DOMESTIC DEBT, EXTERNAL DEBT, AND INFLATION:

A CASE OF PUBLIC DEBT LIQUIDATION USING INFLATION IN KENYA

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF ECONOMIC THEORY IN THE SCHOOL OF BUSINESS, ECONOMICS AND TOURISM IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF A DEGREE OF MASTER OF ECONOMICS (POLICY & MANAGEMENT) OF KENYATTA UNIVERSITY

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DECLARATION

This research project is my original work and has not been presented for a degree or any other award at another university.

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DEDICATION

To my father Kennedy Buhere who believes in me so overwhelmingly it scares me. Thank you, your faith and belief in me, challenging me to apply myself.

To my mother Night Buhere, brothers Jay and Tovesi, and sister Nella who claim to hold persuasive evidence of my brilliance and shall not be persuaded otherwise.

To Cecilia Rague-Kaisha, who earnestly believes that I could have done more. You inspire me to want more from life.

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ACRONYMS AND ABBREVIATIONS

AfDB	Africa Development Bank
ARDL	Autoregressive Distributed Lag
BLUE	Best Linear Unbiased Estimator
EAC	East African Community
ECM	Error Correction Model
CBK	Central Bank of Kenya
FY	Fiscal Year
GCR	Global Credit Ratings
GDP	Gross Domestic Product
HIPC	Highly Indebted Poor Countries
IDA	International Development Association
IMF	International Monetary Fund
KES	Kenya Shillings
KNBS	Kenya National Bureau of Statistics
LDCs	Least-Developed Countries
LICs	Low-Income Countries
MTDS	Medium Term Debt Strategy
OECD	Organisation for Economic Cooperation & Development
OLS	Ordinary Least Squares
PFM	Public Finance Management
US	United States
USA	United States of America
USD	United States Dollar
UK	The United Kingdom

DEFINITION OF TERMS

Concessional loan – a loan with terms that are more favourable that market offerings. Terms could include lower interest rates, longer moratoriums, restructuring options, and income-contingent repayments.

Domestic debt – the portion of total public debt owed to domestic lenders.

Debt debasement - reduction, degradation or erosion in value of debt.

Debt overhang - when accumulated debt is so high that creditors have little confidence in full repayment.

External borrowing – public debt that is owed to non-residents of a given country.

G20 countries – an international economic cooperation consisting of advanced economies including 19 countries and the European Union that engage in international economic cooperation.

G7 countries – a group of advanced economies including the United Kingdom, Canada, USA, Germany, Japan, Italy, and France.

Public debt liquidation – the reduction, degradation or erosion in the value of public debt.

Public debt sustainability – ability of government to easily and consistently meet all its debt repayment commitments, both present and future, without requiring extraordinary financial support or risking default.

Shock inflation – A sudden change in inflation that has substantial impact on other macro-economic variables.

ABSTRACT

In the period between 2009 and 2021, Kenya's debt rose from 32.2% in 2009 to 67.3% in 2022 relative to the gross domestic product. High indebtedness has led to negative economic consequences including slowed economic growth, inflation, depreciating exchange rates, income inequality, private sector crowding-out, low capital formation, and debt overhang. Kenya adopted Medium Term Debt Strategies in 2001 with concerted policies to decrease external borrowing while allowing access to external concessional debt, slowing down the accumulation of domestic debt, longer maturities, and adopting debt ceilings. This notwithstanding, concerns about Kenya's public debt sustainability persists. This necessitates continuous exploration of different strategies to ensure its sustainability. Shock inflation has been demonstrated to contribute significantly to public debt liquidation in developed countries. Though a potential tool for public debt management, the effectiveness of shock inflation in liquidating public debt has neither been established nor considered for developing countries like Kenya. This study used 1983–2022 Kenyan data to investigate the possibility of public debt liquidation using shock inflation, making a distinction between domestic and external debt. Following appropriate time series methodology, the autoregressive distributed lag was adopted to model domestic debt to gross domestic debt ratio as the autoregressive distributed lag error correction model was adopted to analyse external debt to gross domestic debt ratio. Five- and ten-year dynamic baseline forecasts were drawn up and investigated against the debt level after a 2% shock inflation treatment. The findings of this study suggested that two% shock inflation had a minimal impact on domestic debt in five years and only decreased by 0.024% in ten years. In contrast, it increased the external debt level by three and a half percent in five years and decreased external debt level by 282% in 10 years, possibly eliminating it. This is consistent with global findings that longer-term debt is more sensitive to shock inflation. Further, the inflationary effect may need a prolonged period to realise its benefits. Results will contribute to new literature to inform fiscal policy on the role of inflation in public debt management in developing countries like Kenya.

CHAPTER ONE

1 INTRODUCTION

1.1 Background

High income countries hold the largest share of global debt. G20 countries' average debt to Gross Domestic Product (GDP) ratio estimate was 85.9% against the Americas' (74.3%), Africa's (67.8%), Europe's (65.9%), Asia's (62%) and the Australias' (49%) in 2021. The top 5 indebted nations were Japan (262%), Venezuela (241%), Greece (193%), Eritrea (165%), and Singapore (160%). Least indebted countries included Kuwait (7.1%), Cayman Islands (4.5%), and Brunei (1.9%) in 2021 (IMF Debt Database).

Public debt is generally rising globally due to a combination of factors including but not limited to rising budget deficits, higher development spending, rising social welfare spending, fiscal stimulus spending, financial globalization and access to lower interest rates, economic growth, and ineffective debt management.

Business cycles have a profound effect on the trends in public debt, with notable events in the past 20 years including the Dot-Com crisis (great tech meltdown) (1990s-2001), the 2006/08 financial crisis, the Eurozone crisis (2009-12), and the global health crisis (2020-21) (Covid 19 pandemic). In these instances, advanced economies demonstrated a significant role in global economic stability. These economic events prompted acquisition of public debt to counter lower tax revenues, increased spending in social programs and unemployment spending, and large military spending (Iraq, Afghanistan wars).

A result of the global financial crisis was the Eurozone crisis that threatened to topple global stability. This heightened potential sovereign debt defaults from Greece, Italy, Spain, Ireland, and

Portugal that led to bailouts by the European Commercial Bank and the International Monetary Fund. Without the intervention of the International Monetary Fund, the European Central Bank, or other Eurozone members, these countries could neither repay, refinance debt nor undertake bank bailouts. The crisis, triggered by a balance of payment crisis, could not be resolved by currency devaluation because of the currency union. In several countries in the Eurozone for instance Greece, Ireland, Portugal and Italy, non-productive government expenditures increased dramatically and led to serious budget deficits (Demirel et al., 2017).

In the advent of the Covid 19 global health crisis in 2020, an ensuing deep recession and direct health sector response generated the largest debt increment since World War II. Global debt increased to USD 226 trillion. More than 50% of this debt was sovereign debt and global public debt to GDP ratio peaked at 99% of GDP (IMF, 2021). For example, the US spent approximately USD 5 trillion on stimulus packages directed towards households, firms and local governments. The recession and uncertainty over some countries' ability to repay debt may have led to more restricted access to credit and credit rating downgrades for many developing countries.

These global crises, while occurring thousands of miles away from Kenya still impact credit availability, rising inflation and interest rates and export shocks.

While some nations execute proper debt management, others continue to struggle with unsustainable levels of debt, with potential for long-term economic instability. Maintaining sustainable debt is likely to remain a key concern for many countries.

Sovereign defaults, however infrequent, are not a new narrative. Several countries have defaulted on sovereign debt, among them: Argentina (2001), Greece (2015, twice), Mozambique (2016), Venezuela (2019), Zambia (2020), Sri Lanka (2020) and Lebanon (2021), and Russia (1998, 2022). Over the past 20 years, most defaults have occurred due to and after economic crises.

As demonstrated in table 1.1 below, developed countries demonstrated persistently high(er) public debt levels include the United States, European countries, and Japan. Japan remains heavily reliant on public debt due to several factors including business cycles, geographical proclivity to natural disasters including earthquakes and tsunamis, the Fukushima nuclear accident in 2011 as well as the COVID-19 pandemic in 2020. While low-income developing countries demonstrated one of the lowest public debt levels. Clements & Jones (2010) warn that public debt burden is higher in LICs and high public debt could stifle economic growth mainly because of inefficient resource utilisation. Global debt to GDP ratio declined from almost 100% in 2020 to 96% in 2021, owed to robust real GDP growth, rising inflation, and conclusion of COVID-19 welfare spending (Haile & Meron, 2022)

In the illustration below in table 1.1, while Kenya maintained a comparatively low debt/GDP ratio compared to the world average of advanced economies, it does not necessarily mean that Kenya is doing better. As developing country, Kenya is experiencing or is at risk of default due to heavy public debt burden and debt overhang. Debt overhang is when accumulated debt is so high that creditors have little confidence in full repayment. The IMF and the World Bank recommend a debt ceiling of 60% and 64% respectively for developing countries. The EAC and the African Union further recommend a debt ceiling of 50% and 65% of GDP respectively. In 2022, with public debt of 67.3% of GDP, Kenya was in breach of these recommendations according to data from the Kenya Bureau of National Statistics (KNBS) and the Central Bank of Kenya (CBK).

Table 1.1. Global Trends in Public Debt as a percentage of GDP

Debt to GDP Ratio								
Region	**2007**	**2008**	**2009**	**2010**	**2011-18 (Average)**	**2019**	**2020**	**2021**
World	**61.2**	**64.1**	**74.8**	**76.9**	**80.9**	**84.1**	**99.8**	**95.7**
Advanced Economies	**71.8**	**78.5**	**91.8**	**98.2**	**105.2**	**105.3**	**124.6**	**119.5**
Euro Area	66	69.7	80.4	86	92.1	92.1	99	97.5
United Kingdom	43	50.7	64.6	75.7	85.2	85.2	103.6	103.8
China	29.2	27.2	34.6	33.9	42.6	42.6	68.1	71.5
Japan	172.8	180.7	198.7	205.7	229.1	229.1	259.4	262.5
United States	64.6	73.4	86.6	95.1	104.7	104.7	134.5	128.1
Emerging Market Economies	35	32.9	38.4	37.4	43.3	43.3	64.5	64
Others	36.7	34.7	40	38.7	43.7	43.7	61.4	57.6
Low-Income Developing Countries	**29.2**	**27.3**	**29.6**	**28**	**34.8**	**34.8**	**48.6**	**48.7**
Sub-Saharan Africa	**23.9**	**23.2**	**26.7**	**25.7**	**36.2**	**50.1**	**57.6**	**57**
Kenya	**43.7**	**41.3**	**32.2**	**34.1**	**42.5**	**56.7**	**62.5**	**63.7**

Source: IMF Debt Database, KNBS

1.1.1 Trends in Public Debt in Low-Income Countries

Several low-income countries have reduced their public debt levels through a combination of fiscal discipline, economic development, and debt relief programmes. The Bretton Woods institutions launched the debt relief programmes that included the Heavily Indebted Poor Countries (HIPC) programme (1996) and the Multilateral Debt Relief Initiative (MDRI)(2004–2054) to counter poverty and debt overhangs among LDCs and to work towards sustainable debt. They so far jointly granted USD 79.4 Billion total debt relief so far, benefitting over 37 African, Latin, and Caribbean countries (International Monetary Fund, 2017). The Inter-American Development Bank (IADB) also agreed in 2007 to grant further debt relief to the five Western Hemisphere HIPC (International Monetary Fund, 2007).

Panizza (2008) observed that that trends indicate a shift inward, with pro-lesser external debt consumption to veer away from its undesirable effects that include higher interest servicing costs, currency depreciation, debt overhangs, and higher home interest rates. However, warning that

shifting from external to domestic borrowing may result in countries exchanging one sort of vulnerability for another for exchanging a currency mismatch (external) for a maturity mismatch (domestic), private sector crowding, and higher ex-post home interest rates.

1.1.2 Trends in Public Debt in Continental and Sub-Saharan Africa

In the past 20 years, public debt in Africa was on the upward trend due to difficulties in financing development initiatives and meeting socio-economic requirements, higher capital expenditure and primary deficits (Olanike, 2020), rising domestic and international interest rates, frequent debt restructuring at market rates, and capitalisation of non-liquidated service contracts at market interest rates (Saungweme & Odhiambo, 2018), economic crises such as the 2008 financial crisis and the Covid 19 global health crisis, and financial globalization (Bataka, 2021). In 2021, African governments spent 16.5% of revenue servicing external debt, increasing from less than 5% in 2010 (World Bank Group, 2022).

The global financial crisis of 2007-08 hit Africa hard, albeit lagged. It led to falling equity markets, capital flow reversals, exchange rate pressures, and tightened global credit. These were felt mainly through the emerging and frontier markets of South Africa, Kenya, Nigeria, and Ghana.

There is a growing preference for concessional loans and development funding because they are cheaper, with more flexible terms than commercial loans. Such loans are usually offered by development agencies such as the World Bank, IMF, Africa Development Bank (AfDB), International Development Association (IDA). In 2024, IDA contributions totaled USD 37.7 billion, with Africa receiving 73% of overall commitments in zero-to-low-interest loans, and grants for development programmes with the aim of stimulating economic growth, improving living standards and narrow inequalities among poor countries. Out of the Sub-Saharan Africa

(SSA) region, 8 out of 38 IDA-eligible nations were in debt distress, and 14 nations at high risk (World Bank, 2022)

Interestingly, according to global news reports and commentary, China emerged as a large bilateral lender who lent USD 152 billion to African countries between 2000 and 2018 in the Belt and Road Initiative (BRI) projects (South China Morning Post). Chinese loans have raised brows across the world due to their perceived predatory nature. For instance, Sri Lanka's default on a USD 1.1 billion deal resulted to its ceding operational and territorial control of the very important USD 1.3 billion Hambantota Port to China as part of a 99-year lease agreement (Mallawarachi et al., 2022)

Three (2021) observed that in the aftermath of the implementation of HIPC in 1996, certain SADC nations transitioned from external debt to domestic debt and thus recorded comparatively low debt compared to the crisis period, albeit with higher debt service rates than during the high debt period.

In the EAC, public debt is one of the most pressing economic policy concerns, with a growth rate of 5.9% against 4.1%-point average of Sub-Saharan nations in 2021. Uganda was awarded debt relief of USD 650 million in 1998 under HIPC, while Tanzania, having qualified as HIPC in 2002, was granted debt cancellation totaling USD190.75 million from the AfDB. Rwanda and Burundi are also HIPC-eligible (IMF). Just three months after the first Covid 19 case, East African countries amassed nearly $2.3 billion in new loans and reached a record USD 100 Billion total in 2020. In 2021, Kenya maintained the highest level of debt at 63.7% of GDP while Tanzania maintained the lowest level at 31% of GDP.

Some African nations have been successful in efforts to decrease their public debt levels through fiscal discipline, economic reforms, economic recovery, and debt relief. Despite these efforts,

Africa's general trend of public debt continues upward, and many African countries continue to face high levels of debt and grapple the issues that come with it.

1.1.3 Trends in Public Debt in Kenya

Through the 1980s and 1990s, the government maintained substantive external debt relative to domestic debt, attributed to government policy targeting external concessional debt due to both their availability and cheapness. Domestic debt to GDP ratio generally decreased over the period. After the 2000s, the government aggressively borrowed from both domestic and external markets with both domestic and external GDP ratios rising sharply to fund the new democratic regime which introduced Free Primary Education (FPE). Between the years 2000 and 2022, the highest debt to GDP ratio was 67.2% in 2022, with a record low of 32.2% in 2009. Total public debt increased briefly in 2003 by 13.5% to 61.5% to usher in the new democratic era with heavy welfare spending and free primary education. From 2003 – 2012 however, Kenya's debt/GDP ratio was on the downward trend and averaged 44.3%. It is significant to note that public debt increased sharply in 2009 with the initial stages of implementation of Vision 2030 and afterwards increased annually by double digit percentage points.

After implementation of the expensive inaugural devolution government of 2013, public debt increased year on year by an average annual rate of about 18%. From 2012, Kenya's debt to GDP ratio level rallied upward, from 34.3% in 2012 to 67.2% in 2022. Kenya breached IMF's recommended debt ceiling of 60% for developing/emerging markets. Kenya's debt increased by 11.5 percent to KES. 8.5 trillion as of June 30, 2022, with 50.01 percent external debt and 49.99 percent domestic debt. The world cast doubt cast over the affordability of Kenya's interest and principal repayments as it became identified as a 'Risk of Public Debt Crisis' country (Debt Justice, 2021) as Fitch downgraded Kenya's ratings to B- due to uncertainty over affordability of

repayments of the USD 2 Billion Eurobond maturing in June 2024. However, the Eurobond was refinanced in February 2024, an event that reversed and then decelerated depreciation of the Kenya Shilling against the US Dollar. In 2022, the Auditor General (Kenya) reported that Kenya defaulted on some interest and principal payments on three separate loans totaling of KES. 5.1 Billion earmarked for the construction of Arror, Kimwarer and Itare dams.

Since 2015, China has been Kenya's largest bilateral lender. China's total lending to Kenya increased to USD 7.05 billion in 2021 up from USD 3 billion in 2016. However, due to more involvement by IMF and World Bank, Kenya's Chinese debt dropped USD 6.83 billion in 2022.

County governments were also eligible to join the national government in acquiring public debt. Makueni, Kisumu, Bungoma, and Laikipia counties were sanctioned to borrow internally and externally after Global Credit Ratings (GCR) agency issued favourable ratings. Laikipia issued a 7-year KES. 1.16 billion infrastructure bond in 2022.

Kenya's ballooning debt is a combination of various agents including persistent budget deficits, high development spending, constitutional reform, high public wage bill, heavy infrastructure and welfare spending, access to international credit, and ineffective debt management. The undesirable effects of this debt was private sector crowing (Kamundia, 2015; King'wara, 2014), rising inflation (Ndemange, 2018), unstable exchange rates and currency depreciation (Arisa, 2020), and rising income inequality (Obiero, 2022). Due to this, Kenya is keen on attaining a sustainable debt level and adopting public debt management best practices.

Up until the 2000s, Kenya's strategy was to target external debt with keenness on concessional debt. Like with its African counterparts, since 2001, Kenya's debt strategy was to access external concessional debt and slow down the accumulation of domestic debt while lengthening its maturity

(Republic of Kenya). In sharp contrast, since 2009, the government's strategy favoured domestic over external debt and continued aggressively borrowing to fund Vision 2030 projects and to meet the costs of devolution. There was rapid expansion of and liberalisation and inclusion in domestic debt market with the emergence and prevalence of private-sector-crowding interest rate capping of 2016 (repealed in 2019), entrance of M-Akiba mobile bond trading in 2017 and the Dhows CSD bond-trading and management app in 2023. In the 2020s, Domestic debt was highest due to a tightening international credit market, global economic recession due to the Covid 19 pandemic and deterioration of Kenya's international credit ratings. With standard deviation of < 1, both domestic and external debt to GDP ratios have had little variation throughout the years under review.

The Medium-Term Debt Strategy (MTDS) is a framework developed by the IMF and the World Bank that sets guidelines for public debt management and operations in line with the specific country's macroeconomic policy. Kenya is one of the countries that have adopted and are implementing annual MTDS. Kenya adopted the Medium-Term Debt Strategy (MTDS) to minimize costs of borrowing and work towards debt sustainability. Kenya adopted MTDSs since 2009 and is now on its 15th strategy. After 2015, the government preferred domestic to external debt to decrease its exposure to rising foreign exchange risks associated with borrowing. It also focused on developing the domestic debt market to meet budget financing requirements leading to the launch and operationalization of M-Akiba, a retail bond mobile-trading platform in June 2017. Further, the government policy on external debt focused on concessional loans and limiting non-concessional loans to financing projects with high expected risk-adjusted returns and critical infrastructure. As with the trends in Sub-Saharan Africa, Kenya sought to move away from external debt due to its detrimental impact on the economy. This was demonstrated through its

annual MTDS aimed towards sustainable debt, favouring domestic over external debt as illustrated in Figure 1.1 below.

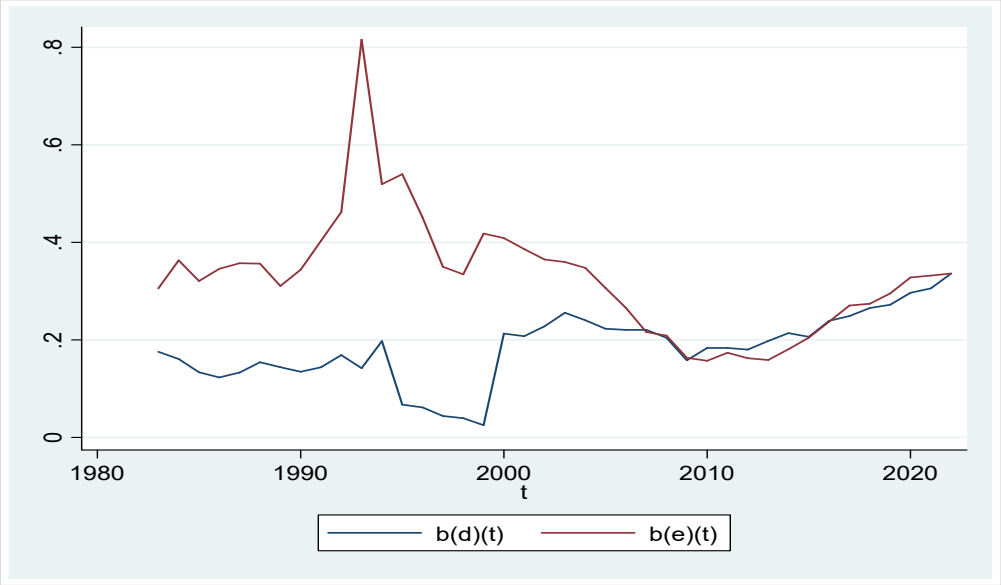

Figure 1.1 Composition of Public Debt in Kenya

Source: Data from CBK, (b(d)t-domestic debt, b(e)t – external debt)

However, due to budgetary pressures, through PFM Act amendments, MTDS adopted the raised public debt ceiling of KES. 10 trillion in 2022, up from KES. 9 trillion in 2021 and KES. 6 trillion in 2019. As per the UN Statistical Commission, in 2021, Kenya rebased its GDP and gained USD 4 billion in GDP to expand the economy and the debt ratio appear more attractive to lenders

Amidst a restricted credit environment due to the unfavourable global financial market shocks arising from the Covid 19 pandemic crisis, Kenya missed its net financing mix targets in FY2019/20 and FY2021/22 (Republic of Kenya, 2022). Kenya's elevated sovereign credit risk and uncertainties regarding affordability of interest and principal payments could also have been a hindrance. Table 1.2 below presents the evaluated performance of the MTDS since FY2017/18.

Table 1.2 Kenya's MTDS Targets against Actual Performance

Borrowing Source		FY2017/18	FY2018/19	FY2019/20	FY2020/21	FY2021/22	FY2022/23
	MTDS (per cent)	60	57	38	28	27	25
	Actual (per cent)	55	58	28	19	15	22
External	**Deviation (per cent)**	**5**	**-1**	**10**	**9**	**12**	**3**
Domestic	MTDS (per cent)	40	43	62	72	73	75
	Actual (per cent)	45	42	72	81	85	78
	Deviation (per cent)	**-5**	**1**	**-10**	**-9**	**-12**	**-3**

Source: Republic of Kenya

While Kenya remains committed to achieving debt sustainability, it is yet to explore the option of using inflation to liquidate public debt through decreasing the real value of debt.

Kenya could also benefit from more concessional and affordable loans. Fiscal discipline and prudent management of public funds are touted to decrease public budget leakages. Policymakers should work towards compliance with international agency debt ceilings to ensure continued access to affordable international credit and secure investor confidence. A cautious approach and an uncompromising stance while signing up for strategic high-stakes loans to secure sustainable development and Kenya's sovereignty

1.1.4 Inflation and Public Debt in Kenya

Inflation averaged 11.13% between 1983-2022 with double digit average inflation in the 1980s and early 1990s, the highest average inflation was in the 1990s at 17% with a record high of 46% in 1993 immediately after the general elections of 1992. Kenya eased into single digit inflation in the 2010s and 2020s averaging 7% and 6% respectively. More generally, between 2000 and 2022, Kenya's inflation rate remained fairly stable, averaging 8.47%, peaking at 26.2% in 2008 due to the 2008 post-election violence recession. Between 2000 and 2022, seven years experienced

double digit inflation, majority of which were years between 2003 and 2011, an era of large social spending, onset of development spending and civil crisis (post-election violence). In 2005, the Central Bank of Kenya adopted a flexible inflation target of 5±2.5% with tolerances to address adverse shocks. Notably, for some years since, Kenya's inflation was outside the bounds of this target due to economic downturns and changes in political climate. Higher inflation leads to high rising interest rates hence debt servicing expenses and costlier new debt, and potential currency depreciation.

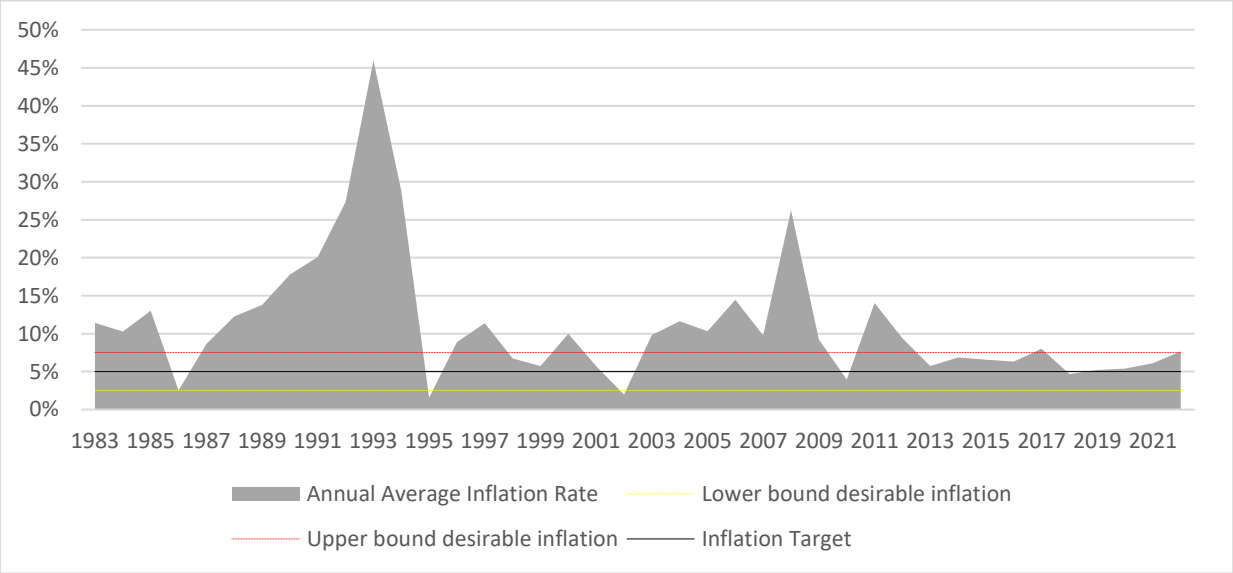

Figure 1.2 Inflation and Inflation Targeting in Kenya

Source: Data from KNBS, CBK

The use of inflation as a tool to liquidate or erode domestic and external debt has been explored in advanced countries. Historically, periods of greater inflation (including the Panic of 1907, WWI hyperinflation, the Great Depression after WWII, the oil shocks of the 1970s, the stock crash of the 2000s, and the financial crisis of 2008 were observed to coincide with periods of lower debt to GDP ratios. (Aizenman & Marion, 2011) illustrated how, within a decade, inflation after World War II decreased the US debt ratio of 108.6% to 59.3%. Using US data, the authors concluded that with interrupted economic growth, the debt overhang caused a 5% increase in inflation over several

years, which dramatically lowered the debt ratio. Other studies of the G7 and other advanced economies concur that inflation may liquidate debt.

For developing countries like Kenya, the potential of inflation-induced debt erosion has neither been established nor considered within the MTDSs. As illustrated in Figure 1.3, in Kenya, from the year 2008 when inflation was generally on the downward trend, public debt was on the rise, indicating a possible negative relationship that should be explored and developed further. The negative effects of inflations may be compared against the potential tradeoffs.

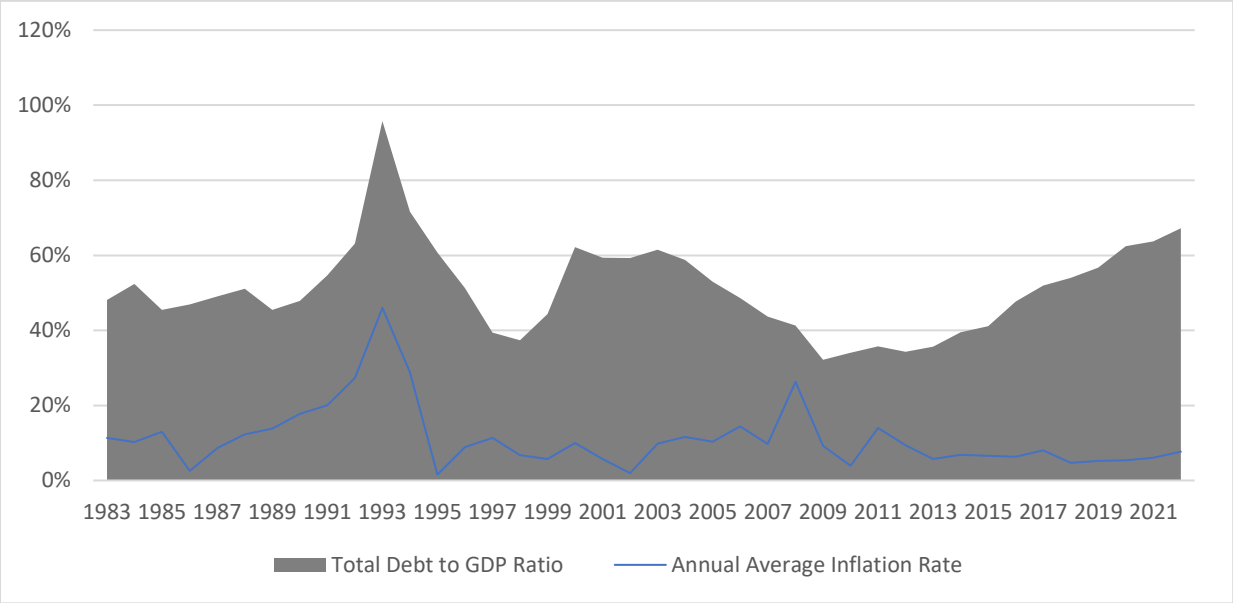

Figure 1.3 Kenya Debt to GDP Ratio and Inflation Rate

Source: Data from CBK and KNBS

1.1.5 Consequences of Public debt

High levels of public debt have some negative impacts on the economy. Such effects include slowed output growth (Baum et al., 2013; Kaminsky & Pereira, 1996; Ndemange, 2018; Sachs, 1989; Savvides, 1992), increased inflation (Akhanolu et al; Ndemange, 2018; Romero & Marin, 2017), depreciating exchange rates (Arisa, 2020), and income inequality (Obiero, 2022)(United Nations, 2017).

Further, public debt presented an element of private sector crowding and a general disincentive to investments through private sector crowding and debt overhangs that inadvertently raise interest rates and discourage private investments. Public debt presents further concerns of potential sovereign insolvency and loss of strategic collateral sovereign assets, as well as open challenges to sovereignty (Broner et al., 2014; Huang et al., 2018; Kaminsky & Pereira, 1996; Kamundia, 2015; King'wara, 2014; Krugman, 1988b, 1988a; Ndemange, 2018; Sachs, 1989).

Modgiliani (1961) and Eggertsson & Krugman, (2012) posed that public debt creates generational burden, developing public debt unsustainability. This leads to a higher tax burden for future generations, intergenerational income inequality, educed future fiscal flexibility, and limited access to resources, and potential social unrest. Excessive public debt leading to rising interest rates (Baum et al., 2013) and debt obligations may expose a country to fiscal crisis and budgeting complications (Bhattacharya et al., 2022; Huang et al., 2018; Nautet & Menseel, 2011; United Nations Conference on Trade and Development, 2019). This could lead to the inability of government to deliver essential services to the nation's citizenry to meet essential obligations (Cecchetti et al., 2011).

IMF loans that impose austerity measures open the market to international competition, including restrictions on agricultural subsidies, increased taxes (Kenya, Greece, Nigeria, Angola), decreased government expenditure including wage freezes (Kenya, Greece, Barbados, El Salvador, Lesotho), decreased public healthcare spending (Ecuador, Kenya) to reduce budget deficits. Most recent austerity measures in Kenya fueled coordinated protests against the Finance Bill 2024 that introduced higher taxes and expanded the tax base (Kang'ethe & Odoyo, 2024). These may cause social and civil unrest evidenced by the 2025 These measures expose debt-strapped countries to external shocks, increased income inequality and poverty.

1.1.6 Public Debt Management and Control

Several countries have been able to decrease their public debt through a combination of various fiscal, monetary, humanitarian and political strategies including (i) economic growth (ii) fiscal consolidation and austerity measures (iv) outright default (v) debt relief and restructuring (vi) liquidation using inflation and (vii) financial repression accompanied by constant inflation. The HIPC, MDRI, Paris Club and the Debt Service Suspension Initiative (DSSI) programmes played a big role in debt relief and restructuring for countries in debt distress.

Domar conditionality for public debt ideate that sustainability of debt is for economic growth rate to surpass both the rate of growth of public debt and the interest rate on public debt (Domar, 1944). The IMF's debt sustainability models further present two approaches towards debt sustainability: (a) adherence to the intertemporal budget constraint where the present value of future primary surpluses equals current nominal public debt, and (b) maintaining a steady or declining debt to GDP ratio in the medium term to long term, in this case then, the interest rate on sovereign debt should not be higher that rate of economic growth (of GDP).

Treaty organisations also prescribe target public debt to GDP ratios as a debt management strategy. Current targets include the Eurozone's 60%, IMF's 60% for developing countries, World Bank Group's 77% for developed markets and 64% for emerging markets, African Union's 65% and EAC's 50%. The IMF imposes austerity measures for non-compliance including public sector spending freezes and budget cuts, revenue growth, lower subsidies, and opening up the economy.

Other Countries, like Kenya develop and implement Medium Term Debt Strategies (MTDSs) towards debt sustainability. Kenya's initial target was to minimize costs of borrowing and establish debt sustainability. Since 2015, the strategy was preferential acquisition of domestic debt over external debt to decrease its exposure to foreign exchange risks. Further, the MDTS's success was

enhancing and revolutionizing the domestic public debt market. Kenya also gradually decreased its share of external debt and is now its external and domestic debt now nearly evenly split.

1.2 Statement of the problem

Kenya's debt was on the upward trend since the 2000s, posting highest debt to GDP ratio 78.3% in 2000, with a record low of 32.2% in 2009. The Vision 2030, and the new Constitution of Kenya (2010) and financial globalization ushered Kenya into an era of heavy development spending and high public wage bills. In 2022, public debt as a percentage of GDP was 67.3% which breached debt to GDP ratio ceiling recommendations of the IMF (60%), World Bank (64%), African Union (65%), and EAC (50%) creating fears of higher borrowing costs, economic instability, tightened external financing conditions, and exchange rate pressure. Kenya's approach of implementing MTDS towards public debt sustainability has demonstrated limited success; debt ceilings are breached and readjusted, and its domestic and external debt profile targets missed, and Kenya's ability to afford interest and principal payments was called into question globally.

The strategies employed in Kenya's MTDS towards public debt sustainability include targeting higher domestic borrowing, lengthening maturities, accessing external concessional debt, and nominal public debt ceilings through the PFM Act. The huge public debt in Kenya necessitates continuous exploration of different strategies to ensure its sustainability.

Historically, developed countries, shock inflation has been reported to have experienced erosion of public debt during inflationary periods, as well as empirically demonstrated that shock inflation may contribute significantly to the reduction of public debt levels. It is a radical approach, and for developing countries like Kenya, there is non-existent empirical literature and research on the potential of shock inflation as a tool for public debt management; it has yet to be considered. This study investigated the possibility of public debt liquidation using inflation and distinguished

external from domestic debt and introduced a shock inflation to empirically estimate its effect on public debt.

Several studies of the Kenyan macro-economy focus on the negative effects of public debt on various macroeconomic indicators and to caution Kenya against high indebtedness while faulting its ability to meet these debt obligations. None have established the possibility and effectiveness of using inflation to liquidate public debt in Kenya.

1.3 Research Questions

The research is guided by the following questions:

i. What is the effect of inflation on external and domestic public debt in Kenya?

ii. What is the effect of a 2% shock inflation on inflation on external and domestic public debt in Kenya?

1.4 Research Objectives

The general objective of the study is to investigate the possibility of public debt liquidation using inflation in Kenya using data from the period 1983-2022, distinguishing domestic from external de. Specifically, the study seeks to:

i. Investigate the effect of inflation on domestic and external public debt in Kenya.

ii. Simulate the impact of a 2% shock inflation on domestic and external debt in Kenya.

1.5 Significance of the Study

Similar studies were previously conducted in advanced economies to examine whether inflation could be targeted to decrease public debt. There are few explorative studies of the same kind focused on developing economies. Because Kenya is classified under one or more of the following categories: EMDE country, lower-middle income country and Sub-Saharan economy, this research could be sampled for similarly characterised countries.

The findings of this study will guide economic policy formulation in regard to ensuring that run - away debt or debt overhangs are effectively liquidated and paid off to decrease undesirable effects on macroeconomic indicators, households and firms. Regional financial organisations, Central Banks, and the National Treasury, policymakers, and economists could be guided by this research in their fiscal policy formulation to achieve manageable public debt levels. This will inform policy on Central Bank's inflation targets and public debt management by Kenya's National Treasury including revisions of the MTDSs to reflect debt profiles likely to benefit the most from shock inflation.

This study will contribute to the theoretical and empirical database of scholarly research and investigations into managing and/or paying down public debt using inflation. Further research is encouraged to investigate whether shock inflation can be used as a tool to liquidate public debt in developing and least developed markets.

The Central Bank of Kenya (CBK) and the National Treasury and Economic Planning in their jointly coordinated efforts, could explore the use of inflation to liquidate public debt to decrease its negative effects on the economy.

1.6 Scope of the Study

This study will focus on Kenya's debt profile and inflation between 1983 and 2022 to investigate whether inflation can indeed be targeted to decrease the real value of debt, distinguishing domestic from external debt. During this period, Kenya faced a myriad of socio-political and economic structural changes including liberalization and modernization of the economy. A simulation of a shock inflation of 2% will also be undertaken and examined. Because Kenya is a developing, lower-middle income Sub-Saharan Africa economy, this research could be sampled for countries with similar characteristics.

1.7 Limitations of the study

There is limited empirical literature to compare the liquidating effect of inflation on public debt. While these findings will be relevant to Kenya, they may not be directly applicable to countries with different fiscal or economic structures.

CHAPTER TWO

2 LITERATURE REVIEW

2.1 Introduction to Literature

This chapter focuses on the theories presented on how shock inflation and financial repression may be used to liquidate public debt to put the country on the path of public debt sustainability. It discusses the theories and literature of public debt liquidation using inflation that sovereigns may adopt. These theories involve both fiscal and monetary interventions or a mix of both. Periods of high inflation have demonstrated to have significantly decreased the level of public debt in advanced economies. However, this has not been established in developing countries like Kenya.

Nevertheless, higher inflation and financial repression are not without significant risks and trade-offs. Inflationary periods and financial repression have been demonstrated to cause serious macro-economic, social and economic disruptions, including reduced purchasing power, higher cost of living, increased interest rates, investment uncertainty, income redistribution, currency depreciation, fiscal pressure, social unrest.

2.2 Theoretical Literature Review

2.2.1 Shock Inflation

Keynesian theory in the book "Tract on Monetary Reform" (Keynes, 1923) presented shock inflation as a likely tool to attempt to temporarily decrease a government's excessive monetary fixed-value liabilities, especially domestic debt by eroding the real value of money.

Between 1914-1920, (Keynes, 1923) observed that several European countries printed massive amounts of money that resulted in decreased value of debt by between 50-100% through inflation taxation. The German hyperinflation of the 1920s, and the long-prevailing Brazilian and Argentinian hyperinflations in the early 1990s were extreme cases where public debt was wholly

liquidated. Argentina, a country notorious for persistently high inflation rates had negative real ex-post interest rates in every single year during the 1944-1974 period except for the deflationary year 1953 with 97% of debt liquidation years. The real interest rates reached -53% in 1959 liquidating its public debt considerably but with the negative externality of retiring the domestic debt market. In the UK, the share of liquidation years was almost 60% from 1945 to 1980. While these were serious macroeconomic events with devastating impact, the positive externality was public debt liquidation.

The theory suggests that shock inflation would momentarily decrease real interest rate payments on domestic, non-indexed public debt. These are payments adjusted for inflation, reflecting the true purchasing power of money. The government budget constraint that proposes that countries should run budget surpluses to minimize a growing public debt, can be modified, to reveal a factor of inflation that is inversely correlated with the level of public debt. The real value of debt would thus be eroded by temporarily and artificially maintaining the real interest rates lower than they would otherwise prevail by manipulating inflation. In the short run, the interest rate expenses for a given stock of debt, usually non-indexed, would contribute to a debt reduction. Effectively, this takes money away from creditors. Inflation is a monetary event, such that monetary and fiscal policy conditions can be manipulated for inflation control through the Fisherian effect ($r \approx i - \pi$). Here, nominal interest rates tend to increase or decrease to compensate for inflation.

Keynes suggested that using temporary inflation could address sudden or exceptional fiscal needs and would especially be more effective when prices are sticky and unanticipated although not strictly so. While there is consensus that while both anticipated and unanticipated shock inflations would significantly impact public debt in a liquidating effect, the impact would be smaller with anticipated inflation. It could also work on both long and short term non-indexed domestic and

external debt maturities. The optimal inflation rate is widely regarded as positively correlated to the proportion of external debt, the tax collection costs, and the share of non-indexed debt. Effective liquidation requires domestic-currency-denominated, fixed-rate-longer-term-maturities with an assumption of no new financing needs, and an environment of financial repression where interest rates are administered or predetermined.

Kenya has a flexible inflation target of 5±2.5%, thus a shock inflation while ensuring that inflation remains within this range. Kenya's debt is almost evenly split between external and domestic debt and thus important to characterise and distinguish them in analysing the possibility of liquidation using inflation.

There is consensus that the impact of shock inflation would be higher if accompanied by financial repression that could be achieved by a blend of policies that control the monetary and fiscal environment including more regulation in key sectors of the economy. However, care should be taken *when* the share of short-term or foreign currency-denominated debt is significant and to also consider the entrenchment of expectations in nominal interest rates.

Shock inflation theory is applicable to this study because it is one of the ways through which public debt can be managed.

2.2.2 Financial Repression

Keynesian theory in (Keynes, 1923) presented financial repression by way of currency depreciation could address sudden or fiscal requirements; with emphasis on temporary measures to managing the political economy. This would especially be more effective when prices are sticky and unanticipated although not strictly so. Keynes further opined that even with permanent fixed currency devaluation, the option was available in addressing temporary emergencies as previously executed in Germany, France and Italy. In Germany, for instance, the rate of currency depreciation

was twice that of inflation and led to 100% liquidation. It could however raise the annual fixed public debt burden to an unsustainable level and result in political or civil unrest.

Mckinnon (1974) described financial repression as coordinated policy instruments that control the macroeconomic environment to control interest rates, inflation, banking reserve requirements, and resource allocation. Further, preparing captive audiences to hold regulated or low interest government debt, foreign exchange controls, cross-border capital controls, and currency manipulation. Direct ownership of banks by government like in India or China, or free management of financial institutions as in Japan also offer an opening for financial repression.

Kenya is not new to the practice of financial repression. For instance, there are requirements to channel government revenue through a singular collection point and introduction of housing levies that are administered by central government. Further, regulations and directives create captive audiences, requiring financial institutions and even government agencies hold certain amounts of assets in treasury securities, sometimes lengthening maturities ex-post as a form of financial repression.

Financial repression is sometimes coded ‘prudential regulation’ as an aversion from negative political connotations.

With sensitive nominal domestic interest rate, and unanticipated currency devaluation in an economy with higher international capital mobility could produce bigger effects, but may provoke inflationary pressures. This could be achieved through money printing or deliberate currency adjustment. Currency devaluation and inflation have a proven positive bi-directional relationship as in Fisherian dynamics. Particularly in a fixed exchange economy, a stronger government paired

with a little-independent Central Bank may freely guide monetary policy to impose capital controls.

Accompanied by steady anticipated or unanticipated inflation, interest rate manipulation to negative zones is widely regarded as the most effective at liquidating public debt. An independent central bank has the power and mandate to artificially fix interest rates low to allow inflation targets to rise. Low nominal interest rates decrease domestic non-indexed debt servicing costs while negative real interest erodes the real value of public debt. However, in a Bretton Woods system, it is near-impossible to employ this method because of tighter controls of the international debt market. Further, countries in a monetary union may not individually benefit from this system because of centralized monetary policies dictated by the regional central bank.

Nevertheless, caution should be exercised because financial repression may lead to disappearance of the domestic market, currency abandonment, sovereign bankruptcy, capital flights, misallocation of resources, hampered economic growth, liquidity trap and out of control deflation, and thinned banks margins.

In liquidating public debt, the government may make concerted efforts to manipulate inflation rates to rise through currency devaluation and depreciation, artificially keeping interest rates low, and raising bank reserves requirements.

This study will not adopt this theory because of its difficulty in application, uncertainty in meeting an inflation target due to the stochastic behavior of these variables, and mindfulness for the political economy. Further, some of these variables are outside the scope of the model specification.

2.3 Empirical Literature Review

Various studies investigated and quantified the role of inflation in liquidating debt including comparing cases of long term and short-term debt, domestic and foreign currency denominated debt, and the share of domestic and external debt.

Reinhart and Sbrancia (2011) studied 28 countries over 1900-2009 and analysed incidences of shock inflations and debt reduction. A surprise inflation (unanticipated) was described as the years with inflations with two standard deviations from the 10-year moving average. A liquidation year was described as a year with negative or sub-market real interest rates. A reduction in the debt to GDP ratio over a three-year period was defined as a debt reduction. Twenty-five per cent (25%) of liquidation years coincided with shock inflations and particularly in the 1970s punctuated by oil shocks and high commodity prices. Further review of the frequency distribution of the debt reduction years identified the largest debt liquidation episodes; twenty-two (22) out of twenty-eight (28) out of countries were observed to have coincidences of high inflation and episode-years of debt, where higher inflation and negative real interest rates debased debt more. Germany's (1920s) and Brasil's & Argentina's (1990s) hyperinflations wholly liquidated their public debt with the consequential disappearance of the Argentinian domestic debt market. For effective inflation-induced debt liquidation note that fixed-rate-long-maturity-debt is preferred under assumption of no new financing needs and an environment of financial repression where interest rates are administered or predetermined (Reinhart et al., 2011; Reinhart & Sbrancia, 2015).

To investigate US debt and inflation data 1940-2009, (Aizenman & Marion, 2011) built a stylistic model subject to the intertemporal budget and laffer constraints to illustrate the costs and benefits of inflating away some public debt. The model was set to maximize consumers' wealth subject to tax laffer's constraint as specified below:

$$MAX\left[(1-f)b\bar{Y}(\frac{1-\theta}{1+\pi_1}+\bar{Y}(1-h\pi_i^{\emptyset}+\frac{1}{r})\{1-t(\pi_1)\}\right]$$

$\bar{Y}$ denotes the GDP without inflationary or disinflationary cycle, h is a parameter and i denotes time period. With baseline assumptions of various variables including, debt to GDP ratio *(b),* inflation *(π),* maturity *(m),* real interest rate *(r),* the proportion of foreign public debt *(f)*, the proportion of inflation-indexed debt*(θ),* tax rate *(t),* ratio of fiscal expenditure to GDP *(g),* and cost of inflation*(Φ),* the authors conducted a sensitivity analysis of debt to GDP ratio to inflation. The assumptions of the model were constant annual interest rate, constant output, efficient political processes, and debt maturity that is invariant to the impact of inflation. The model predicted that starting with a debt overhang, in 4 years, a modest shock inflation of 6 percent could likely decrease the debt to GDP ratio by 20 percent. It was noted that shorter maturities were less responsive to inflation and that foreign-held domestic-currency debt is more appealing to inflation-induced erosion. The authors also observed a significant correlation of 0.7 between debt to GDP ratio and debt maturities over the period between 1946 and 1991 which ceased over the period 1992–2008. The study concluded that the optimal inflation rate required to effectively liquidate debt is directly proportional to the share of external debt, tax collection costs, the share of non-indexed debt, and the proportion of non-indexed debt. Conversely, it is inversely proportional to the share of indexed debt and proportion of government spending to GDP were inversely proportional to debt maturity, proportion of indexed debt and proportion of government spending to GDP.

Reinhart and Sbrancia (2015) undertook an investigative study of ten (10) advanced and emerging countries in the post-WWII period between 1945-1980 that was characterised by debt overhangs, high inflation and multiple currency use. These countries gained annual interest cost savings, while countries with higher debt and/or higher inflation experienced higher savings. They described a

'liquidation year' as a year with negative real interest rates or when real government interest rate was below market. The actual negative interest rate (tax rate) *times* the nominal outstanding public debt was described as the "liquidation effect" or "financial repression tax. The share of liquidation years was presented as the portion of years under study that experienced the liquidation effect. From the full sample, 92% of the years between 1945-1980 were found to be liquidation years with sizeable savings including Argentina (38%), India (27.2%), Italy (24.5%) and USA (13.4%). For the USA and the UK, savings amounted to 2-3% of GDP annually which were estimated to be about 30-40% within a decade. It was noted that while Argentina had a higher average negative real interest rate of -21% compared to UK's -3.5%, average annual savings were about the same due to steady shrinking of the Argentinian domestic debt market.

Using six Euro Area's 1991-2013 data of nominal values of outstanding debt, maturities, government bond prices, primary surpluses and rates of returns on the bonds, Equiza-Goñi (2016) simulated the impact of current and future inflation, and debt maturities on the debt to GDP ratio using the debt equation subjected to the fiscal budget constraint. Data was adjusted to remove inflation-indexed bonds and Central Bank holdings. The findings were that a 1% permanent shock to inflation would liquidate public debt by 4.2%, which was higher than the USA's liquidation of 1.7%. Equiza-Goñi (2016) observed that compared to the USA, the Euro Area countries' debt profiles were characterized by progressively longer average residual maturities and smaller proportion of short-term debt. In inflation induced liquidation of debt, longer maturities have the benefit of protecting debt against interest rate risks and create higher capital losses to bondholders.

With a New Keynesian dynamic general equilibrium model with imperfect stochastic inflation targets, stochastic maturities, and adherence to the Taylor's rule for monetary policy, Krause & Moyen (2016) analysed US data 2008-2013 by simulating of the interplay of inflation and

maturities in the transformation of real public debt after an inflation target is set post-debt crisis. The study concluded that debt-debasement would only occur with very persistent inflation targeting. Persistence was defined by the autoregressive coefficient of 0.99. After 10 years, it was predicted that a persistent increase in the inflation target of 4% would erode a third of the additional debt accumulated during a debt crisis, with longer maturities being impacted more.

Similarly, Akitoby et al. (2017) presented the standard debt equation with categorized debt. The study categorized debt into foreign-currency-denominated, domestic-currency-denominated, and inflation-indexed debt, and accounted for short-, medium-, and long-term debt. The study simulated shock inflations and assessed their impact on net debt ratios of G7 countries in the years 2012—2017. The results indicated that in advanced countries, higher inflation could potentially moderately decrease the debt to GDP ratio, but only for medium to long-term domestic-currency-denominated non-indexed debt. It was demonstrated that at zero inflation, net debt to GDP ratio could decrease by about 5% in the following 5 years. In comparison, however, over the same period, raising inflation to 6% could also potentially decrease the average net debt to GDP ratio by about 11% under the full Fisher effect and about 14.5% under the partial Fisher effect.

With debt dynamics and the intertemporal budget constraint, Hilscher et al., (2022) constructed a forward-looking model with probability distribution of inflation to quantify the probability of future inflation significantly liquidating the real value of debt using present data of the US privately held public debt between 2009-2017. The variables selected were full maturity structures of future promised payments including current debt, market prices and par value of national debt and real liabilities. The study conducted stress tests on probability distribution of inflation to determine the probability of debt liquidation of various sizes. The probability of debt debasement being below 3% of GDP was about 0.95; and the probability of debasement of over 3.7% of GDP was estimated

as 0.01. It was also estimated that a 1% persistent increase in inflation would decrease the debt to GDP ratio by only 1.75%. The study concluded that inflation-induced debt debasement at significant level would be unlikely in the USA due to its concentration of short-term debt and privately held debt. Further, it was observed that the size of debt debasement would be larger with unanticipated and more persistent inflation, longer debt maturities, larger private holdings, and a larger debt burden. It was also shown that there would be a significant reduction in the debt to GDP ratio if inflation is strongly correlated with GDP or real interest rates. Anticipated shock inflations would also have a small impact with little, short run persistence, but more successful if combined with financial repression by forcing extension of maturities ex-post (Hilscher et al., 2022; Kose et al., 2021).

To analyse the impact of shock inflation on level of public debt in 19 advanced economies which averaged 86.3% using data between 2018-2022, Fukunaga et al. (2022) used the simulation approach with an underlying debt dynamics equation. In the equation, subsequent primary surpluses, inflation, GDP growth rate, inflation, real and nominal interest rates and current value of debt are exogenous. Further, the study distinguished short and long-term debt in the model. An unexpected shock inflation stylized Δ_t was imposed on existing debt that simultaneously increased nominal interest rates upwards on existing short-term debt but not nominal interests on long term debt since it is predetermined. On average, both simulations suggest that over 5 years, a 1 pp shock to inflation decreases the debt to GDP ratio by about 0.7 pp and a persistent shock that raises inflation to 6% takes 10% off the liquidates short-term debt to GDP ratio and 10.1% off longer-term debt to GDP ratio. The impact was observably larger with more persistent shock inflations and larger initial debt-GDP ratios. Countries with a lower rollover ratio of debt experienced larger impact. Further a 2% shock to the real interest rate created an additional erosion of debt by 0.5%

of GDP. Cases of simulated financial repression vis a vis the control cases experienced higher debt liquidtion. These results indicate that fairly higher inflation with some financial repression that forces longer debt maturities, could somewhat alleviate the public debt burden in advanced countries.

2.4 Overview of literature

The literature review provided two theories, consisting of shock inflation and financial repression that are applicable to the analysis of public debt liquidation using inflation. This study will adopt the shock inflation will be adopted because Kenya already undertakes inflation targeting. However, this must remain within Central Bank of Kenya's targets. Further, a coordinated response between the Central Bank of Kenya and the National Treasury is required. Financial repression requires using other variables such as exchange rates, interest rates and bank reserves requirements which are not the subject of this study.

Empirical studies are of the majority view that public debt liquidation using inflation in decreasing the real value of debt is possible. It is also effective with longer maturities and if the shock inflation is prolonged. Further, many studies have suggested that effective debt-debasement via inflation should be accompanied by financial repression.

The empirical review of literature covers advanced economies including US, the Euro Area, and G7 economies. However, there are limited related empirical studies investigating debt liquidation using inflation in emerging and developing countries that include the vast majority of Africa.

CHAPTER THREE

3 METHODOLOGY

3.1 Introduction to Methods

This chapter is divided into sections consisting of research design, theoretical framework, model specifications for estimation, definition and measurement of variables, data sources, time series data properties analysis methods, diagnostic tests, and data analysis methods.

3.2 Research Design

Time series research design was used to identify the nature of select macroeconomic variables over the period as well as predict future values of the dependent variable in the time series by simulating impacts of various levels of inflation on public debt. In this design, quantitative and predictive research approach was adopted. Time series data on inflation, public debt, primary surplus, nominal interest servicing payments on public debt, for the period 1983 - 2022, will be used.

3.1 Theoretical Framework

This study explored the use of shock inflation in the liquidation of public debt as suggested by Keynes (1923). This phenomenon may be demonstrated in the standard debt model derived from the government budget constraint that proposes that countries should run budget surpluses to minimize a growing public debt. The model, herein referred to as the standard debt equation, was used to estimate and simulate the effect of inflation on the debt to GDP ratio.

The standard debt equation was derived as follows:

The GDP in period t (Y_t) is given as

$$Y_t = (1 + g_t)Y_{t-1} \quad \text{.....(3.1)}$$

Where g_t is GDP growth rate and Y_{t-1} is GDP for period t-1. The GDP in the current year is the previous GDP plus growth.

The government budget constraint is;

$$G_t + r_t B_{t-1} = (B_t - B_{t-1}) + T_t \quad \text{.....(3.2)}$$

This equates government's outgoings; expenditure and real interest payments to its outgoings; tax revenue and stock of new debt acquired, where B_t – stock of existing public debt in period t, B_{t-1} – stock of public debt in the prior year, r_t – implicit real interest rate on the public debt in period *t*, G_t – nominal government expenditure in period *t* and T_t is the tax revenue in period t.

Thus, in nominal terms, this may be rearranged as follows;

$$r_t B_{t-1} - (B_t - B_{t-1}) = T_t - G_t \quad \text{.....(3.3)}$$

and further to;

$$B_t = -S_t + (1 + r_t) B_{t-1} \quad \text{.....(3.4)}$$

where S_t is the primary balance surplus given as $T_t - G_t$

Dividing (3.4) by (3.1) gives;

$$\frac{B_t}{Y_t} = \frac{-S_t}{Y_t} + \frac{(1+r)B_{t-1}}{Y_t} \quad \text{.....(3.5)}$$

Plugging equation 3.1 into 3.5 gives;

$$\frac{B_t}{Y_t} = \frac{-S_t}{Y_t} + \frac{(1+r_t)B_{t-1}}{(1+g_t)Y_{t-1}} \quad \text{.....(3.6)}$$

The Fisher equation presents nominal interest rate as real interest rate incorporating an inflation adjustment as follows;

$$1 + i = (1 + r)(1 + \pi) \quad \text{.....(3.7)}$$

Plugging and Substituting $(1 + r)$ into equation 3.6 gives;

$$b_t = -s_t + b_{t-1}\frac{1+i_t}{(1+g_t)(1+\pi_t)} \quad \text{.....(3.8)}$$

Where b_t – debt to GDP ratio, s_t - primary surplus to GDP ratio, i_t – implicit nominal interest rate on public debt, g_t –economic growth rate, and π_t –inflation rate.

The equation 3.8 illustrates an identity where inflation and the level of public debt may bear a possibly negative relationship. In this context, a shock inflation may play a significant role in decreasing the level of debt.

3.3 Model Specification

The models for objective 1 and objective 2 are specified in (3.9) and (3.11) respectively.

$$b_t^d = -s_t + b_{t-1}^d\frac{(1+i_t^d)}{(1+g_t)(1+\pi_t)} \quad \text{.....(3.9)}$$

$$b_t^d = \beta_0 + \beta_1 s_t + \beta_2 b_{t-1}^d + \beta_3 i_t^d + \beta_4 g_t + \beta_5 \pi_t + e_t \quad \text{.....(3.10)}$$

and

$$b_t^e = -s_t + b_{t-1}^e\frac{(1+i_t^e)}{(1+g_t)(1+\pi_t)} \quad \text{.....(3.11)}$$

$$b_t^e = \beta_0 + \beta_1 s_t + \beta_2 b_{t-1}^e + \beta_3 i_t^e + \beta_4 g_t + \beta_5 \pi_t + e_t \quad \text{.....(3.12)}$$

With d implying domestic, e implying external, and t implying time.

3.4 Definition & Measurement of Variables

Table 3.1 Definition & Measurement of Variables

Variable	Definition	Measurement
b_t^d	The domestic debt to GDP ratio at a specified time t	This is annual domestic debt stock in Kenya shillings divided by the annual nominal GDP in Kenya shillings in period *t*
b_t^e	The external debt to GDP ratio at a specified time t.	This is annual external debt stock in Kenya shillings divided by the annual nominal GDP in Kenya shillings in period *t*
s_t	This is the primary balance surplus expressed as a percentage of the GDP at a specified time t. The primary balance surplus is the difference between government revenue collected and government expenditure (less interest payments on debt).	This is the difference between the annual tax revenue and annual government expenditure in Kenya shillings divided by the annual nominal GDP in Kenya shillings in period *t*
i_t^d	This is the country's implicit interest rate on domestic debt at a specified time t.	This is the annual nominal interest payments on domestic debt in Kenya shillings at time *t* divided by the stock of domestic debt in Kenya shillings at time *t-1* expressed as a percentage as proposed by (Ryan & Maana, 2014)

Variable	Definition	Measurement
i_t^e	This is the country's implicit interest rate on external debt at a specified time t.	This is the annual nominal interest payments on external debt in Kenya shillings at time *t* divided by the stock of external debt in Kenya shillings at time *t-1*. expressed as a percentage as proposed by (Ryan & Maana, 2014)
π_t	This is inflation which is the steady increase in the price level in the economy as measured by the annual percentage change in the Consumer Price (CPI) index at fiscal end year.	The annual average inflation rate as estimated by the KNBS
g_t	This is the growth rate of the economy measured herein as GDP growth rate at a specified time t	This is the GDP growth as estimated by the KNBS

3.5 Sources of data

Annual data was be collected from the KNBS and the Central Bank of Kenya.

3.6 Time Series Properties

Economic variables, when not stationary over time, result in spurious regression. Therefore, it is always advisable that stationarity tests be conducted on time series data. There are different methods available for conducting stationarity tests. The commonly used tests are the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test and the Augmented Dickey-Fuller (ADF) test.

In this study, both methods were adopted. In the ADF test, the null hypothesis states that a variable is non-stationary while the alternative hypothesis states that the variable is stationary. However, in the KPSS test, it is the reverse. The null hypothesis states that a variable is stationary and the alternative hypothesis states that the variable is non-stationary.

3.7 Diagnostic tests

Diagnostic tests evaluate various assumptions of the model and investigate the validity of the model and variables. Various tests were conducted on the variables and the models.

Autocorrelation is when random error terms exhibit high correlation, such that previous observations have an impact on current observations. This may lead to biased and inefficient estimators. The methods available for testing autocorrelation include the Breusch-Godfrey test, and the Durbin-Watson test. The Breusch-Godfrey test is a general test and the most preferred and will be adopted in this study. The null hypothesis states that the random error term does not exhibit autocorrelation against the alternative hypothesis that there is autocorrelation.

Multicollinearity is when explanatory variables in the equation have a strong correlation with one or more variables that may diminish the statistical significance of the variables. This results in regression that is very sensitive to small changes in the specification which would significantly widen confidence intervals of the parameters. In this study, the correlation matrix of all independent variables was plotted. In the correlation matrix, two variables are correlated using Pearson correlation coefficient. A coefficient of between 0.8 and 1, in absolute terms, was considered evidence of multicollinearity. In the presence of multicollinearity, this study used reasonable judgement to ignore sufficiently small correlations. Further, because of the individual relevance of every variable within the model, the study's sample size was 40 to decrease multicollinearity.

Normality is the assumption that the random error term is normally distributed, that is ($e_t \sim$ N (0, σ^2). To conduct hypothesis on the model's parameters, the assumption of normality holds. The Shapiro-Wilks test and the Jarque-Bera tests were conducted to determine normality. If this condition is violated, it would be difficult to make valid inferences on the significance of the variables. To avoid this, the sample size used was sufficiently large (n=40) such that the distributions of the random errors will be approximately normally distributed in line with the Central Limits Theorem.

To determine if the errors in the equation have constant variance, the widely used White's test was conducted testing that $Var_{e_t}=\sigma^2$ with H0: homoscedasticity. The White's test uses coefficients and unbiased predicted values while correcting the estimates for the biased estimates of variances of coefficients. If regression is continued even in the presence of heteroskedasticity, the estimators would have given unbiased but not consistent estimators (which is not *BLUE*). The standard errors could be wrong and thus any conclusions made misleading.

The model specified in this study is a linear model. To determine whether the model should be linear, the Ramsey RESET test was conducted. The Ramsey RESET test was conducted to test that the models were correctly specified, and no variables were omitted, and that the true relationship between dependent and explanatory variables would be established.

To assess the stability of the parameters, a CUSUM of squares test was conducted on the means of the variables. This detects abrupt changes in the mean level of the time series and identify any structural breaks.

3.8 Estimation Process

Equations 3.10 and 3.12 were estimated as appropriately guided and dictated by stationarity and cointegration tests, and the estimated coefficients were assessed and tested for statistical significance using the t-test. The overall model's parameters were also tested for joint significance using the Wald's test. The coefficients of the parameters were analysed and discussed and relationships with the dependent variable and select relevant explanatory variables reviewed.

More specially, the relationship between inflation and external and domestic debt levels were analysed and discussed.

3.9 Forecasting the Debt to GDP Ratio

The Local Projection method was used to prepare a baseline forecast of up to ten (10) years into the future, that is 2032. It is simple to use method that is also robust to misspecification. This study analysed historical data on the specified macroeconomic variables in the specified models to predict 5 year and 10-year predictions of the domestic debt to GDP ratio to find b_5^d, b_{10}^d being forecasts under objective 1. Similarly, under objective 2, 5 and 10-year predictions of the external debt to GDP ratio b_5^e, b_{10}^e being forecasts under objective 2.

3.10 Simulating the Shock Inflation

In the study, a persistent shock inflation Δ_t was be imposed on the existing debt in the equation over a period of ten (10) years following the methodology of (Akitoby et al., 2017). A shock of Δ_t of 2%, where t = year 2022 was set as a one-off arbitrary shock inflation to forecast its effect on the debt to GDP ratio in 5 and 10 years. This modest shock aligns well with Kenya's flexible inflation targeting framework. The simulated models are presented below:

$$b_t^{d*} = -s_t + b_{t-1}^d \frac{1+i_t^d}{(1+g_t)(1+\pi_t^*)} \quad \text{.....(3.13)}$$

$$b_t^{e*} = -s_t + b_{t-1}^{e} \frac{1+i_t^e}{(1+g_t)(1+\pi_t^*)}$$ ……..(3.14)

Where,

π_t^* contains $\pi_{2022} + \Delta_t$ ……...…(3.15)

The study compared the 5- and 10-year baseline and treated forecasts under objective 1, and similarly for objective 2. The presence of or lack of a debt-liquidating effect of a shock inflation was analysed and discussed.

CHAPTER FOUR

4 EMPIRICAL FINDINGS

4.1 Introduction

The findings of this research study are in this chapter. This presents and discusses the ARDL model estimation and outcomes, descriptive statistics of variables, time series properties results, model diagnostic test results.

Further, a discussion of the possibility of inflation liquidating public debt in Kenya is presented. The short and long run relationships of inflation and debt to GDP ratios from the outcome of ARDL model estimation are analysed and discussed.

4.2 Descriptive Statistics

Annual Kenyan data for the period 1983 – 2022 were used in this study. The data had 40 observations except for implied interest rate of domestic debt and implied interest rate on external debt which were generated from lagged variables and thus had 39 observations that excluded the year 1983. Descriptive statistics of the variables in the regression analysis are shown in Table 4.1 below.

Table 4.1 Summary Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max
b_t^d - Domestic Debt to GDP (ratio)	0.1837	0.0722	0.0252	0.3360
b_t^e - External Debt to GDP (ratio)	0.3284	0.1244	0.1572	0.8156
s_t - Primary balance surplus to GDP (ratio)	-0.1071	0.0668	-0.3326	-0.0056
i_t^d - -Implied interest on domestic debt (%)	0.2577	0.2797	0.0273	1.1683
i_t^e - Implied interest on external debt (%)	0.0365	0.0243	0.0118	0.1192
π_t- Inflation rate(%)	0.1113	0.0851	0.0155	0.4598
g_t - Real GDP growth rate(%)	0.0380	0.0229	-0.0080	0.0806
i_t^d^2 - The square of implied interest on domestic debt	0.0019	0.0029	0.0001	0.0142
π_t^2 - The Square of the inflation rate	0.0195	0.0367	0.0002	0.2114

Over the period reviewed, domestic debt to GDP ratio averaged 18.37% with a minimum of 3.52% and a maximum of 33.60%. Conversely, external debt to GDP ratio averaged 32.84% with a minimum of 15.72% and maximum of 82.56%.

The primary balance surplus to GDP ratio averaged -10.71% with a low of -33.26% and high of -0.56%.

Implicit interest rate on domestic debt averaged 25.77% over the period with a minimum of 2.73% and a maximum of 116.83%. Conversely, implicit interest rates of external debt averaged 3.65% with a minimum of 1.18% and maximum of 11.92%.

The inflation rate averaged 11.13% with a low of 1.55% and high of 45.98%.

The GDP growth rate averaged 3.80% over the period with a minimum of -0.8% and maximum of 8.06%.

Relatively high standard deviation of the external debt to GDP ratio, domestic debt to GDP ratio, and the implied interest on domestic debt indicate high volatility of the dataset.

4.3 Unit Root and Cointegration Testing, and Model Selection

ADF and KPSS tests were conducted on all variables in the models to determine stationarity. According to the KPSS tests, all variables were stationary. However, with the ADF tests, some variables including domestic debt to GDP ratio, external debt to GDP ratio, and implied interest on external debt were non-stationary, however, they were confirmed stationary at first difference. All variables were tested for non-stationarity using the ADF test with H0: presence of unit root (non-stationarity).

The results of the ADF test are shown in Table 4.2 and Table 4.3.

Table 4.2 ADF Matrix of Cointegration Test Results at levels

Variable	**t-statistic at levels**	**Critical Value at 5% significance level**	**Conclusion**
Domestic Debt to GDP (ratio)	-1.224	-2.961	Non-stationary
External Debt to GDP (ratio)	2.158	-2.961	Non-stationary
Primary balance surplus to GDP (ratio)	-3.809	-2.964	Stationary
Implied interest on domestic debt (%)	-3.385	-2.964	Stationary
Implied interest on external debt (%)	-2.496	-2.964	Non-stationary
Inflation rate(%)	-3.324	-2.961	Stationary
Real GDP growth rate(%)	-4.620	-2.961	Stationary

Variable	t-statistic at levels	Critical Value at 5% significance level	Conclusion
The square of implied interest on domestic debt(%%)	-4.202	-2.964	Stationary
The square of the inflation rate((%%)	-3.488	-2.961	Stationary

Table 4.3 ADF Matrix of Cointegration Test Results at first difference

Variable	t-statistic at first difference	Critical Value at 5% significance level	Conclusion
Domestic Debt to GDP (ratio)	-7.055	-2.964	Stationary
External Debt to GDP (ratio)	-7.991	-2.964	Stationary

To support these results, the KPSS test with H0: Stationarity was also conducted, and all variables were confirmed to be stationary.

The next step was to conduct the cointegration test because according to the ADF test, some variables were stationary at level while others were stationary at first difference.

The ARDL process was allowed to select optimal lags. For the first objective, due to the misspecification of the functional model of the Domestic Debt to GDP ratio, the square of the implicit interest rate on domestic debt was introduced as an explanatory variable. The explanatory variables were thus, primary balance surplus to GDP Ratio, implied interest rate on domestic debt, inflation, GDP growth rate and the square of the implied interest rate on domestic debt. The first model's ARDL process produced the lag matrix (4 4 1 3 3 4). The ARDL bounds test for H0: no levels relationship conclusively revealed that with F = 23.805 and t = 0.412, there existed a

cointegrating relationship among the variables at 5% level of significance and thus the long-run ARDL model was considered more appropriate to estimate the dependent variable.

In the second objective, to avoid misspecification error even after including the square of the implicit interest rate, the square of inflation rate was introduced to the model. Thus, the dependent variable was the external debt to GDP ratio, and the explanatory variables were primary balance surplus to GDP ratio, implied interest rate on external debt, inflation, GDP growth rate, and the square of the annual average inflation. The second model's ARDL process produced the lag matrix (1 0 3 4 3 2). The ARDL bounds test for H0: no levels relationship conclusively revealed that with F = 15.937 and t =-6.88, there existed a cointegrating relationship among the variables at 5% level of significance and thus the long run ARDL was considered more appropriate as well. The results of the ARDL bounds tests were conducted for both models and the results are shown in Table 4.4.

Table 4.4 Results of the ARDL bounds test

Pesaran/Shin/Smith (2001) ARDL bounds test results at 5%level H0: no levels relationship			
Model 1	**F=23.805**	**t=0.412**	**Conclusion**
I(0) - Lower-bound critical values	2.96	-3.13	Levels relationship
I(1)- Upper-bound critical values	4.18	-4.46	Levels relationship
Model 2	**F=15.937**	**t=-6.883**	**Conclusion**
I(0) - Lower-bound critical values	2.96	-3.13	Levels relationship
I(1)- Upper-bound critical values	4.18	-4.46	Levels relationship
Note. Accept H0 if F < critical I(0) value, reject if F > critical I(1) value. Accept H0 if t > critical I(0) value, reject if t < critical I(1) value.			

Since ARDL bounds tests indicated showed existence of cointegration, the ARDL-ECM estimation was considered theoretically the most appropriate model to estimate the relationship

between domestic debt to GDP ratio and external debt to GDP ratio and their explanatory variables and more specifically, inflation. However, for the first model, the ARDL-ECM Model's adjusted coefficient had an expected positive error correction term 0.0371667 that was statistically insignificant at 5%level which is considered explosive error correction (Nkoro & Uko, 2016). Thus, the ARDL short-run model was considered the most appropriate to use in estimation.

For the first objective estimated by equation 3.10, as appropriately guided by stationarity and cointegration test, the short-run ARDL ((4 4 1 3 3 4) was estimated with domestic debt to GDP ratio as the dependent variable alongside the following explanatory variables: primary balance surplus to GDP Ratio, implied interest rate on domestic debt, inflation, GDP growth rate and the square of the implied interest rate on domestic debt.

For the second objective estimated by equation 3.12, the ARDL-ECM (1 0 3 4 3 2) model was used in the estimation as guided by stationarity and cointegration tests. The dependent variables were the external debt to GDP ratio, and the explanatory variables were primary balance surplus to GDP ratio, implied interest rate on external debt, inflation, GDP growth rate, and the square of the annual average inflation. The long and short-run relationships were analysed and discussed.

ARDL and ARDL-ECM models are suitable for analysing variables over time.

4.4 Results of Diagnostic Tests

4.4.1 Autocorrelation

In both models tested, the variables were concluded to have no autocorrelation. Durbin Watson's d-statistic (25, 35) = 2.604138 and d-statistic (19, 36) = 2.14588 supported by the Breusch Godfrey tests where $\chi^2(4.640)$ > p-value (0.0312) and $\chi^2(1.386)$ > p-value (0.2391) respectively leads to a rejection decision of H0: no serial correlation. This is presented in Table 4.5.

Table 4.5 Results of Autocorrelation Tests

Test	Model 1	Model 2	Conclusion
DW test (d-statistic)	2.604138	2.14588	No serial Correlation
Dreusch-Godfrey test χ^2	4.640	1.386	No serial Correlation
p-value	0.0312	0.2391	No serial Correlation

4.4.2 Multicollinearity

From the Breusch-Godfrey autocorrelation tests, all variables in the models displayed no serial correlation. However, in checking for multicollinearity with the pairwise correlation test, various relationships were observed as in Table 4.6

Table 4.6 Correlation matrix

Variable	b_t^d	b_{t-1}^d	b_t^e	b_{t-1}^e	s_t	i_t^d	i_t^e	π_t	g_t	i_t^d^2	π_t^2
b_t^d	1										
b_{t-1}^d	0.8266	1									
b_t^e	-0.2981	-0.2739	1								
b_{t-1}^e	-0.2811	-0.321	0.777	1							
s_t	0.2421	0.2189	-0.5718	-0.5431	1						
i_t^d	-0.4565	-0.7099	0.4855	0.5386	-0.5756	1					
i_t^e	-0.5384	-0.4955	0.3992	0.4741	-0.2167	0.1735	1				
π_t	-0.1123	-0.1348	0.5379	0.3575	-0.4516	0.2357	0.09	1			
g_t	0.1665	0.2795	-0.4086	-0.2946	0.2276	-0.3408	-0.1994	-0.4366	1		
i_t^d^2	-0.3424	-0.6335	0.3374	0.432	-0.4836	0.9684	0.0363	0.1465	-0.2922	1	
π_t^2	-0.1077	-0.0919	0.6516	0.3558	-0.4971	0.251	0.0375	0.9444	-0.4179	0.1484	1

It is important to observe the negative relationship between inflation and domestic debt vis a vis the positive relation between inflation and the external debt to GDP ratio. This study concentrated on analysing this relationship in the shorter and longer term and its forecast in five and 10 years.

Inflation and the level of interest payments are positively related, although weakly, but more so more related to the interest rate on domestic debt.

The primary surplus to GDP ratio was positively related to domestic debt and negatively related to external debt. This indicates that budget deficits rise with increased acquisition of external debt. Rising interest rates on domestic debt also decrease the level of primary surplus balance (rather, increasing levels budget deficits) more than rising interest rates on external debt. Higher level of interest payments on domestic debt likely discourages domestic debt levels while encouraging uptake of external debt.

4.4.3 Normality

The Shapiro Wilks test for normal data for Ho: normality was conducted against 5% level of significance with the following results in Table 4.7.

Table 4.7 Results of the Shapiro-Wilks test for normal data

Shapiro Wilks Test for normal data			
Variable	Sample size	Prob>z	Decision
Domestic Debt to GDP Ratio	40	0.4833	Normal
Domestic Debt to GDP Ratio one period prior	39	0.2191	Normal
External Debt to GDP Ratio	40	0.0006	Non-normal
External Debt to GDP Ratio one period prior	39	0.0008	Non-normal
Primary balance surplus to GDP Ratio	39	0.0003	Non-normal
Implied interest rate on domestic debt	39	0.0000	Non-normal
Implied interest rate on external debt	39	0.0000	Non-normal
Inflation rate	40	0.0000	Non-normal
GDP growth rate	40	0.2468	Normal
Square of the implied interest rate on domestic debt	39	0.0000	Non-normal
Square of the inflation rate	40	0.0000	Non-normal

To support the Shapiro-Wilks test, the Jarque-bera test for normality with H0: Normality at 5% level of significance was also conducted with the results presented in Table 4.8.

Table 4.8 Results of the Jaque-Bera Test for Normal Data

Statistic	χ^2	**Prob > F (p-value)**	**Decision**
Model 1	3.597	0.1655	Normality
Model 2	4.752	0.0928	Normality

These variables are dynamic in a time series, and with the sample size of data is 40, meeting the Central Limit Theorem for assumption of normality. Thus, it is concluded that the variables in the time series are normal according to the Jarque-bera test and the Central Limit theorem.

4.4.4 Heteroskedasticity

The White's test returned p values of 0.4204 and 0.4215 for objective 1 and 2 respectively, and the study concluded that at 5% level of significance, there was no heteroskedasticity in the variables. This is presented in Table 4.9.

Table 4.9 Results of White's test of homoskedasticity

White's Test for homoskedascticity			
Variable	χ^2	Prob>χ^2	Decision
Model 1	35	0.4204	homoskedasticity
Model 2	36	0.4215	homoskedasticity

4.4.5 Specification

In model 1, with $R^2 = 99.31\%$ and R^2_{adj}=97.65%, indicating goodness of fit of the variables. The Ramsey Reset test with H0: No omitted variables returned p value of 0.1571 with a decision to fail to reject H0 at five percent level. The model was thus correctly specified in its functional form, and no variable was omitted.

In model 2, with $R^2 = 99.11\%$ and R^2_{adj}=96.10%, indicating goodness of fit of the variables. The Ramsey RESET test for omitted variables was not significant, F(3, 14)=1.40, p = 0.2855, indicating that the model did not have any omitted variables and correctly specified in its functional form.

4.4.6 Stability

For both models, the CUSUM of squares test indicated slight changes in the parameters, indicating that at 99% confidence, there were no sudden changes in the coefficients as observed in Figure 4.1 and 4.2. Model 1 and Model 2 track the data, leading to the conclusion that the parameters were

stable in their parameters. The CUSUM-of-squares test is a powerful test and thus appropriate because of its robustness in capturing shifting parameters (Caporale & Pittis, 2004).

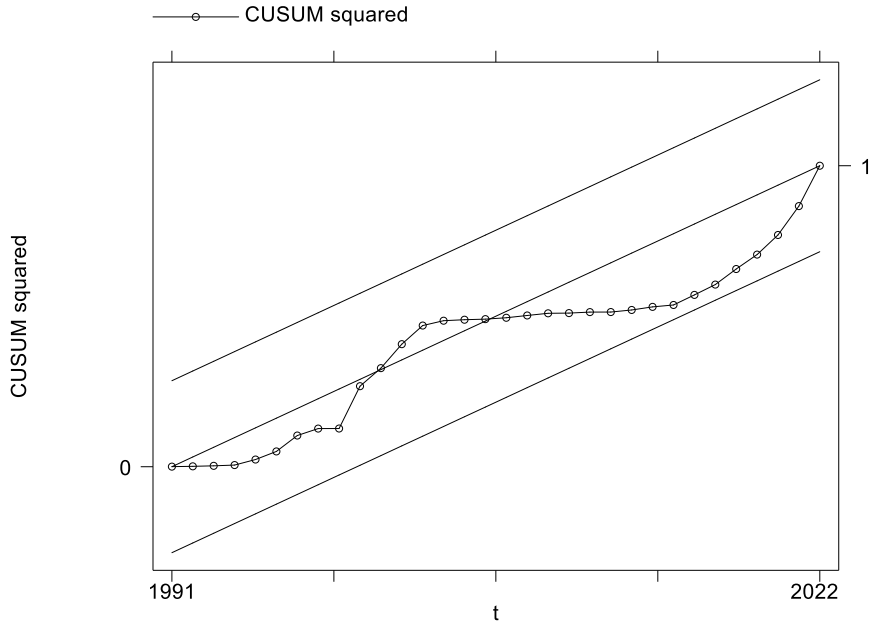

Figure 4.1. CUSUM of Squares test Results for Domestic debt to GDP Ratio

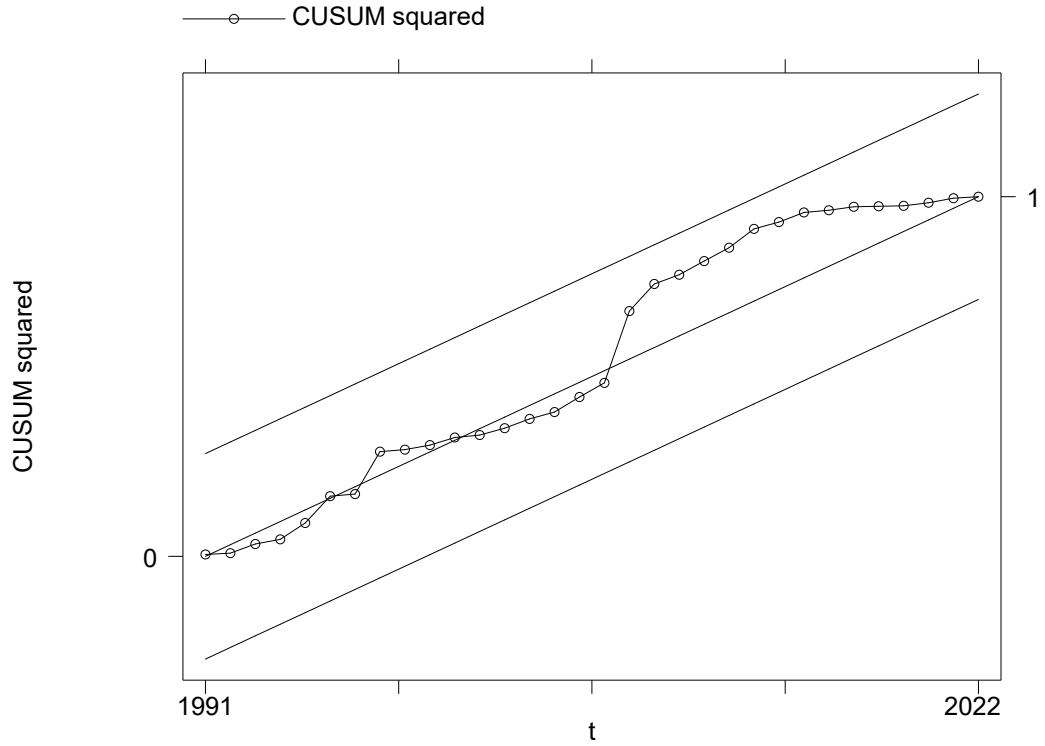

Figure 4.2 The CUSUM of Squares test for External Debt to GDP Ratio

4.5 The Effect of Inflation on Domestic Public Debt in Kenya

The ARDL short-run model was considered the most appropriate to use and the results are shown in Table 4.10.

Table 4.10 Short Run ARDL (4 4 1 3 3 4) estimation results on domestic debt to GDP ratio

Variable	Coefficient	Std. Error	t-statistic	p-value	Conclusion
L1. Domestic Debt to GDP Ratio	0.392712	0.186247	2.11	0.061	Not significant
L2. Domestic Debt to GDP Ratio	-0.3982	0.125059	-3.18	0.01	Not significant
L3. Domestic Debt to GDP Ratio	0.526346	0.190026	2.77	0.02	Not significant
L4. Domestic Debt to GDP Ratio	0.516306	0.170592	3.03	0.013	Significant
Primary Balance Surplus to GDP Ratio	-0.46094	0.166553	-2.77	0.02	Significant
L1. Primary Balance Surplus to GDP Ratio	-0.83351	0.182079	-4.58	0.001	Significant
L2. Primary Balance Surplus to GDP Ratio	0.219971	0.074234	2.96	0.014	Significant
L3. Primary Balance Surplus to GDP Ratio	0.191242	0.102658	1.86	0.092	Not significant
L4. Primary Balance Surplus to GDP Ratio	0.555919	0.089445	6.22	0	Significant
Implied Interest Rate on Domestic Debt	-0.16026	0.089588	-1.79	0.104	Not significant
L1. Implied Interest Rate on Domestic Debt	-0.12359	0.110193	-1.12	0.288	Not Significant
Inflation rate	-0.01657	0.050574	-0.33	0.75	Not significant
L1. Inflation rate	-0.13532	0.060025	-2.25	0.048	Significant
L2. Inflation rate	-0.13936	0.091984	-1.52	0.161	Not significant
L3. Inflation rate	-0.45806	0.088414	-5.18	0	Significant
GDP Growth Rate	0.109683	0.15195	0.72	0.487	Not significant
L1. GDP Growth Rate	0.197614	0.142505	1.39	0.196	Not significant
L2. GDP Growth Rate	-0.21267	0.187971	-1.13	0.284	Not significant
L3. GDP Growth Rate	-0.28523	0.182585	-1.56	0.149	Not significant
Square of Implied Interest Rate on Domestic debt	0.164308	0.054502	3.01	0.013	Not significant
L1. Square of Implied Interest Rate on Domestic debt	-0.04301	0.065164	-0.66	0.524	Not significant
L2. Square of Implied Interest Rate on Domestic debt	0.211788	0.027772	7.63	0	Significant
L3. Square of Implied Interest Rate on Domestic debt	0.136725	0.031447	4.35	0.001	Significant
L4. Square of Implied Interest Rate on Domestic debt	-0.03361	0.011922	-2.82	0.018	Significant
_constant	0.072493	0.035381	2.05	0.068	Not significant
R-squared = 0.9931 Adj R-squared = 0.9765					

Variable	Coefficient	Std. Error	t-statistic	p-value	Conclusion
Key: Ln: nth lag of the variable					

As shown in Table 5.1, inflation was captured by the current values and its three lags. All the coefficients of the current values and lags of inflation were negative as expected. The coefficients of the current year's inflation rate and its second lag were not statistically significant at the 5% level. The coefficients of the first and third lags of the inflation variable were statistically significant at the 5% level. These results implied that the liquidating effect of inflation occurred during the first and the third lags. A percentage increase in the first and third lag of inflation would result in a 0.13 and 0.45 percent respective decrease in the domestic debt to GDP ratio which was statistically significant. The Walds test also indicated that the coefficients of inflation and its lags were jointly significant at 5% level. Overall, while the short-run effects were mixed, the results suggest that higher inflation in prior years tended to reduce Kenya's domestic debt level in the current period, potentially in an inflation liquidation effect due to lower real cost of interest rate payments due to decrease in real value of money. This indicated that from Kenyan historical data from 1983-2022, inflation may have potentially liquidated some domestic debt. This result is consistent and similar to the findings of the study on Italian debt (Akitoby et al., 2017) and Reinhart et al., (2011) (1900-2009) and Reinhart & Sbrancia (2015) observations that between 1945-1980, a majority of advanced countries under study including Germany, Argentina, Italy, USA, UK and India, periods of high inflation coincided with lower inflation levels .This modest debasement on domestic debt compared to external debt was also consistent with the assertions of Equiza-Goñi (2016) of minimal to non-existent liquidation of inflation of with USA's characteristically shorter term debt maturities, and the observation by Aizenman & Marion (2011) that shorter maturities

were less responsive to inflation and that foreign-held domestic-currency debt would be more appealing to inflation-induced erosion. Kenyan domestic debt is characterized by majority shorter-term and domestic held securities.

The regression results for the domestic debt model shed light on the factors influencing Kenya's domestic debt to GDP ratio over time. Several lags of the domestic debt ratio itself exhibited significant autoregressive effects, with the coefficients on the first, third, and fourth lags being positive and statistically significant. However, the third lag's coefficient had a negative statistically significant coefficient.

The primary balance surplus to GDP ratio and its lags had a mix of significant negative and positive effects. The current primary balance and its first had negative coefficients which were statistically significant at 5% level, while the second, third, and fourth lags were positively related to domestic debt, although the third lag was not statistically significant at 5% level.

The implied interest rate on domestic debt and its levels had largely insignificant effects. The coefficients of correlation between inflation and implied interest on domestic debt, and between inflation rate and GDP growth rate were low (0.23 and -0.43 respectively) and hence the inflation variable at levels had no significant impact on domestic debt to GDP ratio.

As indicated by Reinhart & Sbrancia (2011) and Reinhart & Sbrancia (2015), lower real interest rates occasioned by higher inflation also played a role in the liquidation of public debt in a majority of advanced countries studies including Argentina, Brasil, and Germany. This leads to the assumption that domestic debt erosion in Kenya could only have been initiated by inflation alone and not through its effects on interest rate as suggested by Hilscher et al. (2022) who concluded there would be significant reduction in the debt to GDP ratio if inflation was strongly correlated with GDP growth rate and real interest rates. However, the coefficients of the squared terms of the

second, third, and fourth lags of implicit interest rate on domestic debt were statistically significant suggesting that the relationship between implicit interest rate on domestic debt and domestic debt to GDP ratio may have a non-linear relationship where lower interest rates could potentially decrease the level of domestic debt in the second and third lag, but increase it in the fourth lag.

Annual GDP growth rate and its lags did not have significant coefficients in this model. Annual GDP growth rate and its lags did not have significant coefficients in this model.

Overall, the t-statistic of the Domestic Debt to GDP Ratio at the first level was significant. Further, the coefficient of the variable of interest annual average inflation rate at the first level is significant. Thus, with $R^2 = 99.31\%$ and $R^2_{adj} = 97.65\%$ the short-run ARDL model is a good fit. At 5% significance level, a percentage increase in the first lag of the domestic debt to GDP ratio is associated with a 0.39 percent increase in the domestic debt to GDP ratio. At levels, a percentage increase in the primary balance surplus to GDP ratio is associated with a 0.46 percent increase in the domestic debt to GDP ratio. While implicit interest rate has no statistically significant impact on the Domestic Debt to GDP ratio, a percentage change in the square of the implicit interest rate results to a 0.16 percent increase in the Domestic debt to GDP ratio but a 0.21 percent decrease in the third period. There is an implied non-linear relationship between the level of interest payments and the domestic debt-to-GDP ratio. A percentage increase in the first lag of inflation would result in a 0.13 percent decrease in the domestic debt to GDP ratio which is statistically significant. Economic growth has no significant impact on the domestic debt-to-GDP ratio.

4.6 The Effect of Inflation on External Public Debt in Kenya

The ARDL-ECM was estimated, with the error correction term (alpha) indicating a moderate speed of adjustment to equilibrium level which was statistically significant. Thus, both long and short run effects of the explanatory variables on the external debt to GDP ratio were investigated. The results of the ARDL-ECM are shown in Table 4.11.

Table 4.11 ARDL-ECM (1 0 3 4 3 2) estimation results on external debt to GDP ratio

D.ExternalDebttoGDP Ratio	**Coefficient**	**Std. Error**	**t-statistic**	**p-value**	**Statistical Conclusion**
Adjustment					
L1.External Debt to GDP Ratio	-0.5172	0.0751	-6.88	0.0000	Negative sign of error correlation term indicates speed of adjustment which is also statistically significant
Long-run					
Primary Balance Surplus to GDP Ratio	-0.6206	0.2519	-2.46	0.0250	Significant
Implied Interest Rate on External Debt	3.4936	0.4508	7.75	0.0000	Significant
Annual Average Inflation Rate	-2.3539	0.5431	-4.33	0.0000	Significant
Annual GDP Growth Rate	-3.2620	0.6352	-5.14	0.0000	Significant
Square of Annual Average Inflation Rate	5.4446	1.3642	3.99	0.0010	Significant
Short run					
D1.Implied Interest Rate on External Debt	-0.7564	0.285	-2.65	0.017	Significant
LD.Implied Interest Rate on External Debt	-0.6323	0.254	-2.49	0.023	Significant
L2D.Implied Interest Rate on External Debt	-0.7167	0.2479	-2.89	0.01	Significant
D1.Annual Average Inflation Rate	0.2845	0.2739	1.04	0.313	Not significant
LD.Annual Average Inflation Rate	0.982	0.1627	6.04	0	Significant
L2D.Annual Average Inflation Rate	0.3336	0.0856	3.9	0.001	Significant

D.ExternalDebttoGDP Ratio	Coefficient	Std. Error	t-statistic	p-value	Statistical Conclusion
L3D.Annual Average Inflation Rate	0.3399	0.0593	5.73	0	Significant
D1.Annual GDP Growth Rate	1.7215	0.4382	3.93	0.001	Significant
LD.Annual GDP Growth Rate	1.3461	0.3557	3.78	0.001	Significant
L2D.Annual GDP Growth Rate	0.9796	0.2583	3.79	0.001	Significant
D1.Square of Annual Average Inflation Rate	0.9327	0.6744	1.38	0.185	Not significant
LD.Square of Annual Average Inflation Rate	-1.4498	0.3525	-4.11	0.001	Significant
_constant	0.21718	0.03806	5.71	0	Significant
R-squared = 0.9811					
Adj R-squared = 0.9610					
Key: Ln: nth lag of the variable, D1:first difference of a variable, LD: first lag of the first difference, LnD: nth lag of the first difference					

The regression results revealed several significant factors influencing Kenya's external debt to GDP ratio. In the long run, the external debt to GDP ratio exhibited a negative and statistically significant autoregressive effect.

The coefficient of inflation exhibited an expected negative sign, where in the long run, a percentage increase in inflation is associated with a 2.35% decrease in external debt to GDP ratio. This consistent with the findings of Fukunaga et al. (2022) who observed a larger effect of an increase in inflation on longer-term debt than on shorter term debt by 0.1%. Kenya's external debt is traditionally longer term characterized by longer-term creditors including international development agencies and bilateral country creditors.

Conversely, in the short run, a percentage increase in the first, second and third lags of inflation variable would result in a 0.98%, 0.33% and 0.34% increase in the external debt to GDP ratio.

The Walds test also indicated that the coefficients of inflation and its lags were jointly significant at 5% level. This study lends credence to the empirical suggestions (Fukunaga et al., 2022; Hilscher et al., 2022; Kose et al., 2021; Krause & Moyen, 2016) on inflation persistence, where higher inflation is to be allowed to persist for a longer period to realize its debt-liquidating effects.

Inflation also appeared to have a non-linear relationship with external debt to GDP ratio. In the long run, at the turning point, that is, where inflation ceases to have a liquidating effect on external debt is when the inflation rate rises to 22.56%.

The primary balance surplus to GDP ratio had a negative and significant coefficient indicating that higher primary surpluses were associated with lower external debt burdens in the long run with a percentage change in the primary balance surplus to GDP ratio resulting in a 0.62 percentage decrease in external debt to GDP ratio.

Implicit interest rate on external debt and external debt had an expected positive and statistically significant long-run relationship. A one% decrease in interest rate could potentially decrease the level of external debt to GDP by 3.49%. This is similar to the conclusion by Reinhart & Sbrancia (2011, 2015) where lower real interest rates occasioned by higher inflation also played a role in the liquidation of public debt in a majority of advanced countries studies including Argentina, Brasil, and Germany. Further, this aligns with the expectations of the Fisher effect and the results of Akitoby et al. (2017) where an increase in inflation decreases net debt in the fisher effect, where raising inflation to 6% simultaneously decrease real interest rates via the Fisher effect to potentially liquidate debt by 11%. In contrast however, the opposite effect is observed in the short run where the coefficients of implicit interest on external debt's first difference and its two lags exhibited an inverse relationship where a one percent decrease in the first difference of implicit interest on external debt and its two lags implicit interest rate could potentially increase the external debt to

GDP ratio by 0.75%, 0.63% and 0.71% respectively. This indicates that perhaps the combination of lower interest rates and higher inflation suggested by this study may only have an impact on external debt to GDP ratio in the long run but not in the short run.

In the long run, the GDP growth rate had an expected statistically significant negative relationship with external debt to GDP ratio. A percentage increase in GDP growth rate may potentially decrease external debt to GDP ratio by 3.26% in the long run. However, in the short run, in stark contrast, GDP growth rate had a positive relationship with the external debt to GDP ratio where a one percentage increase in the first difference of GDP growth rate and its two lags would result in a 1.72%, 1.35% and 0.97% respectively. This suggested that in the short-run, acquisition of a larger share of external debt could stimulate economic growth.

As expected, the primary balance surplus ratio was negatively associated with external debt to GDP ratio with statistical significance at 5% level. A percentage increase in the primary balance surplus ratio potentially resulting in a 0.62% decrease in external debt to GDP ratio.

4.7 Forecasting and Simulating Debt to GDP Ratio

For Objective 1 and Objective 2, debt-to-GDP ratio was forecasted and compared under two distinct scenarios: the baseline forecast assuming no inflation shocks, and the forecast with a simulated 2% shock inflation imposed on the existing debt over a period of 5 and 10 years under the local projection method was used.

4.7.1 Domestic Debt to GDP Ratio Forecasts and Simulation

The graph in Figure 4.3 presents the forecasted domestic debt-to-GDP ratio under two distinct scenarios: the baseline forecast and the forecast with a simulated 2% shock inflation imposed on the existing debt over a period of 5 and 10 years. The local projection method was used to forecast data up to ten (10) years into the future, i.e. 2032. The solid line represents the baseline forecast,

which depicts the projected path of the domestic debt to GDP ratio based on historical data and the specified macroeconomic variables in the ARDL model, without considering any shock inflation. Conversely, the dashed line illustrates the forecasted domestic debt-to-GDP ratio after incorporating the impact of the one-off 2% shock inflation, as outlined in the study's methodology.

This visual representation aligns with the study's objectives, allowing for a comparison of the 5-year and 10-year forecasts with and without the shock inflation for the domestic debt to GDP ratio. The graph highlights the slight decrease in the domestic debt-to-GDP ratio due to the imposition of the 2% shock inflation, particularly in the latter part of the forecast period. Like the external debt-to-GDP ratio, where the impact of the shock inflation escalated over time, the graph suggests that the impact on the domestic debt-to-GDP ratio is more felt, albeit slightly towards the end of the horizon period.

As illustrated in figure 4.3, the forecast lines exhibit a gradual upward trend, indicating a steadily increasing domestic debt to GDP ratio over the time under consideration with and without a shock to inflation. While the effect of the shock inflation on the domestic debt-to-GDP ratio appears not to be present throughout the entire time horizon, it becomes more pronounced towards the latter part of the forecast period. In the longer term in the tenth period, it is evident that a 2% shock inflation will result in a domestic debt to GDP ratio of 33.871% against the baseline's 33.879%, representing a slight decrease of 0.024% of the domestic debt level towards the end of the 10-year forecast. In contrast, in 5-years, inflation may potentially increase the domestic debt to GDP ratio by 0.03%. This is consistent with the finding of various studies that for shorter term debt maturities, the liquidating effect of inflation was minimal to nonexistent because shorter maturities were less responsive to inflation (Aizenman & Marion, 2011; Equiza-Goñi, 2016; Hilscher et al., 2022; Reinhart & Sbrancia, 2011, 2015).

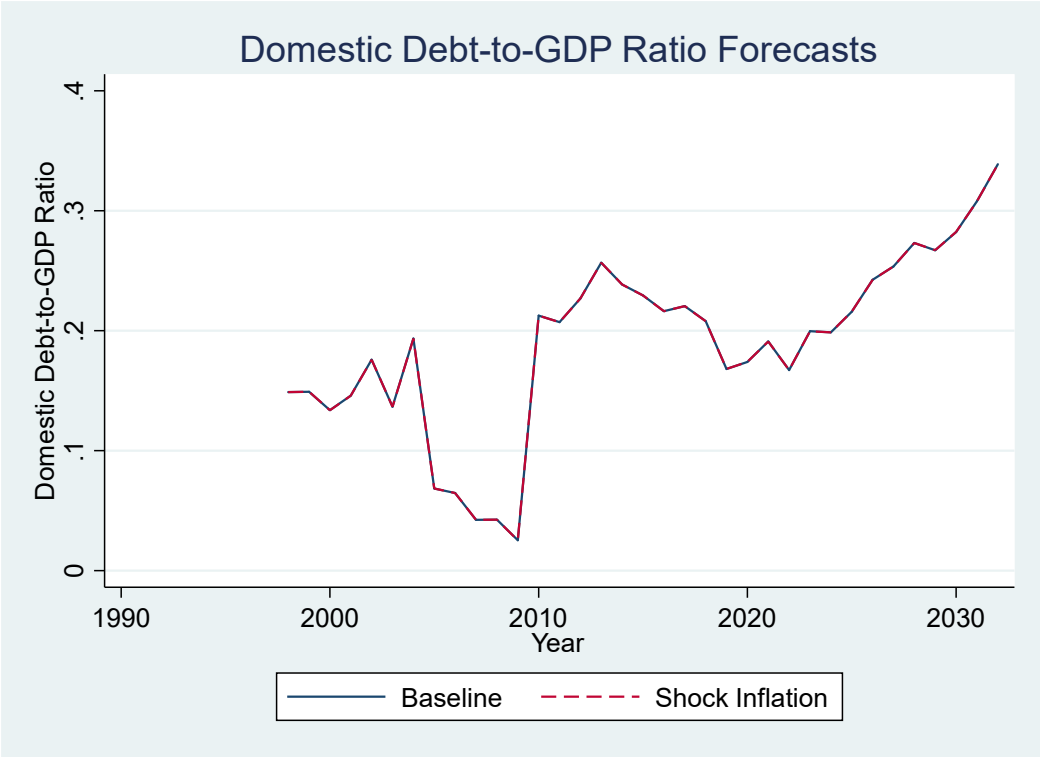

Figure 4.3 Forecast and Simulation of Domestic Debt to GDP Ratio

Kenyan domestic debt is characterized by majority shorter-term and domestic held securities and hence, a shock inflation may worsen the economy in 5 years and only minimally in 10 years. Even in 10 years, the very slight benefits of the shock inflation cannot warrant the trade off with its significant macroeconomic risks.

For Kenyan data, juxtaposed against the findings from advanced countries, the impact of a shock to inflation was evidently low in comparison. For instance, in the US, a one percentage shock resulted in liquidation of 0.7% (Fukunaga et al., 2022) , 1.75% (Hilscher et al., 2022) or 1.7% (Equiza-Goñi, 2016). In the Euro Area and other Advanced countries, a 1% shock inflation liquidated debt by 1.75% (Akitoby et al., 2017), 4.2% (Equiza-Goñi, 2016) and 0.7% (Fukunaga et al., 2022).

4.7.2 External Debt to GDP Ratio Forecasts and Simulation

The local projection method was used to forecast data up to ten (10) years into the future, i.e. 2032.

Figure 4.4 provides a visual representation of the forecasted external debt-to-GDP ratio under two scenarios: the baseline forecast and the forecast with simulated shock inflation. The baseline forecast, represented by the solid line, depicts the projected path of the external debt to GDP ratio based on historical data and the specified macroeconomic variables in the ARDL model, without considering any shock inflation. In contrast, the dashed line illustrates the forecasted external debt-to-GDP ratio after imposing a one-off 2% shock inflation (+0.02) in the year 2022 on the existing debt over a period of 5 and 10 years, as outlined in the study's methodology.

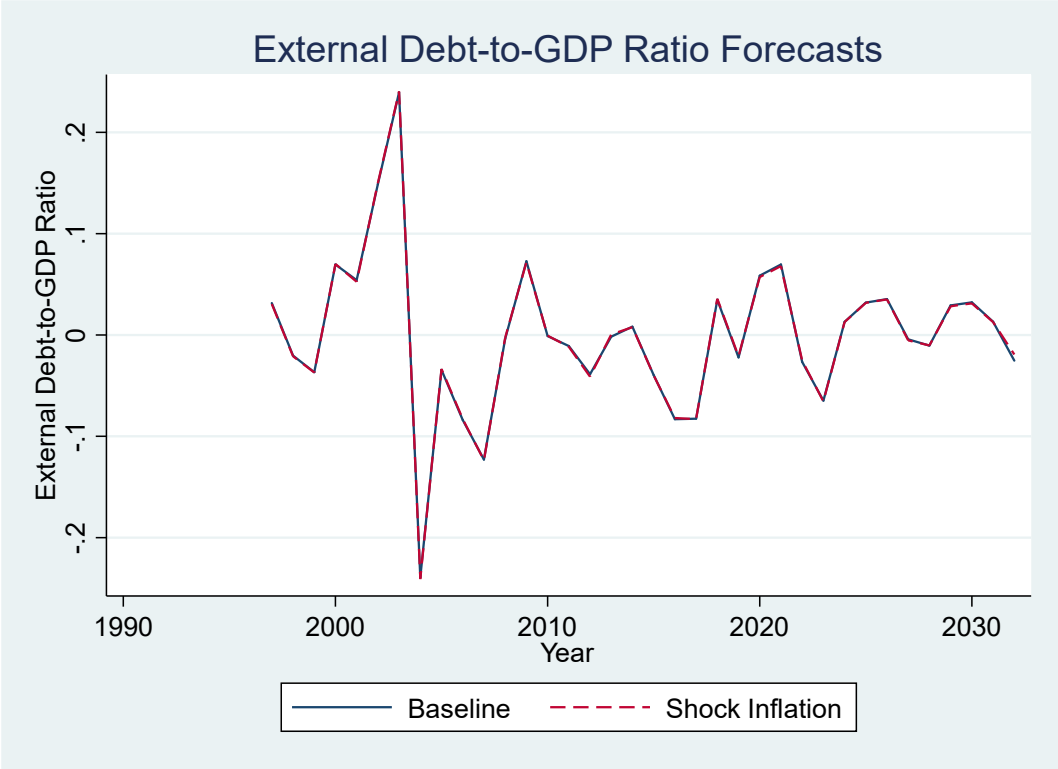

Figure 4.4 Forecasts and Simulation of External Debt to GDP Ratio

Notably, the forecast lines in Figure 4.5 exhibit smooth turns, exhibiting little volatility, fluctuating around a value of approximately 0.1 for most of the periods under consideration. More prominent

changes occur towards the 10th forecasted period, where the shock inflation forecast of -0.654% which was lower than the untreated forecast of 0.36% by 282%. It appears that in the longer term, 2% shock to inflation would have a significant effect on external debt, possibly eliminating it. This follows the findings of Fukunaga et al. (2022) who indicated that a 2% shock inflation would liquidate US debt by 0.7%, and Krause & Moyen (2016)'s 4% shock liquidating about 33% of debt with the opinion that longer term maturities would be more prone to erosion. Similarly, a 1% shock to inflation would liquidate debt by 4.2% in the Euro Area vis a vis 1.7% in the US, a difference due to US' shorter term maturity debt profile (Fukunaga et al., 2022). However, this effect on external debt is inconsistent with Krause & Moyen (2016)'s posit that the liquidating effect of inflation may only be observed with domestic debt.

In five years however, it was observed that inflation has the undesirable effect of increasing external debt level from 2.426% to 2.513% or by 3.5%. This could suggest that inflation should persist for a longer period as suggested by (Equiza-Goñi, 2016; Fukunaga et al., 2022; Hilscher et al., 2022; Krause & Moyen, 2016).

In comparison, sustained inflation may help reduce Kenya's external debt more effectively over the long term, unlike domestic debt.

CHAPTER FIVE

5 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section summarises the study, drawing conclusions and providing policy implications and recommendations. Areas for further research were identified and proposed for further research.

5.2 Summary

The study intended to separately investigate the effect of inflation on domestic and external debt levels. Specifically, the study sought to determine the effect of shock inflation on debt, and to investigate the impact of shock inflations on domestic and external debt to determine the possibility of using inflation to liquidate public debt. The study was motivated by the increasing debt burden that Kenya has borne in recent years culminating in near-defaults, sovereign credit rating downgrades, debt overhangs, and reputational damage with its identification as a Risk of Public Debt Crisis country. This has led to detrimental effects on the economy including currency depreciation, unstable exchange rates, risk of loss of sovereignty, private sector crowding, and income inequality. There is thus an increasing need to maintain sustainable debt; this study explored the alternative of possibly artificially liquidating away some of this debt.

The general objective of the study was to investigate the possibility of public debt liquidation using inflation in Kenya using data from the period 1983-2022 distinguishing domestic from external debt. There were two objectives; (i) Investigate the effect of inflation on domestic and external public debt in Kenya, and (ii) Simulate the impact of a 2% shock inflation on domestic and external debt in Kenya. Time series annual data with forty (40) observations) were used. Afterwards, a shock inflation was incorporated to investigate the impact of sudden macroeconomic changes initiated by targeted policy annunciation or even inflation targeting.

Literature lends support to the possibility of inflation liquidating away inflation, or rather eroding debt through the fisher effect and by eroding the value of real interest payments. The choice to investigate domestic and external public debt separately was informed by literature whose findings indicated that domestic and external debt and congruently in Kenya's case, shorter term and longer-term debt might respond differently to shock inflations. While available literature is concentrated in, and concerns itself with advanced economies including the G7, Euro Countries and the US, this study presents an emerging economy's perspective and makes necessary comparisons of the findings.

The objectives of this study were achieved by running the ARDL and ARDL-ECM model on the first and second objective respectively with the necessary lag selections. The results of both models were tested for the goodness of fit through standard diagnostic tests. The study provides a discussion of the results and makes comparisons to theoretical and empirical expectations according to available literature. A local projection of dynamic forecasts with a horizon period of ten (10) years was undertaken and compared to the dynamic forecasts after a shock to inflation. With an assumption that a five (5)-year period is a fair representative for shorter-medium term period and the ten (10)-year period a fair representation of a longer-term period, this study drew comparison between domestic and external debt and shorter and longer-term public debt. Empirical discussions and comparisons were made to determine consistency with literature and to provide the Kenyan perspective and commence conversation about the possibility of inflation-induced debt liquidation.

5.3 Conclusions

The findings of the study suggest that the liquidating effect of shock inflation on Kenyan debt was generally minimal on domestic debt to GDP ratio which is characterized by its short-term nature.

This is consistent with various literature where the liquidating effect of debt is minimal to almost non-existent with shorter-term debt maturities and more pronounced on longer-maturity debt. Relative to domestic debt, external debt appeared to be more sensitive to inflation-induced erosion, going as far as dissolving external debt entirely, although this study makes no pronouncement that this effect was entirely due to the imposed shock inflation.

It is also noted that in the shorter/medium term, shock inflation might have more detrimental impact in the shorter term and as such, such a shock should be allowed to persist for a longer horizon to realize its potential to liquidate debt_ short term sacrifices for long-term benefits. This means that shock inflation should not be reversed in a short horizon period.

5.4 Contributions to Knowledge

This study contributes to global literature on the role of inflation in liquidating debt. By distinguishing domestic from external debt, this study also gives insight into the different responses of domestic and external debt to a shock inflation as well as its effect in the near and short term. The maturity structure of debt is also discussed including their response to shock inflation.

This novel study introduces empirical evidence into the public debt liquidation using inflation, providing a valuable benchmark for countries with similar to Kenya's economic structure.

5.5 Policy Implications and Recommendations

A few policy implications may be drawn from this study. First, that inflation may not be necessarily bad and may serve as an important fiscal tool in public debt management and may be considered in subsequent Medium-Term Debt Strategies (MTDSs). Government of Kenya may not rush to address inflationary pressures and instead, as a positive externality, benefit from its debt liquidating effects.

Artificial shock inflations may also be explored through the National Treasury's Inflation Targeting Practices (within limits) as a temporary tool to decrease Government of Kenya's real outgoings and to make interest savings on domestic debt, and inflate away some of its debt, albeit minimally. This may however be pronounced in absolute terms by rallying up the share of domestic debt via financial repression where institutions and persons' investments are held captive by the Central Bank with a simultaneous shock inflation to decrease government's real spending on interest payments.

The Central Bank of Kenya should be consulted to decrease real interest rates through its monetary policies, to avoid a situation where a shock inflation induced by fiscal policymakers is inadvertently cancelled by higher real interest rates induced by monetary policymakers. This, however, should be employed with caution, ensuring that this shock is persistent (i.e. not reversed) for the longer term, and that maturities are longer or increased ex-post.

The fiscal policy of inflating away public debt may also be extravagantly employed in addressing external debt burden or overhangs but for a prolonged period.

In using inflation as a debt liquidating tool, fiscal policy should ensure that the shares of external and domestic debt are appropriately balanced and to amass enough longer-maturity debt ahead of imposing a shock inflation.

5.6 Areas for Further Research

This study's objectives were to (i) investigate the effect of inflation on domestic public debt in Kenya, and (ii) investigate the effect of inflation on external public debt in Kenya and further investigated the possibility of using shock inflation to liquidate public debt. Annual data from 1983-2022 were used to model this relationship. While the impact of a 2% shock to inflation was found to be minimal in the case of domestic debt, it may be that higher shocks may be required to

generate larger responses. Further, the debt liquidating power of shock inflation was overall observed to augment in the horizon, necessitating longer horizon forecast to observe its full potential. Due to varying responses in literature over this effect on shorter and longer maturity debt, an exploration of Kenya's debt profile in investigating separate effects of a shock inflation may offer an interesting perspective on Kenya's public finance and public debt management landscape.

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APPENDICES

Appendix I: ARDL-ECM of Domestic Debt to GDP Ratio with an explosive error correction term

RESULTS ARDL(4,4,1,3,3,4) regression

model: ARDL DomesticDebttoGDP PrimaryBalanceSurplustoGDPRatio ImpliedInterestRateonDomesti AnnualAverageInflationRate AnnualGDPGrowthRate SQImpliedInterestRateonDomesti, lags(4 4 1 3 3 4) ec

Sample: 1988 thru 2022		Number of obs = 35 R-squared = 0.9796 Adj R-squared = 0.9306		
Log likelihood = 128.41673		Root MSE = 0.0115		
D.DomesticDebttoGDPRatio	Coefficient	Std. err.	t-statistic	p-value
ADJ				
DomesticDebttoGDPRatio				
L1.	0.0371667	0.0902755	0.41	0.689
LR				
PrimaryBalanceSurplustoGDPRatio	8.80674	22.94574	0.38	0.709
ImpliedInterestRateonDomesti	7.637264	20.3919	0.37	0.716
AnnualAverageInflationRate	20.16074	49.05966	0.41	0.69
AnnualGDPGrowthRate	5.128332	18.28939	0.28	0.785
SQImpliedInterestRateonDomesti	-11.73619	29.35854	-0.4	0.698
SR				
DomesticDebttoGDPRatio				
LD.	-0.6444552	0.2065835	-3.12	0.011
L2D.	-1.042652	0.2306156	-4.52	0.001
L3D.	-0.5163059	0.1705924	-3.03	0.013

Appendix II: ARDL-ECM of Domestic Debt to GDP Ratio with an explosive error correction term continued

D.DomesticDebttoGDPRatio	Coefficient	Std. err.	t-statistic	p-value
PrimaryBalanceSurplustoGDPRatio				
D1.	-0.1336	0.1854	-0.72	0.488
LD.	-0.9671	0.1142	-8.47	0
L2D.	-0.7472	0.10679	-7	0
L3D.	-0.5559	0.08944	-6.22	0
ImpliedInterestRateonDomesti				
D1.	0.12359	0.11019	1.12	0.288
AnnualAverageInflationRate				
D1.	0.73274	0.09411	7.79	0
LD.	0.59742	0.1162	5.14	0
L2D.	0.45806	0.08841	5.18	0
AnnualGDPGrowthRate				
D1.	0.30029	0.34061	0.88	0.399
LD.	0.4979	0.27199	1.83	0.097
L2D.	0.28523	0.18258	1.56	0.149
SQImpliedInterestRateonDomesti				
D1.	-0.2719	0.10069	-2.7	0.022
LD.	-0.3149	0.05114	-6.16	0
L2D.	-0.1031	0.03487	-2.96	0.014
L3D.	0.03361	0.01192	2.82	0.018
_cons	0.07249	0.03538	2.05	0.068

Appendix III: Data Set

Year	Domestic Debt	External Debt	Total Public Debt	Interest Payments on Domestic Debt	Interest Payments on External Debt	Total Revenue	Total Expenditure	GDP	Annual GDP Growth Rate	Annual Average Inflation Rate	Implied Interest Rate on Domestic Interest Rate	Implied Interest Rate on External Debt
1983	670,900,000	1,167,700,000	1,838,600,000			824,300,000	1,190,680,000	3,820,000,000	0.0131	0.1140		
1984	678,500,000	1,531,900,000	2,210,400,000	108,900,000	64,750,000	920,910,000	1,117,890,000	4,219,000,000	0.0176	0.1028	0.1623	0.0555
1985	642,400,000	1,542,580,000	2,184,980,000	121,870,000	74,030,000	1,016,890,000	1,309,090,000	4,810,000,000	0.0430	0.1301	0.1796	0.0483
1986	722,940,000	2,030,900,000	2,753,840,000	175,010,000	91,040,000	1,182,590,000	1,420,800,000	5,874,000,000	0.0718	0.0253	0.2724	0.0590
1987	873,180,000	2,342,730,000	3,215,910,000	198,170,000	102,040,000	1,386,670,000	1,841,790,000	6,559,000,000	0.0594	0.0864	0.2741	0.0502
1988	1,164,390,000	2,690,930,000	3,855,320,000	249,500,000	120,850,000	1,614,310,000	2,012,920,000	7,551,000,000	0.0620	0.1226	0.2857	0.0516
1989	1,241,000,000	2,676,260,000	3,917,260,000	306,870,000	156,890,000	1,887,390,000	2,386,180,000	8,617,000,000	0.0469	0.1379	0.2635	0.0583
1990	1,339,140,000	3,419,000,000	4,758,140,000	33,933,000	160,890,000	2,049,960,000	2,735,590,000	9,939,000,000	0.0419	0.1778	0.0273	0.0601
1991	1,591,890,000	4,458,950,000	6,050,840,000	523,120,000	223,000,000	2,436,820,000	4,098,840,000	11,062,000,000	0.0144	0.2008	0.3906	0.0652
1992	2,233,620,000	6,112,980,000	8,346,600,000	546,120,000	238,850,000	2,788,060,000	4,432,450,000	13,224,000,000	(0.0080)	0.2733	0.3431	0.0536
1993	2,370,160,000	13,604,710,000	15,974,870,000	1,188,790,000	203,870,000	3,476,080,000	6,065,610,000	16,681,000,000	0.0035	0.4598	0.5322	0.0334
1994	3,956,720,000	10,403,560,000	14,360,280,000	2,222,440,000	515,530,000	5,051,680,000	8,977,960,000	20,036,000,000	0.0263	0.2881	0.9377	0.0379
1995	1,533,700,000	12,301,350,000	13,835,050,000	1,294,850,000	473,550,000	6,136,540,000	8,212,900,000	22,785,000,000	0.0441	0.0155	0.3273	0.0455
1996	1,592,860,000	11,672,900,000	13,265,760,000	533,520,000	1,466,040,000	7,171,190,000	9,124,350,000	25,896,000,000	0.0415	0.0886	0.3479	0.1192
1997	27,422,000,000	218,106,400,000	245,528,400,000	405,060,000	1,277,210,000	7,354,190,000	9,129,310,000	623,235,100,000	0.0047	0.1136	0.2543	0.1094
1998	27,295,000,000	231,038,800,000	258,333,800,000	32,037,140,000	7,775,740,000	167,145,810,000	315,037,590,000	690,910,000,000	0.0329	0.0672	1.1683	0.0357
1999	18,665,800,000	310,227,350,000	328,893,150,000	21,409,410,000	7,508,430,000	180,326,710,000	243,008,730,000	742,135,700,000	0.0231	0.0574	0.7844	0.0325
2000	206,127,000,000	395,694,000,000	601,821,000,000	20,752,000,000	8,635,000,000	178,443,000,000	175,119,000,000	967,838,000,000	0.0060	0.0998	1.1118	0.0278
2001	211,812,600,000	393,978,000,000	605,790,600,000	23,232,000,000	7,803,000,000	194,713,000,000	232,921,000,000	1,020,022,000,000	0.0378	0.0574	0.1127	0.0197
2002	235,991,000,000	377,748,000,000	613,739,000,000	23,744,000,000	6,640,000,000	197,768,000,000	226,915,000,000	1,035,374,000,000	0.0055	0.0196	0.1121	0.0169
2003	289,376,970,000	407,053,000,000	696,429,970,000	27,567,000,000	8,459,000,000	210,750,000,000	264,144,000,000	1,131,783,000,000	0.0293	0.0982	0.1168	0.0224
2004	306,234,660,000	443,157,430,000	749,392,090,000	23,281,000,000	6,419,000,000	254,681,000,000	282,187,000,000	1,274,328,000,000	0.0510	0.1162	0.0805	0.0158
2005	315,572,500,000	433,975,650,000	749,548,150,000	23,375,000,000	7,427,000,000	289,802,000,000	303,705,000,000	1,415,823,000,000	0.0591	0.1031	0.0763	0.0168
2006	357,838,950,000	431,236,830,000	789,075,780,000	31,445,000,000	9,664,000,000	313,595,550,000	376,482,000,000	1,622,565,000,000	0.0647	0.1445	0.0996	0.0223
2007	404,690,110,000	396,564,000,000	801,254,110,000	36,860,000,000	5,677,000,000	373,030,000,000	406,752,000,000	1,833,511,000,000	0.0685	0.0976	0.1030	0.0132
2008	430,611,730,000	439,967,000,000	870,578,730,000	42,181,000,000	5,696,000,000	432,220,000,000	534,841,000,000	2,107,589,000,000	0.0023	0.2624	0.1042	0.0144
2009	518,346,150,000	535,143,700,000	1,053,489,850,000	45,949,000,000	6,109,000,000	487,893,000,000	595,598,000,000	3,275,642,000,000	0.0331	0.0923	0.1067	0.0139
2010	660,267,680,000	565,452,000,000	1,225,719,680,000	58,438,000,000	6,341,000,000	586,377,000,000	791,793,000,000	3,597,630,000,000	0.0806	0.0396	0.1127	0.0118
2011	764,222,800,000	722,888,310,000	1,487,111,110,000	69,209,000,000	6,989,000,000	660,764,000,000	817,089,000,000	4,162,514,000,000	0.0512	0.1402	0.1048	0.0124
2012	858,829,550,000	774,550,000,000	1,633,379,550,000	82,339,000,000	8,880,000,000	690,732,000,000	915,888,000,000	4,767,191,000,000	0.0457	0.0938	0.1077	0.0123
2013	1,050,628,570,000	843,562,270,000	1,894,190,840,000	94,513,540,000	11,335,230,000	822,666,960,000	1,263,371,950,000	5,311,322,000,000	0.0380	0.0572	0.1100	0.0146
2014	1,284,327,250,000	1,085,928,570,000	2,370,255,820,000	119,193,050,000	14,934,320,000	969,162,150,000	1,281,162,820,000	6,003,835,000,000	0.0502	0.0688	0.1134	0.0177
2015	1,420,444,380,000	1,408,613,590,000	2,829,057,970,000	139,727,920,000	29,289,050,000	1,083,161,900,000	1,605,406,320,000	6,884,317,000,000	0.0497	0.0658	0.1088	0.0270
2016	1,815,470,500,000	1,803,256,300,000	3,618,726,800,000	172,857,040,000	30,510,020,000	1,222,014,740,000	1,776,768,410,000	7,594,064,000,000	0.0421	0.0630	0.1217	0.0217
2017	2,111,710,440,000	2,294,735,880,000	4,406,446,320,000	212,865,240,000	53,520,420,000	1,397,100,240,000	2,163,721,810,000	8,483,396,000,000	0.0384	0.0801	0.1173	0.0297
2018	2,478,835,090,000	2,560,199,430,000	5,039,034,520,000	239,469,900,000	84,420,240,000	1,487,227,070,000	2,111,458,890,000	9,340,307,000,000	0.0565	0.0469	0.1134	0.0368
2019	2,785,483,130,000	3,023,139,470,000	5,808,622,600,000	264,832,380,300	103,717,570,000	1,644,673,317,000	2,389,528,741,000	10,237,727,000,000	0.0511	0.0524	0.1068	0.0405
2020	3,178,421,280,000	3,515,810,780,000	6,694,232,060,000	315,361,942,700	121,840,089,500	1,733,631,111,000	2,565,443,502,000	10,716,034,000,000	(0.0027)	0.0540	0.1132	0.0403
2021	3,697,093,180,000	4,015,299,380,000	7,712,392,560,000	388,829,563,600	106,312,318,400	1,738,384,623,000	2,706,297,552,000	12,098,200,000,000	0.0759	0.0611	0.1223	0.0302
2022	4,288,332,960,000	4,290,775,570,000	8,579,108,530,000	456,848,608,200	120,811,740,000	2,199,807,769,000	3,023,183,147,000	12,761,190,160,000	0.0485	0.0766	0.1236	0.0301