare due to income disparities may be contributing factors. The study controls for population density, literacy rate, and GDP per capita, revealing complex relationships with life expectancy. Health workforce density is used as a valid instrumental variable, satisfying the relevance and exogeneity conditions. The study's findings have significant implications for healthcare policy and resource allocation in Zimbabwe. To improve healthcare outcomes, the study recommends conducting budget analysis, engaging the private sector through public-private partnerships, strengthening community-based approaches, conducting institutional capacity assessments, and capacitating village health workers.

Keywords: *Health expenditure Life expectancy, Instrumental variable analysis, Healthcare infrastructure, Health workforce density, Healthcare policy, Resource allocation, Zimbabwe.*

LIST OF TABLES

Table 4.1.1: Data Description.....	17
Table 4.1.2: Summary Statistics.....	18
Table 4.2.1.1: Durban-Wu-Hausman (DWH) test.....	19
Table 4.2.1.2: Gragg-Donald Wald F-statistic (eigenvalue statistic).....	19
Table 4.3.1.1: 2SLS Regression Results.....	20
Table 4.3.1.2: 2SLS Regression Results with robust standard errors.....	20

LIST OF FIGURES

Figure 1: Historical Life Expectancy Data.....	2
Figure 2: Health % of the Budget allocation.....	2

LIST OF APPENDICES

Appendix 1 Summary Statistics.....	31
Appendix 2 Durban-Wu-Hausman (DWH) test.....	32
Appendix 3 Gragg-Donald Wald F-statistic (eigen value statistic)	33
Appendix 4 2SLS Regression results.....	34
Appendix 5 2SLS Regression results with robust standard errors.....	35
Appendix 6 Data Set	36

TABLE OF CONTENTS

APPROVAL FORM.....	i
DEDICATION	ii
ACKNOWLEDGEMENTS.....	iii
ABSTRACT.....	iv
LIST OF TABLES	v
LIST OF FIGURES	vi
LIST OF APPENDICES	vii
CHAPTER ONE: INTRODUCTION AND BACKGROUND	1
1.0 INTRODUCTION	1
1.1 BACKGROUND TO THE STUDY	1
1.2 STATEMENT OF THE PROBLEM.....	3
1.3 OBJECTIVES OF THE STUDY	3
1.3.1 Specific Research Objectives	3
1.4 RESEARCH QUESTIONS	3
1.5 RESEARCH HYPOTHESIS	3
1.6 SIGNIFICANCE OF THE STUDY	3
1.7 ASSUMPTIONS OF THE STUDY.....	4
1.8 STUDY LIMITATION.....	4
1.9 DELIMITATION OF THE STUDY	5
1.10 DEFINITION OF TERMS	5
1.10.1 Life Expectancy.....	5
1.10.2 Total Health Expenditure	5
1.10.3 Health Workforce Density	5
1.10.4 Instrumental Variable	5
1.10.5 Population Density	5
1.10.6 Literacy Rate	5
1.10.7 GDP per Capita	6
1.11 CONCLUSION.....	6
1.12 ORGANISATION OF CHAPTERS	6
CHAPTER TWO: LITERATURE REVIEW	7
2.0 INTRODUCTION	7
2.1 THEORETICAL LITERATURE REVIEW	7
2.1.1 Grossman health production function	7
2.1.2 Malthusian theory.....	8
2.1.3 Social Determinants of Health Theory.....	8
2.2 EMPIRICAL LITERATURE REVIEW	9

2.3	RESEARCH GAP.....	11
2.4	CONCLUSION.....	11
	CHAPTER THREE: RESEARCH METHODOLOGY	13
3.0	INTRODUCTION	13
3.1	RESEARCH DESIGN	13
3.1.1	Model estimation.....	13
3.2	DATA COLLECTION PROCEDURES	13
3.3	DATA PRESENTATION AND ANALYSIS.....	14
3.4	DATA ANALYSIS	14
3.5	DIAGNOSTIC TESTS	14
3.5.1	Test for weak instruments: Gragg-Donald Wald F-statistic (eigenvalue statistic)....	14
3.5.2	Test for endogeneity: Durbin- Wu- Hausman (DWH) test	14
3.5.3	Test for Heteroscedasticity: Breusch-Pagan Test	14
3.6	RESEARCH PHILOSOPHY.....	15
3.6.1	Pragmatism.....	15
3.7	RESEARCH ETHICAL CONSIDERATIONS	15
3.7.1	Respect for Intellectual Property.....	15
3.7.2	Integrity	15
3.8	CONCLUSION.....	15
	CHAPTER FOUR: DATA PRESENTATION AND DISCUSSION.....	17
4.0	INTRODUCTION	17
4.1	DATA PRESENTATION PROCESS	17
4.1.1	Data Description.....	17
4.1.2	Summary Statistics.....	17
4.2	PRESENTATION ANALYSIS	19
4.2.1	Diagnostic tests	19
4.2.1.1	Durbin-Wu-Hausman (DWH) test	19
4.2.1.2	Gragg-Donald Wald F-statistic (eigenvalue statistic)	19
4.3	PRESENTATION ANALYSIS, INTEPRETATION AND DISCUSSION.....	20
4.3.1	Presentation analysis	20
4.3.1.1	2SLS Regression Results	20
4.3.1.2	2SLS Regression results with robust standard errors.....	20
4.3.2	Interpretation	20
4.3.3	Discussion	21
4.4	CONCLUSION.....	22
	CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS	24
5.0	INTRODUCTION	24

5.1	SUMMARIES.....	24
5.2	CONCLUSIONS.....	24
5.3	RECOMMENDATIONS	25
5.4	CONCLUSION.....	26
	REFERENCE LIST.....	28
	LIST OF APPENDICES.....	31

CHAPTER ONE: INTRODUCTION AND BACKGROUND

1.0 INTRODUCTION

The relationship between total health expenditure and life expectancy is critical to identify if its causal and establish the effect and direction of the causal effect. This assists policy makers to make evidence informed policy decisions and avoid conflicting intentions between what the policy intends to address and the effect of the policy when implemented. Apparently, Zimbabwe's pursuit of the Abuja declaration which calls for allocating 15% of the National budget towards health expenditure Azodi (2019), has resulted in mixed results over the past 4 years of the National Development Strategy¹ (NDS1). This has prompted questions about the effectiveness of total health expenditure on life expectancy.

The study seeks to investigate the impact of total health expenditure (THE), on life expectancy in Zimbabwe from 1990 to 2023 using an instrumental variable approach to address for potential endogeneity bias. The research seeks to have an assessment of the paradoxical trend between health expenditure and fluctuating life expectancy rates. The exploration shall yield empirical evidence that shall contribute to the ongoing discourse on healthcare allocation and its implication on health outcomes particularly life expectancy.

1.1 BACKGROUND TO THE STUDY

Over the years, Zimbabwe has been making strides to make drastic improvements on public health expenditure. This is evidenced by its effort to, conform with the Abuja Declaration which entails increasing Domestic funding for health to 15%. The Universal Health Coverage index for Zimbabwe is 54 which is above the Sub-Saharan Africa of 43.89 Nyabani (2024). The Government of Zimbabwe's budgetary support demonstrate an upward trajectory from 2020 to 2024. Life expectancy at birth refers to the number of years on average a newborn can expect to live. The exact age of any birth cohort cannot be known in advance. The trends of Life expectancy over the period of 2020 to 2024 has shown an increase according to Macro trends statistics.

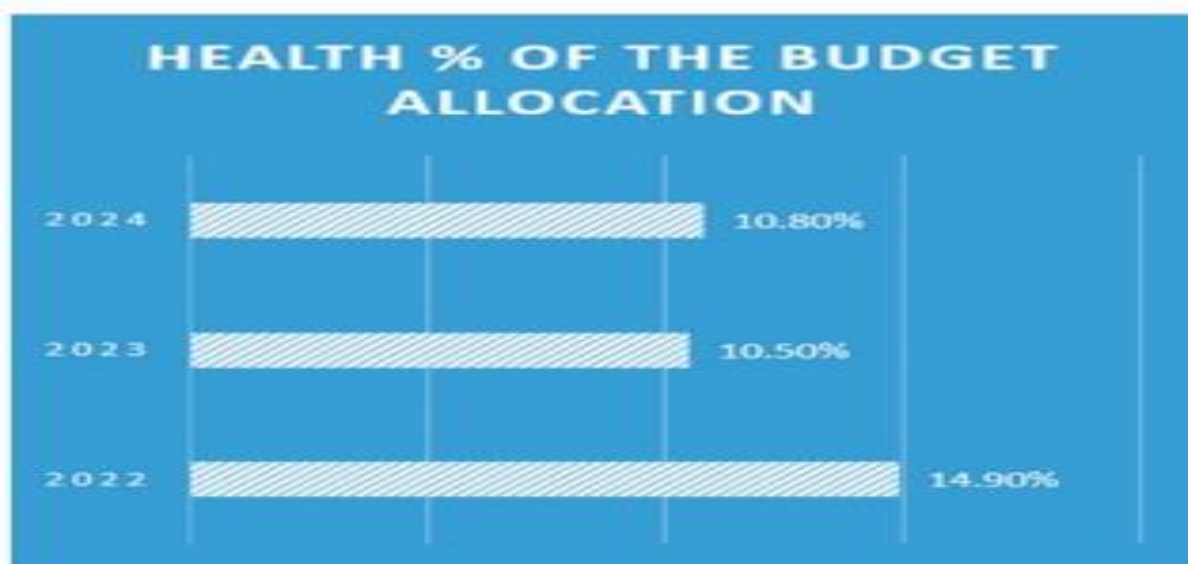
Figure 1: Historical Life Expectancy Data.

Zimbabwe - Historical Life Expectancy Data		
Year	Life Expectancy	Growth Rate
2024	62.41	0.410%
2023	62.16	0.430%
2022	61.89	0.430%

Source: Macrotrends Statistics

The figure above shows an increase in life expectancy from 61.89 years in 2022 to 62.41 in 2024. The figures show an increase in life expectancy over the three-year program.

Figure 2: Health % of the Budget allocation



Source: Macrotrends Statistics

Figure 2 shows a 14.9% allocation of the National budget in 2022, 10.5% allocation in 2023 and 10.80% in 2024.

The somewhat trend relationship between life expectancy and health expenditure is sought to be discovered by this research. As Zimbabwe strives to achieve SDGs, particularly goal number 3 ensuring good health and wellbeing across all citizens. The findings of the study will be crucial in understanding the intricate dynamics at play.

1.2 STATEMENT OF THE PROBLEM

Despite fluctuations in health expenditure shown by a decrease from 14.9% in 2022 to 10.5% in 2023 and a slight rise to 10.8%. Consequently, life expectancy continued to rise from 61.89 to 62.41. The non deterministic trend demonstrated by the two variables as well as inconclusive empirical evidence by reviewed literature has motivated the researcher to intend to carryout research. Given the background information above, the question pondering the researcher's mind is. Does total health expenditure impact on life expectancy?

1.3 OBJECTIVES OF THE STUDY

- To assess the causal effect of total health expenditure on life expectancy

1.3.1 Specific Research Objectives

- To assess the validity of Health workforce density as an Instrumental variable (IV)
- To examine the relationships between population density, literacy rate, GDP per capita on life expectancy.

1.4 RESEARCH QUESTIONS

- Does Total Health Expenditure (THE) have a causal effect on Life expectancy (LE) in Zimbabwe?
- Is Health Workforce Density (HWD), a valid instrumental variable for total health expenditure in examining the impact of total health expenditure on life expectancy?
- What is the relationship between population density, literacy rate, GDP per capita on life expectancy in Zimbabwe?

1.5 RESEARCH HYPOTHESIS

HO: There is no causal relationship between Total Health Expenditure and Life expectancy

H1: There is a causal relationship between Total Health Expenditure and Life expectancy

1.6 SIGNIFICANCE OF THE STUDY

The effort towards health expenditure is to archive universal health coverage and access. The broader context of improved health outcomes includes an increase in life expectancy. Findings

of the research shall clarify the inconclusive relationship between health expenditure and life expectancy, shedding more light on the intricate relationship between total health expenditure and life expectancy. In addition, the findings of the research will inform evidence-based health policy decisions to the Government of Zimbabwe (GOZ), optimizing resource allocation and prioritization of health interventions. On the same note, the study will address Zimbabwe's unique health challenges, including limited resources, inadequate infrastructure, and a high disease burden, providing valuable insights for policymakers to strengthen the healthcare system Claborn (2020). The research will also proffer meaningful contributions to the existing body of literature particularly on contemporary issues on health economics, health policy, and health outcomes, bridging knowledge gaps and offering nuanced perspectives on the causal relationship between total health expenditure and life expectancy.

Furthermore, the study's aid to Zimbabwe's progress toward Sustainable Development Goals (SDGs), particularly SDG 3, ensuring good health and well-being for all. Additionally, the findings will empower stakeholders, including policymakers, healthcare professionals, and advocacy groups, with robust evidence to advocate for increased investment in health. The study's longitudinal perspective (1990-2023) will also provide valuable lessons on the impact of historical events, policy changes, and economic shifts on health outcomes, offering critical implications for resource-constrained settings. The study shall assist in informing health policy decisions. The research shall provide a basis for future research.

1.7 ASSUMPTIONS OF THE STUDY

- All potential confounders are accounted for by the study, minimising omitted variable bias
- The study assumes the data used to estimate empirical results does not have measurement errors and other forms of bias.
- There is no endogeneity bias beyond the instrumental variable approach, thereby ensuring the relationship between variables are causal
- The study assumes health workforce density is a valid instrument and it meets the relevance and exogeneity conditions.

1.8 STUDY LIMITATION

The study is limited to Zimbabwe, therefore pausing limited generalisability or external validity to countries outside Zimbabwe. However, the study can provide a basis for comparison and offer proffer research guidance to those who want to carry further research or similar research.

1.9 DELIMITATION OF THE STUDY

The study aims at analysing if there is a causal relationship between total health expenditure and life expectancy. The second area of coverage sought by the research is assessing healthcare workforce density as a valid instrumental variable. The temporal scope of the study covers the period from 1990 to 2023 and the geographical delimitation is confined to Zimbabwe. Anything beyond the objectives of the study, the alluded timeframe and geographical boundaries of Zimbabwe is not covered by the research. Given the clearly stated boundaries, this study ensures a focused and in-depth cross examination of the specified research questions and objectives.

1.10 DEFINITION OF TERMS

1.10.1 Life Expectancy

Life expectancy at birth refers to the average number a person is expected to live relative to mortality rates for a given population WHO (2023).

1.10.2 Total Health Expenditure

Total health expenditure is the total amount spent on healthcare in a country which is inclusive of public and private expenditures Dieleman *etal* (2021).

1.10.3 Health Workforce Density

Health workforce density is defined as the number of health workers (doctors, nurses and midwives) per 1000 population Ahmat *etal* (2022).

1.10.4 Instrumental Variable

According to Angrist and Hull (2023), an instrumental variable is used to estimate the causal effect of a treatment variable on an outcome variable.

1.10.5 Population Density

Population density is the number of people per area often expressed as people per square kilometer OECD (2020).

1.10.6 Literacy Rate

Literacy rate is the percentage of the population with ages 15 and above who can read and write Unicef (2021).

1.10.7 GDP per Capita

GDP per capita is the total output of a county's goods and services divided by its population providing an average standard of living indicator Balima and Sy (2021).

1.11 CONCLUSION

The research seeks to investigate the impact of total health expenditure on life expenditure in Zimbabwe from 1990 to 2023. The background provides an overview to what forms the basis of this study. The study's objectives and research questions provide a basis for addressing the research gap. The significance of the study lies in its potential to contribute to improved health outcomes and policy decisions. The following chapter will review existing theoretical and empirical literature as well as the research gap.

1.12 ORGANISATION OF CHAPTERS

The study shall comprise of 5 chapters. Chapter one includes introduction and background. The second chapter consist of theoretical, empirical literature review and research gap. Chapter three shall include the research methodology and chapter four comprises of presentation of results and discussion. Lastly, chapter five shall include summary, conclusion and recommendations

CHAPTER TWO: LITERATURE REVIEW

2.0 INTRODUCTION

The second chapter focuses on the theoretical and empirical frameworks that support the research. The theoretical frameworks show the theories that support the relationship between the dependent variable (Life expectancy) and explanatory variables (total health expenditure, population, GDP per capita and literacy rate). The empirical framework shows previous studies that were done by other researchers which are of a similar nature as well as the research gap that was identified by the researcher which motivated him to carry the study.

2.1 THEORETICAL LITERATURE REVIEW

2.1.1 Grossman health production function

In this model, health is a durable capital good which is inherited and depreciates over time. Investment in health takes the form of medical care purchases and other inputs and depreciation is interpreted as natural deterioration of health over time. In the model, health enters the utility function directly as a good people derive pleasure from and indirectly as an investment which makes more healthy time available for market and non-market activities Grossman (2022).

The model postulate that, health is a durable good which can be inherited and is subject to depreciation overtime. Hence one needs to continue to invest in health through various forms such as medical care purchases. The model is based on the interaction between demand function for health and a production function for health. The Grossman demand for health forms a basis for explanatory variables such as literacy rates, GDP per capita and total health expenditure. The relationship between literacy rate and life expectancy is expected to be positive. Since as literacy rates level increase it is assumed one is cautious about health habits and invests in health which in turn result in positive health outcomes resulting in higher life expectancy *ceteris paribus*.

GDP per capita is expected to have a positive relationship with life expectancy. The more the country produce the more the central government has fiscal space to facilitate public health expenditure. This will result in increased life expectancy. Total health expenditure is expected to have a positive relationship with life expectancy. The more the total health expenditure increase, assuming a proportionate health utilization. Health outcomes will improve which in turn result in higher life expectancy.

On the contrary the Grossman health production function has a limitation of oversimplifying complex determinants of health. It also assumes rational health decisions which is not always the case. The empirical results shall therefore provide a conformation of the theory or provide insights to critique the theory based on empirical findings.

2.1.2 Malthusian theory

The theory states that the supply of food cannot keep up with the growth of the human population, inevitably resulting in disease, famine, war and calamity. The population growth is potentially exponential Unat (2020). The theory highlights the consequences of unchecked population growth resulting in the inverse relationship between life expectancy and population growth. As population continues to increase, there will be limited fiscal space resulting from competing priorities resulting in a reduction in life expectancy due to disease burden, famine, war and various other reasons.

The limitations of this theory lie on its failure to factor in for technological advances and other macroeconomic interactions such as foreign aid in times of famine as well as Government intervention. In addition, it does not factor in technological interventions such as use of high yield seed varieties and improvements in the Agricultural space as well use of contraceptives to minimise the disproportionate gap between population growth and supply of food. The expected sign remains inverse, on the same note findings of the study shall confirm the validity of the theory in the Zimbabwean context.

2.1.3 Social Determinants of Health Theory

The Social Determinants for health theory, provides insight on the need to factor in the impact of socio-economic factors on health outcomes. The theory postulates that health inequalities are a manifestation of uneven distribution of resources, opportunities and social privileges Synder-Mackler (2020). The key determinants include economic stability, health access, social support, education and environmental conditions. The interaction of these social factors influences individual and population health, highlighting the role of policy and social structures in shaping health outcomes.

This theory emphasises the essence of covariates such as education and population health. Consequently, literacy rate is expected to have a positive relationship to life expectancy which conforms with the Grossman health production function where literacy rates inform rational health decisions *ceteris paribus*.

The Grossman Health Production Function, Malthusian Theory, and Social Determinants of Health Theory collectively provide a comprehensive understanding in establishment of the relationships between total health expenditure, health workforce density, GDP, literacy rate, population density, and life expectancy. The Grossman Health Production Function is pinpointed on individuals' investment in health, on the other hand the Malthusian Theory highlights the consequences of unchecked population growth. The Social Determinants of Health Theory bridges these perspectives by emphasizing socioeconomic factors influencing health outcomes.

The combined framework suggests that, Total health expenditure and health workforce density positively influence life expectancy through improved healthcare access (Grossman). Population density has an inverse relationship with life expectancy due to resource constraints (Malthusian). Socioeconomic factors (GDP, literacy rate) mediate the relationship between total health expenditure and life expectancy, highlighting the importance of social structures and policy (Social Determinants). Health workforce density interacts with socioeconomic factors to improve health outcomes, addressing the Grossman theory's limitations. The Malthusian Theory's focus on population growth is nuanced by the Social Determinants Theory's emphasis on socioeconomic factors influencing health outcomes.

2.2 EMPIRICAL LITERATURE REVIEW

Nkemgha G Z *et al* (2019), conducted a study on health expenditure and life expectancy in Cameroon from 1980 to 2014. The methodology used was ordinary least squares (OLS) regression. The variables included in the model were per capita public expenditure, per capita private expenditure, per capita GDP, prevalence of under nourishment, HIV prevalence, population density and saving rate. The results of the study were a positive relationship between private health expenditure and life expectancy. A negative relationship was observed between public health expenditure and life expectancy. The researcher intends to take a different trajectory and adapt an instrumental variable approach as opposed to the ordinary least squares methodology which does not fully address endogeneity bias making difficult to conclude that the relationship between variables is causal.

Health expenditure shall be measured as total health expenditure as opposed to Nkemgha, who separated private health expenditure and public health expenditure. This might result in serial correlation among regressors since they might be some relationship between the two variables. In addition, the researcher intends to factor in health workforce density as an instrumental

variable to total health expenditure in order to try and address omitted variable bias. GDP per capita and population density were variables of interest to the researcher. The other remaining variables shall not be included in this model as explanatory variables. The research under study relates to the context of Zimbabwe which is as opposed to the afore mentioned study which was done in Cameroon and a different methodology and variables shall be done in this study.

The second empirical study, was on the effect of health expenditure on life expectancy Morina *etal* (2022). The study sought to find the effect of health expenditure on life expectancy among OECD countries. 37 countries were studied from 2005 to 2018. A GMM- Arellano Bond Estimation. Generalised estimation equation was also used. The variables that were included were GDP per capita, productivity, population, infant mortality rate, potential years of life lost from cancer and suicide rate. The study concluded that there was a positive impact of health expenditure on life expectancy. GDP per capita, population, health expenditure are the three recurring variables in both the reviewed empirical studies.

The second study used panel data which is a more appropriate methodology compared to ordinary least squares.in assessing impact since it helps in solving for idiosyncratic errors. This research seeks to find the impact of total health expenditure on life expectancy using the instrumental variable approach. Both studies did not clearly address endogeneity bias. Secondly the researcher intends to assess the impact of health Expenditure in Zimbabwe. This research shall add literacy rate as one of the explanatory variables.

The third research assessed the effect of health expenditure on average life expectance does government effectiveness play a moderating role Bunyaminu (2022). The study employed a panel regression model for 43 countries and its limitation was limited generalisability in the African context since in Africa they are 54 countries. Similarly, Morina *etal* also used panel regression for 37 countries in OECD and employed GMM as well. It used Generalised Methods of Moments (GMM), which attempt to address endogeneity issues in the panel model.

The findings were a positive relationship between health expenditure and average health expenditure with government effectiveness being the moderator. The researcher intends to address endogeneity issues using an instrumental variable approach and is limited to the Zimbabwean context in order to inform policy interventions which suit best the Zimbabwean context to avoid policy incompatibilities.

The fourth study, was about evaluating the influences of health expenditure, energy consumption and environmental pollution on life expectancy in Asia. The study employed

cross sectional dependence and slope heterogeneity due to similarities in Asian countries to account for correlation and non-stationarity, in addition it used inter Autoregressive Distributed Lag Model (CS-ARDL). There was a positive relationship between life expectancy and the health expenditure variable. Although the three studies used panel data serve for the first one that used OLS. They did not fully address endogeneity issues and the fourth study mainly focused on addressing stationarity and serial correlation.

The studies share common findings, such as the positive relationship between health expenditure and life expectancy serve for the first study that observed a negative relationship was observed between public health expenditure and life expectancy. On the contrary, different methodologies were used and limitations exist. Nkema's (2019) study was limited by its focus on Cameroon, while Morina *etal* (2022) study excluded non-OECD countries. Bunyaminu (2022) study only included 43 African countries, leaving out 11 countries, the study neglected the potential impact of literacy rate and health workforce density on health outcomes. This study builds upon existing research by addressing endogeneity, incorporating literacy rate and health workforce density, and examining the impact of total health expenditure on life expectancy using an instrumental variable approach.

2.3 RESEARCH GAP

The relationship between health expenditure and life expectancy remains unclear, despite fluctuations in health expenditure (14.9% to 10.5% to 10.8%) and steady rises in life expectancy (61.8 to 62.4) in Zimbabwe. Theoretical models namely Grossman Health Production Function, Malthusian Theory, Social Determinants for health suggest a positive link between health expenditure and life expectancy, but the four empirical study's findings are inconclusive due to different time bounds, geographic targets and methodological limitations, neglecting endogeneity and omitting crucial variables like literacy rate and health workforce density. This study addresses this gap by employing an instrumental variable approach to examine the causal relationship between total health expenditure and life expectancy, providing clarity on the effectiveness of health expenditure in improving life expectancy.

2.4 CONCLUSION

The Literature review examined theoretical and empirical findings to necessitate the essence of conducting this study. It also managed to synchronise various theories that were foundational to variables that are employed in the study. In addition, review of empirical literature provided a platform for comparing methodologies which aided to the establishment of the research gap.

This chapter provides a basis for the third chapter as the methodology chosen was established after thorough review of methodologies by other scholars. Key findings and gaps in existing literature provides a foundation for the need to establish the relationship between health expenditure and life expectancy in Zimbabwe.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 INTRODUCTION

The third chapter comprises of the research methodology used to estimate the relationship between health expenditure and Life expectancy. The instrumental variable approach is adapted as it addresses endogeneity as well as minimise various forms of bias thereby providing a basis for establishment of causal inferences. In addition, analysis of data is also presented in this chapter. Research ethics and the research philosophy adopted by the researcher are also highlighted in this chapter.

3.1 RESEARCH DESIGN

The study adopted an instrumental variable approach. This method assists in minimising omitted variable bias. To estimate the causal effect of total health expenditure on life expectancy, the researcher shall employ a two stage least squares regression. The first stage least squares shall include health workforce density as the instrumental variable to estimate total health expenditure.

3.1.1 Model estimation

First Stage Regression

$$THE = B_0 + B_1 HWD + B_2 POP + B_3 LIT + B_4 GDPPC + E$$

Second Stage Regression

$$LE = Y_0 + Y_1 THE + Y_2 POP + Y_3 LIT + Y_4 GDPPC + U$$

LE: Life Expectancy

THE: Total health expenditure

HWD: Health workforce density

POP: Population density

LIT: Literacy rate

GDPPC: GDP per capita

E and *U*: error terms

THE: Total health expenditure first stage equation estimate

3.2 DATA COLLECTION PROCEDURES

The Study used annual time series data for Zimbabwe, from 1990 to 2023. The data was collected from World Bank under the database titled Health Nutrition and Population statistics.

Data was collected online through the World Bank data portal. The database provided annual data for the following variables namely life expectancy at birth, total health expenditure, health workforce density, literacy rates, GDP per capita and population growth. The variables were extracted and exported as an excel file for further analysis.

3.3 DATA PRESENTATION AND ANALYSIS

This section outlines the procedures undertaken to establish the causal relationship between total health expenditure and life expectancy as well as life expectancy and control variables that is literacy rate, GDP per capita and population growth. In addition, the steps taken to assess the validity of health workforce density as an instrumental variable.

3.4 DATA ANALYSIS

Data analysis shall be done using descriptive and inferential statistics to find the relationship between the outcome variable (life expectancy) and treatment variables. A statistical package titled STATA 14 was used to analyse data. A causality research design shall also be used to measure impact of total health expenditure on life expectancy.

3.5 DIAGNOSTIC TESTS

To test for the model's internal validity, the following rigor tests shall be done. Test for weak instruments, test for overidentifying restrictions, test for endogeneity and lastly the heteroscedasticity test.

3.5.1 Test for weak instruments: Gragg-Donald Wald F-statistic (eigenvalue statistic)

Ho: The instruments are weak

H₁: The instruments are not weak

Reject Ho if F- statistic (Kleibergen-Paap rk Wald F- Statistic) is greater than 10 (Stock- Yogo critical value) and conclude that the health workforce density is not a weak instrument.

3.5.2 Test for endogeneity: Durbin- Wu- Hausman (DWH) test

Ho: Total health expenditure is exogenous

H₁: Total health expenditure is endogenous

Reject Ho if p values are less than 0.05, if p value is greater than 0.05, we fail to find evidence to reject Ho and conclude that total health expenditure is exogenous.

3.5.3 Test for Heteroscedasticity: Breusch-Pagan Test

Ho: Homoscedasticity

H₁: Heteroscedasticity

Reject H₀ if p values are less than 0.05, if p value is greater than 0.05, we fail to find evidence to reject H₀ and conclude that there is homoscedasticity.

3.6 RESEARCH PHILOSOPHY

According to Schutt (2019) research philosophy is defined as a comprehensive strategy that entails how a study is to be conducted. This involves a belief and assumptions in which data about the research problem is going to be collected, analysed and used. The researcher used the pragmatism research philosophy.

3.6.1 Pragmatism

Pragmatism is based on the proposition that researchers or scholars should make use of a philosophical and methodological approach that best suits a particular research problem under study Kothari and Garg (2018). The researcher chose this approach as it best fits the research strategy which is quantitative. This study adopts a pragmatic research philosophy as it emphasizes practical problem solving. The research aims to provide actionable insights into the relationship between health expenditure and life expectancy.

3.7 RESEARCH ETHICAL CONSIDERATIONS

According to Kothari and Garg (2018) research ethics refers to the appropriateness of a researcher's behaviour in relation to the rights of the respondents and or those who are affected by it. Research ethics relates to the questions such as how the researcher formulates and clarifies the research topic, designs, questions, data collection and analysis. The presentation of the findings in an honest and morally responsible manner.

3.7.1 Respect for Intellectual Property

The study is originated by the author as it is conducted from scratch and all the 39 intellectual property rights were respected by the research. The researcher acknowledged the scholarly work done by other researchers by referencing the information sources.

3.7.2 Integrity

The researcher shall make sure that transparency and integrity is maintained throughout the for entire research process till the approval of the research by the supervisor.

3.8 CONCLUSION

This chapter presented the methodology employed by the researcher. A 2 stage least squares regression was used to estimate the relationship between life expectancy and health expenditure

in Zimbabwe. Health workforce density was the instrument used to estimate the first stage regression. Time series annual data was collected from World Bank Health Nutrition and Population statistics database. Diagnostic tests in order to ensure internal and external validity of the model. By embracing a pragmatic research philosophy and adhering to ethical considerations, this study provides a robust framework for analysing the impact of health expenditure on life expectancy.

CHAPTER FOUR: DATA PRESENTATION AND DISCUSSION

4.0 INTRODUCTION

The chapter gives an overview of the empirical findings of a two stage least squares regression analysis conducted using STATA 14. The study sought to examine the relationship between healthcare expenditure and life expectancy from 1990 to 2023. The research employed an instrumental variable approach to address potential endogeneity issues.

4.1 DATA PRESENTATION PROCESS

4.1.1 Data Description

Table 1

Variable	Model variable	Proxy	Justification
Life Expectancy	Le	Mortality rate, neonatal (per 1,000 live births)	Neonatal mortality rate was used as a proxy for life expectancy due to its strong relationship with health outcomes, consequently a reduction in neonatal mortality rates indicates higher life expectancy.
Total health expenditure	Thee	Current health expenditure per capita (current US\$)	The proxy measures financial investment in healthcare per capita. The current expenditure (current US\$) takes into account for variations in currency volatility and changes currencies as is the case in Zimbabwe.
Health workforce density	Hwdd	Births attended by skilled health staff (% of total)	The instrumental variable captures the impact of health workforce density using births attended by skilled staff gives a reflection of quality healthcare and influence on health expenditure.
Population Growth	Pop	Population growth (annual %)	Population growth, reflects on the rate of change of the population per annum.
Literacy Rate	Litt	Literacy rate, adult total (% of people ages 15 and above)	Literacy rates for adults reflects on health expenditure choices and influence on healthcare access and utilisation.
GDP per capita	Gdp	GNI per capita, Atlas method (current US\$)	The proxy shows the economy's potential to finance all sectors including the health sector, The atlas accounts for income disparities and addresses the purchasing power parity.

Source: Author's computation

4.1.2 Summary Statistics

Under this section, summary statistics for life expectancy (outcome variable), total health expenditure (treatment variable) and the three control variables namely population growth, literacy rates and GDP per capita are provided for. The descriptive statistics provides an

overview for distribution of data and central tendency to identify potential data issues Wooldridge *etal* (2016).

Table 2

Variable	Model Variable	Mean	Std Deviation	Min	Max
Life Expectancy	Le	27.42647	3.228876	22.8	33
Total health expenditure	Thee	160.6217	79.13521	50.67651	313.3456
Health workforce density	Hwdd	73.88137	8.530782	60.2	93.9
Population Growth	Pop	1.547749	0.6421528	0.5238506	2.68096
Literacy Rate	Litt	85.35231	2.716992	82.3689	89.99457
GDP per capita	Gdp	786.7647	486.3265	130	1740
Number of observations	34				

Source: Author's computation (see appendix 1)

Every 10-point decrease in neonatal mortality rate corresponds to a one/two-year increase in Life expectancy. Countries with neonatal mortality rates of 20 to 30 per 1000 live births have a life expectancy of 55 to 65 years World Health Organization (2019). Neonatal mortality rate in Zimbabwe on average is 27 deaths per 1000 live births which corresponds to a life expectancy of 55 to 65 years. 3 deaths per 1000 live births indicates variability in best performing years and worst performing years in the period under study. The minimum neonatal mortality rate was 23 deaths per 1000 and a maximum of 33 deaths per 1000 live births.

On average 160 USD is spent per capita, the health expenditure is lower than the average 200 USD per capita for third world economies. The variability on health expenditure from population groups with low health expenditure and high health expenditure is USD 79.14. The lowest health expenditure per capita from 1990 to 2023 was USD 50.69 and the highest health expenditure was USD 313.35.

Health workforce density on average is 73 health workers per 1000 population. There is moderate variability in health workforce density across population groups of 8 per 1000 population. The minimum and maximum health workforce density are 60 and 93 professional health workers per 1000 population. Zimbabwe's average population growth rate is 1.54% per annum which is relatively moderate compared to other global rates Kaba (2020). There is a population growth variability of 0.64%. The minimum and maximum population growth rates on the period under study are 0.52% and 2.68% respectively.

On average the literacy rate in Zimbabwe is 85.32%. The variability across citizens in Zimbabwe is 2.71%. The minimum and maximum literacy rates levels are 82.37% and 89.99% respectively. Average GDP per capita is USD 786, there is substantial variation in GDP per capita of 486 USD. The minimum GDP per capita is USD 130 whilst the maximum GDP per capita is 1740 indicating high economic activity among such population groups.

4.2 PRESENTATION ANALYSIS

4.2.1 Diagnostic tests

4.2.1.1 Durbin-Wu-Hausman (DWH) test

Table 3

Durban (score) chi2 (1)	= 7.93647	(p=0.0048)
Wu-Hausman F (1.28)	=8.52614	(p=0.0068)

Source: Author's computation (see appendix 2)

The results presented above show existence of endogeneity in health expenditure. This is evidenced by both p values being lower than 0.05 resulting in rejection of the null hypothesis which state health expenditure is exogenous. The implication of the findings is such that the relevance assumption has been satisfied. The relevance assumption postulate that the instrumental variable (health workforce density) should be correlated with the endogenous variable (health expenditure) Kmenta (2010). The relevance assumption is key in the use of the instrumental variable methodology; hence it confirms the model employed in the study has internal validity.

4.2.1.2 Gragg-Donald Wald F-statistic (eigenvalue statistic)

Table 4

Variable	R squared	Adjusted R squared	Partial R squared	F statistic	Prob> F
Thee	0.7878	0.7586	0.3800	17.7755	0.0002

Source: Author's computation (see appendix 3)

The table above shows the results for the weak instrument test. The F- statistic (Kleibergen-Paap rk Wald F- Statistic) is 17.7755 which is greater than 10 (Stock- Yogo critical value). The above condition satisfies the rejection criteria; hence we find evidence to reject the null hypothesis and conclude that health workforce density is a valid instrument. The validity of the instrumental variable entails the exogeneity assumption has been satisfied. Health workforce density is not correlated with the outcome variable (life expectancy) but only through its effect

on the treatment variable (total health expenditure). 75.86% of the variation in health expenditure is explained by the model in the first stage regression. 38% of variation in health expenditure is explained by health workforce density, controlling for other variables.

4.3 PRESENTATION ANALYSIS, INTERPRETATION AND DISCUSSION

4.3.1 Presentation analysis

4.3.1.1 2SLS Regression Results

Table 5

Variable	Coefficient	Standard error	z	P> z	95% confidence interval	
Thee	-0.0674993	0.007607	-8.87	0.000	-0.0824086	-0.0525899
Pop	1.996705	0.7378282	2.71	0.007	0.5505884	3.442822
Litt	-0.8547059	0.251738	-3.40	0.001	-1.348103	-0.3613085
Gdp	-0.006186	0.00151161	-4.08	0.000	-0.0091575	-0.0032145

Wald chi (4) = 146.94

Prob > chi2 = 0.0000

R- squared = 0.8463

Source: Author's computation (see appendix 4)

4.3.1.2 2SLS Regression results with robust standard errors

Table 6

Variable	Coefficient	Robust Standard error	z	P> z	95% confidence interval	
Thee	-0.0674993	0.0069089	-9.77	0.000	-0.0810404	-0.0539581
Pop	1.996705	0.6297347	3.17	0.002	0.7624478	3.230963
Litt	-0.8547059	0.2670741	-3.20	0.001	-1.378162	-0.3312504
Gdp	-0.006186	0.0014419	-4.29	0.000	-0.009012	-0.0033599

Wald chi (4) = 179.81

Prob > chi2 = 0.0000

R- squared = 0.8463

Source: Author's computation (see appendix 5)

4.3.2 Interpretation

Above are results obtained after a two stage least square regression was run using STATA 14. Rigor tests were obtained to ensure internal validity of the model and robustness of regression results. However, due to the small sample size emanating from the period under study, traditional heteroscedasticity tests were not feasible Woodridge (2010). To assess for potential

heteroscedasticity a robust two stage least squares regression was run and results were compared with the original two stage least squares regression results and there was no significant difference between the standard error indicating homoscedasticity among residuals.

The r-squared value indicates that 84.63 of variation in life expectancy is explained by total health expenditure, population density, literacy rate and per capita GDP. The probability of 0.0000 indicates strong evidence against the null hypothesis which states all slope coefficients are equal to zero. This shows total health expenditure, population density, literacy rate and gdp have significant effect on life expectancy.

Total health expenditure is statistically significant at 1% significance level. There is an inverse relationship between health expenditure and life expectancy. For every dollar increase on health expenditure, life expectancy decreases by 6.74%.

Population Density, is statistically significant at 1% significance level. A one percent increase in population density is associated with a 1.997% increase in life expectancy.

Literacy rate, is a significant variable and it's significant at 1% significance level. For every 1% increase in literacy rates life expectancy reduces by 0.854%

GDP per capita, is statistically significant at 1% significance level. A dollar increase in GDP per capita will result in life expectancy reducing by 0.006%.

4.3.3 Discussion

Total health expenditure has a negative causal effect to life expectancy. Contrary to the expectations health expenditure negatively impacts life expectancy which conforms with Nkemgha G Z *etal* (2019). He obtained an inverse relationship between life expectancy and public health expenditure. This could be a result of the majority of the health expenditure breakdown being consumed by administrative costs than being directed to health care services and procurement of medicines and supplies. The second contributing factor could be predominance of private health expenditure which does not prioritise public health needs and is utilised by a limited number due to high costs of accessing medical services. Distance to the nearest hospital could also be a limiting factor to access to healthcare services. Health expenditure does not guarantee better health outcomes but rather health care utilisation does Zhang *etal* (2020).

Health workforce density's validity was assessed to satisfy the two assumptions which warrants the use of an instrumental variable namely relevance and exogeneity condition. To test for the

relevance, condition the Durbin-Wu-Hausman test was conducted to test if health expenditure was an endogenous variable. There was significant evidence to reject the null hypothesis and conclusions that health expenditure is endogenous were drawn. The relevance assumption postulate that the instrumental variable (health workforce density) should be correlated with the endogenous variable (health expenditure) Kmenta (2010). Hence the first condition was satisfied.

The second condition is the exogeneity assumptions which states that health workforce density does not influence life expectancy but only through its effect on total health expenditure. A Gragg-Donald-Wald F test for weak instruments was conducted. The null hypothesis was rejected indicating that health workforce density is a strong instrument. 75.86% of the variation in health expenditure is explained by the model in the first stage regression. 38% of variation in health expenditure is explained by health workforce density, controlling for other variables. Health workforce density is a strong instrument as explained by the rigorous testing process confirms that health workforce density meets the conditions for a valid instrument and it provides a reliable basis for causal inference.

Population density is positively related with life expectancy. This conflicts with the Malthusian theory which states population growth hinders health outcomes. The establishment of such a phenomenon could be a result of urbanisation resulting in better health outcomes. Literacy rates is not always a contributor to health outcomes. Knowledge in chemical technology can fuel experiments such as coming up with drugs that might inhibit better health outcomes. Economic growth might also harm better health outcomes if environmental factors are not put in play. For instance, an increase in agriculture production might fuel the greenhouse effect which might inhibit health outcomes.

4.4 CONCLUSION

This chapter provided empirical results obtained in establishing the relationship between health expenditure and life expectancy. It sought to assess the validity of health workforce density as a valid instrumental variable. The two stage least squares regression results were robust as evidenced by the findings of the rigor tests. Population density, literacy rates and gdp per capita were control variables. Health expenditure had an inverse relationship with life expectancy and it was statistically significant. Health workforce density proved to be a valid instrument.

Population density had a positive relationship with life expectancy. GDP and literacy rates had an inverse relationship with life expectancy.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 INTRODUCTION

Chapter five wraps up the research into one package. This section gives a summary of the research which sought to assess the impact of health expenditure on life expectancy. Conclusions based on the findings of the study as well as recommendations are drawn. The study contributes to existing body of literature however acknowledgement of weaknesses drawn as well as insights for future research are also discussed in this chapter.

5.1 SUMMARIES

Total health expenditure, contrary to the expected sign on theoretical literature review the empirical results established an inverse relationship between total health expenditure and life expectancy. This is likely to be a result of inefficient allocation of health resources and dominance of private sector with a profit than welfarist motive. Insufficient healthcare infrastructure and inequitable healthcare infrastructure due to income disparities could be other contributing factors. The afore mentioned factors could have contributed to the unexpected finding.

Health workforce density proved to be a valid instrumental variable, as it satisfied the exogeneity and relevance assumption. This is evidenced by the Durbin-Wu-Hausman test which satisfied the relevance assumption and the Cragg-Donald Wald F test which tested for the exogeneity condition.

The three control variables population density, literacy rates and GDP per capita were studied to establish their relationship with the outcome variable (Life expectancy). Population had a positive relationship with life expectancy empirically which could be a result of urbanisation which resulted in disparities of the inverse relationship on the theoretical literature as postulated by the Malthusian theory. GDP per capita and literacy rate had inverse relationship with life expectancy.

5.2 CONCLUSIONS

Health expenditure is necessary to improve life expectancy, Zimbabwe shows strides towards achieving the Abuja declaration which states that 15% of the National budget should be allocated to the health sector. Be that as it may efficient allocation of resources to ensure health access and utilisation by the public with a community-based approach is more crucial than

mere health expenditure. Based on the empirical findings it is evident that health expenditure in itself is not sufficient in improving life expectancy. Existence of private healthcare facilities might neutralize the welfare approach due to their profit motive resulting in inflated medical fees resulting in catastrophic expenditure which might accelerate non-communicable diseases such as type two diabetes and hypertension particularly to the retirees.

The findings of the study are such that, health workforce density is indeed a valid instrument. Health workforce density influences health expenditure. For instance, if there is continual skills flight in the health sector, more of the health financing is spent on retention of health workforce and replacement of health workforce rather than allocating funds to improving health outcomes such as life expectancy. The validity of the instrument assists researchers to establish a causal relationship between health expenditure and life expectancy. It also assists in addressing endogeneity issues when assessing the relationship between health expenditure and life expectancy.

Empirical findings on control variables, established intriguing relationships. Population density was positively associated with life expectancy. The potential implication could be a result of urbanisation effects, which may concentrate healthcare resources and expertise. Literacy rates and GDP per capita had an inverse relationship with life expectancy. The inverse relationship between literacy rate and life expectancy could be a result of self-medication practices. Where individuals wrongly diagnose symptoms based on their previous experience and misuse medication.

General literacy levels do not always translate to health-related knowledge and expertise. The driver of the inverse relationship between GDP and health expenditure could be associated with potential negative consequences of economic growth on health expenditure, such as high death rates due to machinery related injuries and environmental degradation such as pollution and global warming as a result of increased productivity

5.3 RECOMMENDATIONS

Health expenditure to impact life expectancy there is need to conduct budget analysis by the Ministry of Finance and Investment promotion in order to ensure treasury disbursements are utilised on health outcomes and avoid inefficiencies in the allocation of resources. There is need to engage the private sector through public-private partnerships to align private sector interests with welfare-oriented goals. There is need to strengthen community-based approaches particularly in rural areas to improve healthcare utilisation. Monitor and evaluate the healthcare

service in order to ensure constant alignment with the National mandate, and give feedback on lessons learnt to ensure equality and equity in the provision of healthcare services. There is need to conduct institutional capacity assessment in order to identify gaps in the Ministry of Health and Childcare's ability to deliver its mandate. There is need to capacitate Village Health Workers (VHWs). This will result in access to healthcare service through community health outreaches by the VHWs

There is need to leverage on capacity building of healthcare workforce, since it is a valid instrument in influencing health expenditure. The Government of Zimbabwe (GOZ) should invest in retention strategies to address healthcare workforce discrepancies in the labour market for health. On the contrary further investigations can be done surrounding this relationship between health expenditure and life expectancy by factoring both supply side and demand side instrumental variables such as healthcare technology adoption and disease prevalence respectively. An additional rigor test will then be required for the over identification of the instrumental variable since more than one instrument would have been implored.

For the control variables namely population density, literacy rate and GDP per capita. Urban planning should mainstream healthcare infrastructure development in densely populated areas in order to improve access to healthcare services. Education on public health should be disseminated to the community and across the entire population in order to have an appreciation of various aspects of health and their implication to every citizen.

There is need to reinforce occupational health issues and environmental protection mechanisms as they might end up conflicting with health outcomes. In addition, further research can be made on large samples to ensure generalisability of findings as well as factor in covariates such as age, gender, disability in order to address cross cutting issues. Also, interaction dummy variables can be generated in order to establish the interaction of control variables on the treatment variable and how they relate in influencing the outcome variable.

5.4 CONCLUSION

The study sought to establish the relationship between health expenditure and life expectancy. Empirically the findings reveal counterintuitive inverse relationship between the outcome and treatment variable. This could be evidenced by inefficient allocation of resources channelled towards health outcomes such as life expectancy. To add on private sector dominance, inadequate health infrastructure and income inequalities also contributed to such a relationship. Health workforce density proved to be a valid instrumental variable as it satisfied the relevance

and exogeneity assumption. Control variables namely GDP per capita, literacy rate and population density. Population density had a positive relationship with life expectancy whilst GDP per capita and Literacy rate had an inverse relationship. This study calls for a multifaceted approach in order to improve life expectancy in Zimbabwe. There is need to take strides from moving beyond health expenditure but rather ensure equitable access to quality healthcare.

REFERENCE LIST

Ahmat, A., Asamani, J.A., Illou, M.M.A., Millogo, J.J.S., Okoroafor, S.C., Nabyonga-Orem, J., Karamagi, H.C. and Nyoni, J., 2022. Estimating the threshold of health workforce densities towards universal health coverage in Africa. *BMJ Global Health*, 7(Suppl 1), p.e008310.

Angrist, J.D. and Hull, P., 2023. Instrumental variables methods reconcile intention-to-screen effects across pragmatic cancer screening trials. *Proceedings of the National Academy of Sciences*, 120(51), p.e2311556120.

Balima, H. and Sy, A., 2021. IMF-supported programs and sovereign debt crises. *IMF Economic Review*, 69(2), p.427.

Bunyaminu, A., Mohammed, I., Yakubu, I.N., Shani, B. and Abukari, A.L., 2022. The effect of health expenditure on average life expectancy: does government effectiveness play a moderating role? *International Journal of Health Governance*, 27(4), pp.365-377.

Claborn, D.M., 2020. A narrative review of the role of economic crisis on health and healthcare infrastructure in three disparate national environments. *International journal of environmental research and public health*, 17(4), p.1252.

Dieleman, J.L., Chen, C., Crosby, S.W., Liu, A., McCracken, D., Pollock, I.A., Sahu, M., Tsakalos, G., Dwyer-Lindgren, L., Haakenstad, A. and Mokdad, A.H., 2021. US health care spending by race and ethnicity, 2002-2016. *Jama*, 326(7), pp.649-659.

Garg, D. and Kothari, R., 2018. The economic effect of suicide on South Korea. *International Journal for Advance Research and Development*, 3(2), pp.7-10.

Grossman, M., 2022. The demand for health turns 50: Reflections. *Health Economics*, 31(9), pp.1807-1822.

Kaba, A.J., 2020. Explaining Africa's rapid population growth, 1950 to 2020: trends, factors, implications, and recommendations. *Sociology mind*, 10(4), pp.226-268.

Kara, O., Grossman's Generalised Health Demand Model: An Application on Türkiye. *İzmir İktisat Dergisi*, 39(3), pp.806-821.

Kmenta, J., 2010. Mostly harmless econometrics: An empiricist's companion.

Morina, F., Komoni, A., Kilaj, D., Selmonaj, D. and Grima, S., 2022. The effect of health expenditure on life expectancy. *International Journal of Sustainable Development and Planning*, 17(5), pp.1389-1401.

Nkemgha, G.Z., Tékam, H.O. and Belek, A., 2021. Healthcare expenditure and life expectancy in Cameroon. *Journal of Public Health*, 29, pp.683-691.

Nyabani, P., Moyo, B. and Mogotsi, K.S., 2024. Analysis of social investment in health systems reform: a case study of results-based financing in Marondera District, Zimbabwe. *The Pan African Medical Journal*, 49(4).

OECD| European Commission, 2020. A new perspective on urbanisation.

Ojo Olusoji, O., Nwosa Philip, I., Alake Olamide, J. and Adebajji Funmilola, B., 2020. Health expenditure and life expectancy in Nigeria. *Lead City Journal of the Social Sciences*, 5(1), pp.66-71.

Polcyn, J., Voumik, L.C., Ridwan, M., Ray, S. and Vovk, V., 2023. Evaluating the influences of health expenditure, energy consumption, and environmental pollution on life expectancy in Asia. *International Journal of Environmental Research and Public Health*, 20(5), p.4000.

Radmehr, M. and Adebayo, T.S., 2022. Does health expenditure matter for life expectancy in Mediterranean countries? *Environmental Science and Pollution Research*, 29(40), pp.60314-60326.

Sadr-Azodi, N., 2019. Following the 2001 Abuja Declaration of committing 15 percent government expenditure on health, is Africa making progress towards universal health coverage?

Schutt, R.K., 2019. *Understanding the social world: Research methods for the 21st century*. Sage Publications.

Snyder-Mackler, N., Burger, J.R., Gaydosh, L., Belsky, D.W., Noppert, G.A., Campos, F.A., Bartolomucci, A., Yang, Y.C., Aiello, A.E., O'Rand, A. and Harris, K.M., 2020. Social determinants of health and survival in humans and other animals. *Science*, 368(6493), p.eaax9553.

Unat, E., 2020. A review of Malthusian theory of population under the scope of human capital. *FORCE: Focus on Research in Contemporary Economics*, 1(2), pp.132-147.

Unicef, 2021. *The state of the global education crisis: a path to recovery: a joint UNESCO, UNICEF and WORLD BANK report*. Paris: UNESCO, cop. 2021.

World Health Organization, 2023. *Trends in maternal mortality 2000 to 2020: estimates by WHO, UNICEF, UNFPA, World Bank Group and UNDESA/Population Division*. World Health Organization.

Wooldridge, J.M., 2010. *Econometric Analysis of Cross Section and Panel Data*, 2nd Edition.

Wooldridge, J.M., Wadud, M. and Lye, J., 2016. *Introductory econometrics: Asia pacific edition with online study tools 12 months*. Cengage AU.

World Health Organization, 2019. *Reaching every newborn national 2020 milestones: country progress, plans and moving forward*.

Zhang, M. and Zhao, X., 2020. Alginate hydrogel dressings for advanced wound management. *International Journal of Biological Macromolecules*, 162, pp.1414-1428.

LIST OF APPENDICES

Appendix 1: Summary Statistics

```
. summarize le thee hwdd pop litt gdp
```

Variable	Obs	Mean	Std. Dev.	Min	Max
le	34	27.42647	3.228876	22.8	33
thee	34	160.6217	79.13521	50.67651	313.3456
hwdd	34	73.88137	8.530782	60.2	93.9
pop	34	1.547749	.6421528	.5238506	2.68096
litt	34	85.35231	2.716992	82.3689	89.99457
gdp	34	786.7647	486.3265	130	1740

```
.
```

Appendix 2: Durbin-Wu-Hausman (DWH) test

```
r(199);  
  
. estat endog  
  
Tests of endogeneity  
Ho: variables are exogenous  
  
Durbin (score) chi2(1)      = 7.93647 (p = 0.0048)  
Wu-Hausman F(1,28)         = 8.52614 (p = 0.0068)  
  
.
```

Appendix 3: Gragg-Donald Wald F-statistic (eigenvalue statistic)

First-stage regression summary statistics

Variable	R-sq.	Adjusted R-sq.	Partial R-sq.	F(1,29)	Prob > F
thee	0.7878	0.7586	0.3800	17.7755	0.0002

Minimum eigenvalue statistic = **17.7755**

Critical Values # of endogenous regressors: **1**
 Ho: Instruments are weak # of excluded instruments: **1**

	5%	10%	20%	30%
2SLS relative bias	(not available)			
2SLS Size of nominal 5% Wald test	16.38	8.96	6.66	5.53
LIML Size of nominal 5% Wald test	16.38	8.96	6.66	5.53

Appendix 4: 2SLS Regression results

```
. ivregress 2sls le pop litt gdp (thee = hwdd)
```

```
Instrumental variables (2SLS) regression      Number of obs   =      34
                                             Wald chi2(4)    =     146.94
                                             Prob > chi2     =      0.0000
                                             R-squared      =      0.8463
                                             Root MSE      =      1.247
```

le	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
thee	-.0674993	.007607	-8.87	0.000	-.0824086 - .0525899
pop	1.996705	.7378282	2.71	0.007	.5505884 3.442822
litt	-.8547059	.251738	-3.40	0.001	-1.348103 - .3613085
gdp	-.006186	.0015161	-4.08	0.000	-.0091575 - .0032145
_cons	112.996	21.35286	5.29	0.000	71.14512 154.8468

```
Instrumented:  thee
Instruments:  pop litt gdp hwdd
```

```
.
```

Appendix 5: 2SLS Regression results with robust standard errors

```
. ivregress 2sls le pop litt gdp (thee = hwdd), robust
```

```
Instrumental variables (2SLS) regression      Number of obs   =      34
                                             Wald chi2(4)    =     179.81
                                             Prob > chi2     =      0.0000
                                             R-squared       =      0.8463
                                             Root MSE       =      1.247
```

le	Coef.	Robust Std. Err.	z	P> z	[95% Conf. Interval]	
thee	-.0674993	.0069089	-9.77	0.000	-.0810404	-.0539581
pop	1.996705	.6297347	3.17	0.002	.7624478	3.230963
litt	-.8547059	.2670741	-3.20	0.001	-1.378162	-.3312504
gdp	-.006186	.0014419	-4.29	0.000	-.009012	-.0033599
_cons	112.996	22.67471	4.98	0.000	68.55434	157.4376

```
Instrumented:  thee
Instruments:  pop litt gdp hwdd
```

```
.
```

Appendix 6: Data set

YEAR	LE	THEE	HWDD	POP	LITT	GDP
1990	23.7	313.3456	69.46667	2.68096	82.3689	740
1991	23.1	302.5908	69.4	2.576033	82.94074	700
1992	22.8	291.836	69.33333	2.509119	83.51258	550
1993	22.9	281.0812	69.26667	1.431392	83.51627	510
1994	23.4	270.3264	69.2	0.588137	83.51996	490
1995	24.1	259.5716	69.84	1.239656	83.52365	470
1996	24.9	248.8167	70.48	1.660946	83.52734	560
1997	25.4	238.0619	71.12	1.634689	83.53104	520
1998	25.8	227.3071	71.76	1.623404	83.53473	410
1999	26.1	216.5523	72.4	1.44504	83.53842	400
2000	26.6	205.7975	71.84286	1.003969	83.54211	360
2001	27.5	195.0427	71.28571	0.642663	83.5458	390
2002	28.7	184.2879	70.72857	0.616567	83.54949	370
2003	29.9	173.5331	70.17143	0.75796	83.55318	340
2004	30.8	162.7783	69.61429	0.701856	83.55687	320
2005	31.6	152.0235	69.05714	0.523851	83.56056	330
2006	32.3	141.2687	68.5	0.861223	83.56426	290
2007	32.7	130.5139	65.73333	0.969119	83.56795	250
2008	33	119.7591	62.96667	0.798207	83.57164	130
2009	32.7	109.0043	60.2	1.026265	83.57533	440
2010	32	98.24946	63.2	1.25365	83.57902	650
2011	31.1	87.49465	66.2	1.438339	83.58271	950
2012	30.1	89.26096	70.8	1.822309	85.28628	1120
2013	29.2	100.1369	75.4	2.163267	86.98985	1200
2014	28.5	114.4443	80	2.191391	88.69342	1210
2015	27.9	105.098	78.1	2.136294	88.83799	1220
2016	27.4	106.1897	80.075	2.081806	88.98256	1200
2017	27	92.25429	82.05	2.04362	89.12714	1170
2018	26.5	114.6329	84.025	2.020537	89.27171	1550
2019	26	54.80851	86	1.989253	89.41628	1450
2020	25.4	50.67651	87.975	2.031112	89.56085	1460
2021	24.8	62.73724	89.95	2.045715	89.70543	1540
2022	24.3	74.79798	91.925	2.024036	89.85	1720
2023	24.3	86.85871	93.9	2.0911	89.99457	1740