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Gross domestic product, savings, investment and inflation, an ARDL approach and Toda-Yamamoto causality: Evidence from Zimbabwe

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A B S T R A C T

This study examined the causal relationships between inflation, Gross Domestic Product (GDP), domestic savings, and investment in Zimbabwe using Toda-Yamamoto causality tests and the Autoregressive Distributed Lag (ARDL) approach with secondary data spanning from 1990-2022. The Granger causality analysis revealed a bidirectional causal effect between inflation and GDP, indicating that inflation significantly impacts the country's economic growth. Additionally, the analysis showed a unidirectional causal relationship from inflation to domestic savings, suggesting that high and persistent inflation can erode the value of existing savings and discourage individuals from saving. Furthermore, the study found a distinct causal flow from savings to investment, without feedback in the opposite direction, highlighting the crucial role of a robust savings culture in providing the necessary foundation for sustained investment and economic growth. The ARDL approach provided further insights into the dynamic relationships between these variables. In the short run, lagged GDP and current and lagged savings positively influenced GDP, while the second lag of savings had a negative impact, supporting the Carroll-Weil hypothesis that savings typically follow, rather than precede, economic growth in the short run. The analysis also found a positive short-run and long-run relationship between investment and GDP, supporting the view that investment is an important factor of economic growth. The study recommends that the policy makers can leverage the synergies between savings, investment, and inflation management to foster sustained economic growth and development in line with the government development policies. Developing policies to attract savings and reduce the cost of savings, as well as promoting long-term savings over transactional savings, can increase the country's overall savings base.

1. Introduction

In today's world, economic growth is a critical aspect of most economies. Citizens desire a higher standard of living, and legislators are eager to deliver that level through economic growth (Abasimi, & Martin, 2018). In 2008, the hyperinflationary environment had a chilling effect on both domestic and foreign investors, as investors became wary of the high levels of risk and uncertainty associated with investing in Zimbabwe. More recently, the introduction of the Zimbabwe Gold Currency (ZiG) in 2024 as a domestic currency was intended to improve the investment promotion although it might be too early to realize its effect on investment, the country is still among developing nations with low investment and savings. The rapid erosion of the value of the ZiG, coupled with economic instability, led to a sharp decline in the ability and willingness of individuals and businesses to save. High inflation rates and ongoing economic uncertainty have continued to discourage both domestic and foreign investment, as investors remain cautious about the long-term viability of the Zimbabwean economy, (Edeme & Ifelunini, 2015; Barro, 1990). According to ZIMSTATS, the inflation rate in Zimbabwe was 57.5% between April 2023 and April 2024, a year on year increase. This, in turn further exacerbated the

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country's economic challenges, as the lack of investment hindered the development of new industries, infrastructure, and technologies that could have helped to drive economic growth and mitigate the impact of inflation. In addition, the economy experienced a relatively low growth rate due to external shocks such as the Russia- Ukraine war and the Middle East war between Palestine and Philippians.

With savings rates plummeting, the pool of available capital for investment also dwindled, further hampering the country's economic prospects. Igbatayo and Agbada (2012) pointed out that higher investment through the multiplier effect drives higher aggregate demand which in turn accelerates economic growth. Standing with endogenous growth models, they predict that an increase in savings rate increases economic growth through its positive impact on investment and capital accumulation. In addition, Ramsey's Optimal Growth model postulates that increased saving leads to an increase in national income and consequently accelerates investment process. Soylu et al. (2019) further argues that the degree of savings in each society is a crucial element in determining economic progress. However, increase in investment can only induce growth in the short-run while in the long-run there may be little or no impact on economic growth. In contrast with the conventional hypothesis of saving led growth postulated by classical growth models, Carroll Weil Hypothesis by Carroll and Weil (1994) argues that saving typically follows rather than precedes economic growth. On the other side, the new growth theories reaffirm that capital accumulation, as a component of aggregate demand and vehicle for creation of productive capacity, is a key driver of long-run economic growth and high saving and investment are crucial in determining growth due to their strong positive correlation with GDP growth rates

The post- COVID-19 pandemic has further exacerbated the challenges faced by Zimbabwe's savings and investment environment (Muzvidziwa et al., 2020). According to ZIMSTATS (2022), the economic disruptions caused by the pandemic have led to a decline in household incomes to 32% as of 2022 from 27% as of 2020 and business profitability average profit margins for small and medium enterprises (SMEs) dropped by 41% in 2022 compared to 2019. Despite the government's efforts to introduce a new local currency in 2024, the link between savings, inflation, investment and GDP remains fragile. This interplay of economic variables is particularly important in the context of Zimbabwe, where these factors often play a crucial role in shaping the trajectory of economic growth and development. Zimbabwe, a country that has faced significant economic challenges since its independence in 1980, provides a compelling case study for understanding the complex dynamics between these variables. Addressing the complex interplay between savings, investment, inflation, and GDP in Zimbabwe will require a comprehensive and sustained effort by the government, financial institutions, and the broader Zimbabwean society. Measures to stabilize the currency, promote long-term savings, attract domestic and foreign investment, and drive economic diversification and growth will be crucial in order to put Zimbabwe on a path towards sustainable economic development and prosperity.

The relationship between saving, investment, inflation, and economic growth has been the subject of extensive empirical research around the world. These macroeconomic variables are crucial for achieving price stability, promoting employment, and contributing to economic growth. However, the linkages among these variables remain ambiguous, with Nailufar et al. (2023) supporting the classical growth theory that shaving promotes economic growth through investment, while Okafor and Ugochukwu (2021) support the Carroll-Weil hypothesis. In the past, developing countries like Zimbabwe relied heavily on official development assistance (ODA) or foreign aid as a source of development finance. However, this trend has shifted towards the mobilization of domestic savings, as external finance has been proven ineffective in reducing credit constraints in these economies. The complex interplay between savings, investment, inflation, and GDP in Zimbabwe has created a vicious cycle that has severely hindered the country's economic development and prosperity. The high and volatile inflation rates have eroded the value of local currency undermining the incentive to save and invest. The lack of a stable and reliable savings and investment environment has, in turn, had a direct impact on Zimbabwe's GDP growth, which has remained sluggish and stagnant for much of the period since 1980 (Bonga et al., 2017).

Despite different ways to mobilize savings, savings mobilization has not been enough to stimulate the investment and growth of the economy and this raises the question on the ability to stimulate growth in conjunction with policies implemented by the government in harnessing savings. However, in the context of Zimbabwe, there are very few empirical studies that relate saving, investment, inflation and economic growth, and those that do commonly over-rely on a bivariate Granger causality separately between saving and economic growth, or between saving and investment, or economic growth and inflation which may suffer from the omission of variable bias. The current study joins the debate into the inquiry of the direction of causality among saving, investment, inflation and economic growth in the context of Zimbabwe by using Autoregressive Distributed Lag (ARDL) bounds testing approach to cointegration and Toda-Yamamoto causality framework. Knowledge about the relationship among these three variables is important in terms of guiding economic policy making in Zimbabwe. The study aims to investigate the dynamic interactions and causal linkages between GDP and savings, investment, and inflation to understand the short-run and long-run dynamics of these variables and also to identify the direction of causality between GDP, savings, investment and inflation among the variables.

2. Literature review

The Keynesian model focuses on the interplay between Aggregate Demand and Aggregate Supply. In the short-run, the Aggregate Supply curve slopes upwards, rather than being vertical. This means that changes in Aggregate Demand can lead to changes in both prices and output. As a result, the Keynesian model suggests a positive adjustment path between inflation

and growth in the short-run. This is because increases in Aggregate Demand led to higher inflation and higher output growth. However, this positive relationship later turns negative as the adjustment process continues. However, Solow (1956), offers different perspectives on the inflation-growth nexus. The model posits that technological change is the primary driver of long-term growth and is exogenously determined. Therefore, they believed that inflation and growth exhibit no relationship, as both are assumed to be independent of each other. However, Tobin (1965), building on Solow's work, included the assumption that money acts as a store of value in the economy. According to Tobin's model, a rise in inflation motivates people to hold more money instead of interest-bearing assets. This, in turn, stimulates economic growth, suggesting a positive relationship between inflation and growth.

The Carroll-Weil hypothesis offers a concise and compelling explanation of the interrelationships between savings, inflation, investment, and GDP. At its core, the theory posits that higher inflation leads to lower personal savings rates, as individuals become less inclined to save when the real value of their savings is eroded by rising prices. As people anticipate their savings to lose purchasing power due to high inflation, they are more likely to spend their income rather than set it aside, resulting in a decline in the overall savings rate. The implications of this savings-inflation dynamic are far-reaching. When savings rates decline, as the theory suggests, the pool of available capital for investment also shrinks. Businesses and entrepreneurs rely on this pool of savings to finance new projects, expand operations, and invest in technology and innovation. A smaller savings base, therefore, can constrain the economy's ability to channel resources towards productive investment activities. The Carroll-Weil hypothesis further links this investment-savings relationship to economic growth, as measured by GDP. By proposing that lower savings lead to reduced investment, the theory suggests that this decline in capital formation can limit the economy's capacity for sustained growth. Insufficient investment in areas such as infrastructure, research and development, and productivity-enhancing technologies can hinder the economy's ability to increase its output and achieve higher levels of GDP over time. Additionally, the Carroll-Weil hypothesis builds upon the broader concept of the permanent income hypothesis which explains why individuals may not immediately adjust their spending patterns in response to short-term fluctuations in their income, but rather aim to smooth their consumption over time.

Empirically, using the ARDL approach to investigate the determinants of gross domestic savings (GDS), most of the studies in different countries have concluded that inflation has a significant negative impact on the country's savings rate. The researchers explain that high and persistent inflation erodes the purchasing power of the local currency, leading individuals and households to shift their savings away from the domestic currency and into more stable assets, resulting in a decline in the overall level of GDS (Nagawa et al., 2020; Girma, 2017; Odhiambo, 2007; Galí et al., 2007).

Coban and Yussıf (2019) examined the relationships between economic growth, foreign direct investment and inflation: ARDL models approach for the case of Ghana. Applying Autoregressive Distributed Lags models and the Toda and Yamamoto (1995) causality test to analyze the relationships as well as the causality properties among various pairs of Ghana’s inflow of Foreign Direct Investment (FDI), Inflation and Economic growth for the period1980 to 2017 found that inflation relates inversely with both Economic growth and inflows of Foreign Direct Investment.

Studies from Arooj and Sajid (2022), Pradhan et al. (2024) in Pakistan used the ARDL approach to examine the impact of inflation on savings and investment, and their subsequent effects on GDP growth. The researchers found that inflation has a negative impact on both savings and investment, which, in turn, affects the country's GDP growth. They suggest that policymakers should focus on reducing inflationary pressures and promoting financial inclusion to enhance the mobilization of savings and the efficient allocation of investment, ultimately supporting sustainable economic development.

The studies generally found that inflation has a negative and statistically significant impact on economic growth. The researchers argue that high inflation can lead to a decline in the competitiveness of exports, as the prices of domestic goods and services become less attractive to foreign buyers, ultimately affecting the country's GDP growth.

3. Methodology

This section presents the methodology used for this study. It explains the adopted methods and some traditional prerequisites to make sure that the methodology produces unbiased results. Marovanidze (2014) warned against the tendency to adopt models from transitional and developed industries before initially evaluating their applicability and acceptance of evidence in the context of emerging countries. In this regard, the current study employs the ARDL cointegration technique, or the bounds cointegration technique, developed by Pesaran et al. (1999, 2001). The ARDL model is an OLS-based approach that can handle variables with mixed orders of integration, providing more flexibility compared to other methods. The ARDL model assumes the dependent variable is a function of its own lags as well as current and past values of the independent variables, making it a dynamic model. The ARDL approach is considered more appropriate when dealing with small sample sizes and when there is a single long-run relationship between the variables (Shrestha and Bhatta, 2018). The model is then called distributed lag model which is a dynamic model since the effect of the repressor on the dependent happens over time and not only in the same time of the repressor (Shrestha and Bhatta, 2018). Within the ARDL model each underlying variable stands as a single equation, thus making endogeneity less of a problem Pesaran et al. (1999). The ARDL is therefore free of residual correlation, i.e., all variables are assumed to be endogenous.

To assess the integration orders of the variables, the study uses the Augmented Dickey-Fuller (ADF) unit root test. In this direction, in order to be able to conduct a healthy analysis and to show whether or not the series is I(0), identifying that unit root exists has a great importance. For this purpose, the unit root test of ADF was utilized. In order to test whether there is any cointegration relationship between the variables an ARDL (boundary test) approach developed by Pesaran et al. (2001) was used. In this direction, ARDL version of the relevant long-run model can be adopted from Perihan et al., (2014) as follows:

$$\Delta S_t=\alpha_0+\sum_{i=1}^{p}\alpha_{1i}\,\Delta S_{t-i}+\sum_{i=0}^{p}\alpha_{2i}\,\Delta G_{t-i}+\sum_{i=0}^{p}\alpha_{3i}\,\Delta P_{t-i}+\sum_{i=0}^{p}\alpha_{4i}\,\Delta R_{t-i}+\theta_1 S_{t-1}+\theta_2 G_{t-1}+\theta_3 P_{t-1}\;\theta_4 R_{t-1}+\mu_t \quad (1)$$

In the above model, *S* represents saving rate, *G* the rate of economic growth, *P* inflation rate, and *R* interest rate. However, Δ is a difference operator, *p* lag length, and *u* error term.

The current study modified the above model to suit the current study as follows,

$$\Delta I_t=\alpha_0+\sum_{i=1}^{p}\alpha_{1i}\,\Delta I_{t-i}+\sum_{i=0}^{p}\alpha_{2i}\,\Delta GDS_{t-i}+\sum_{i=0}^{p}\alpha_{3i}\,\Delta CPI_{t-i}+\sum_{i=0}^{p}\alpha_{4i}\,\Delta GDP_{t-i}\theta_1 I_{t-1}+\theta_2 S_{t-1}+\theta_3 CPI_{t-1}+\theta_4 GDP_{t-1}\varepsilon_t \quad (2)$$

The above-described model is multivariate, with *I* denoting investment measured by capital expenditure, GDS denoting savings, CPI denoting hyperinflation.

Causality model

The directional causality between savings, inflation, and investment is examined using the Toda and Yamamoto (1995) causality test. This is because the Granger causality test is based on the asymptotic idea which suggests that the critical values are only applicable to stable variables and their long-run co-integrating relationship is not bound together and therefore the Toda and Yamamoto (1995) causality test is recommended over the Granger test. This suggests that the Granger causality test results are somewhat shaky and dependent on the model's variables not co-integrating. The Toda and Yamamoto (1995) causality test is appropriate in light of these drawbacks with the conventional Granger causality test and without reliance on the stationary of variables or order of integration of variables. The purpose of this is to account for any co-integration. Consequently, the following VARs can be used to investigate the causal relationship between savings, investment, and inflation.

$$I_t = \alpha_1 + \sum_{i=1}^{k}\beta_1\, I_{t-l} + \sum_{i=1}^{k}\beta_2\, GDS_{t-l} + \sum_{i=1}^{k}\beta_3\, CPI_{t-l} + \sum_{i=1}^{k}\beta_2\, GDP_{t-l} + \varepsilon_{t1} \quad (3)$$

$$GDS_t = \alpha_2 + \sum_{i=1}^{k}\beta_4\, GDS_{t-l} + \sum_{i=1}^{k}\beta_5\, I_{t-l} + \sum_{i=1}^{k}\beta_6\, CPI_{t-l} + \sum_{i=1}^{k}\beta_2\, GDP_{t-l} + \varepsilon_{t2} \quad (4)$$

$$CPI_t = \alpha_3 + \sum_{i=1}^{k}\beta_6\, CPI_{t-l} + \sum_{i=1}^{k}\beta_7\, I_{t-l} + \sum_{i=1}^{k}\beta_8\, GDS_{t-l} + \sum_{i=1}^{k}\beta_2\, GDP_{t-l} + \varepsilon_{t3} \quad (5)$$

$$GDP_t = \alpha_3 + \sum_{i=1}^{k}\beta_6\, GDP_{t-l} + \sum_{i=1}^{k}\beta_7\, I_{t-l} + \sum_{i=1}^{k}\beta_8\, GDS_{t-l} + \sum_{i=1}^{k}\beta_2\, CPI_{t-l} + \varepsilon_{t4} \quad (6)$$

In these equations, *I, GDS, GDP* and *CPI* represent investment as measured by capital expenditure, savings measured as gross domestic savings, *GDP* denote gross domestic product and *CPI* measuring inflation. The model constraints are , $\alpha_1$and α_3 whilst $\beta_1$to β_8 are parameter coefficients termed model restrictions. The above equations are unrestricted since they include lagged values of both the dependent and independent variables on the right side.

Post Vector Autoregressive Analysis

According to Gujarati and Porter (2008) and Enders et al. (2020) understanding the impact of impulse response functions and variance decompositions on the outcomes of the estimated vector autoregressive models is necessary as a result of the specification and estimation of vector auto-regression models. As a result, the study calculates variance decomposition and impulse response functions.

Impulse Response Function Analysis

According to Rujiravanich (2015) the purpose of impulse response functions is to show the path taken by variables during their reactions. In the current study, impulse response functions show the trajectory of endogenous parameters such as Gross

Domestic Product (GDP), capital expenditure (investment), gross domestic savings and consumer price index (inflation) in response to a single unit of standard deviation of external shocks. The Covid-19 pandemic's effects, Russia's and Ukraine conflict and any other factors that are included in the system's error terms, which are presumed to follow a white noise process (independently and identically distributed), are examples of these external shocks. As a result, impulse response functions explain how variables in the model respond over time to external forces (Insel, Ogundipe et al., 2019; Enders et al., 2020).

Variance Decomposition

Variance decompositions are significant because they aid in providing multi-equation time series models with a more intuitive interpretation (Gumus et al., 2018). While variance decomposition reveals the contribution of shocks in the dependent variable attributable to explanatory factors, impulse response function analysis tracks the consequences of shocks on a single dependent component on the other variables in the VAR system (Enders et al., 2020). Thus, variance decompositions demonstrate the amount of information that each particular variable in the vector autoregressive system imparts to the other variables.

Data source

The study utilizes time series secondary data to analyse the link among savings, investment, inflation and GDP. Data for savings, investment, and GDP are from the World Bank Development Indicators database accessed in 2024. Inflation data were collected from the Reserve Bank of Zimbabwe online database accessed 2024. The observation period of the statistics is set to an annual interval spanning from 1980 to 2023.

4. Results presentation and discussion

Descriptive statistics

The descriptive statistics presented in Table 1 provide insights into the characteristics of the variables used in this study for the period 1980 to 2023. The mean investment, as measured by the capital expenditure to GDP ratio is 0.94, indicating a relatively low level of investment on average. However, the standard deviation of 1.23 suggests a high degree of volatility in investment. Both domestic and foreign investments assumed larger positive net outflows during the study period, as indicated by positive skewness of 2.63. This implies that both domestic and foreign investors withdrew more investment processes than they invest. This is further supported by the above-average kurtosis of 3.23, which indicates a leptokurtic distribution.

Inflation, as measured by the Consumer Price Index (CPI) exhibits significant volatility with a standard deviation of 140.72 from the mean. The range of inflation values is also quite wide, with a minimum of 27% and a maximum of 604%, indicating substantial fluctuations in the price level. The positive skewness of 2.83 suggests that there were more observations of higher inflation values than lower ones. The kurtosis of 10.44 indicates a mesokurtic distribution. This implies that investors in Zimbabwe experienced low returns due to the volatile nature of inflation during the study period.

The savings data exhibits different skewness and kurtosis characteristics compared to inflation but is slightly similar to investment. The kurtosis value of 2.1 and negative skewness of -0.45 suggest a leptokurtic distribution, indicating that the savings data has a shape closer to a normal distribution, with a lower peak and shorter tails compared to a leptokurtic distribution. Data for GDP indicates kurtosis and skewness of 3.28 and -0.13 respectively suggest a leptokurtic distribution. The range of GDP values is also quite wide, with a minimum of 17% and a maximum of 21%, indicating low output level.

Table 1
Descriptive statistics

	GDP	GDS	CPI	INV
Mean	2.044757	6.713709	55.35762	0.944686
Median	2.023650	10.13632	2.712950	0.699034
Maximum	21.45206	22.09126	604.9459	6.940053
Minimum	-17.66895	-21.46003	-27.04865	-0.452540
Std.Dev	8.253833	11.60382	140.7246	1.269533
Skeweness	-0.131950	-0.448171	2.833977	2.639177
Kurtosis	3.279272	2.106274	10.44153	13.07515
Jarque-Bera	0.252211	2.737051	149.4827	221.0065
Probability	0.881522	0.254482	0.000000	0.000000
Observations	41	41	41	41

Unit root test

The results of the augmented dickey fuller (ADF) tests are presented in Table 2. These results reveal that the variables are integrated at different orders therefore an ARDL Bound test is the most appropriate method. Investment and GDP are

stationary at levels I(0), while the rest of the variables are stationary after differencing them once I(1). With different stationarity of the variables validated, the determination of co-integration could be performed.

Table 2
Unit root test ADF

Variable	ADF value	Probability value	5% level	Order of integration	Conclusion
INV	-4.088475	0.0027	-2.936942	I (0)	Stationary
CPI	-2.311350	0.0219	-1.949856	I (1)	Stationary
GDS	--9.297984	0.0000	-2.938987	I (1)	Stationary
GDP	-3.769809	0.0065	-2.936942	I (0)	Stationary

Another diagnostic test

Nasrullah et al. (2021) argue that to ensure the estimated model is robust and unbiased, the study should determine the goodness of fit of the model and conduct diagnostic tests. This involves examining the variance in the regressed function explained by exogenous variables as well as conducting residual diagnostics to assess whether the residuals are independently distributed and to minimize errors when running regression models. Regarding serial correlation, Greene (2018) and Asteriou and Hall (2007) emphasize the importance of ensuring the residuals are randomly distributed over the sample when conducting ARDL and Toda-Yamamoto models. The current study subjected the short-run model to normality, serial correlation, and heteroscedasticity tests, and found no evidence of abnormality indicating the model passed the Jarque-Bera normality test and the errors are normally distributed. Additionally, the study was unable to reject the null hypothesis of no serial correlation based on the LM test, and found no evidence of serial correlation or heteroscedasticity in the disturbance of the error term. Overall, the diagnostic tests suggest the estimated model is robust, with no issues detected in the residuals.

Diagnostic test	**P-value**	**Critical value**	**F-value**	**Conclusion**
Ramsey test	0.3900	0.05	0.082626	The model is correctly specified
Serial LM test	0.8829	0.05	0.218197	There is no autocorrelation
Hetreoskedersticity	0.1670	0.05	0.5134	The residuals are homoscedastic

Stability test

The current study conducted the CUSUM and CUSUMSQ tests to investigate the stability of the long-run and short-run coefficients as suggested by Pesaran et al. (1999). The plots of the two graphs indicating the stability of the coefficients are presented in Fig. 1 and Fig. 2 and show the CUSUM and CUSUMSQ tests respectively. For both stability tests the graphs confirm that the investment lay between the critical boundaries at the 5 percent level of significance. Following all the diagnostic tests passed by the model, the stability checks further confirmed the good fit of the ARDL model and the accuracy of the long-run and short run coefficients, which had an effect on investment for the period 2009-2017.

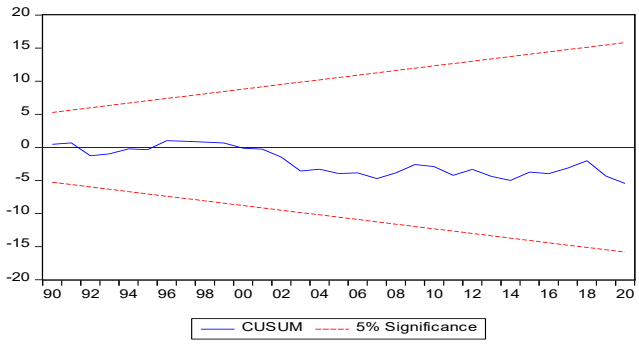

Fig. 1. CUSUM Test

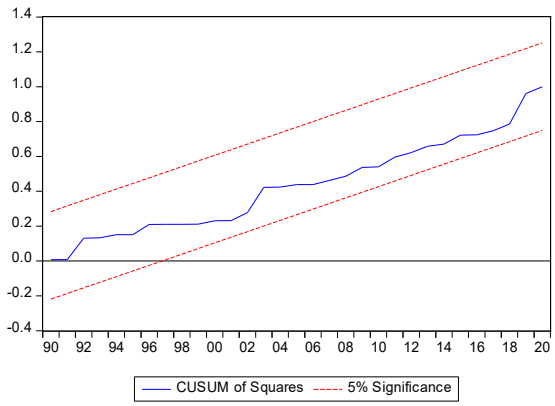

Fig. 2. CUSUMSQ Test

Cointergration test

The absence of I (2) variables in the model sustains the researchers to test for long run relationships among investment, savings and inflation. The ARDL bound test approach is applied following Pesaran et al. (2001). Values of the upper and lower bounds are basic in choosing if there is existence of a long run association. K addresses the quantity of autonomous variables in the model (that is the number of regressors). At 5% significance level the F-statistics is higher than the lower bound and upper bound values and this gives space to infer that there is a long run relationship between the variables.

	Bound test cointergartion			
F-Bounds Test		Signif.	I_0 Bound	I_1 Bound
Test Statistic	Value	10%	2.37	3.2
		5%	2.79	3.67
		2.50%	3.15	4.08
F-statistic	6.26508	1%	3.65	4.66
K	3			

Impulse response function

Gujarati and Porter (2012) state that in order to comprehend the idea of how disturbances to one parameter affect a different factor in the Vector Autoregressive framework, the researcher must employ reactive curves. The results of impulse response functions are displayed in Fig. 3. The impulse response function's findings indicate that it takes nine and half months for GDP and inflation to reach equilibrium thus it signals a long-run dynamics. Savings and investment take eight months until long-term equilibrium is attained and the effect is mitigated. Moreover, it takes 9 months for the effect of savings and investment for a long-term equilibrium to be attained. Long-term equilibrium dynamics can also be seen in responses to savings triggered by external shocks, such as speculative shocks or shocks to consumer confidence. However, the impulse response functions of GDP, investment, inflation and savings suggest that the current study is limited to long-term dynamics, with reactions lasting for more than 9 months. Regarding this, the initial direction of reactions (positive or negative) is largely determined by the shock source and response variable of the vector autoregressive system.

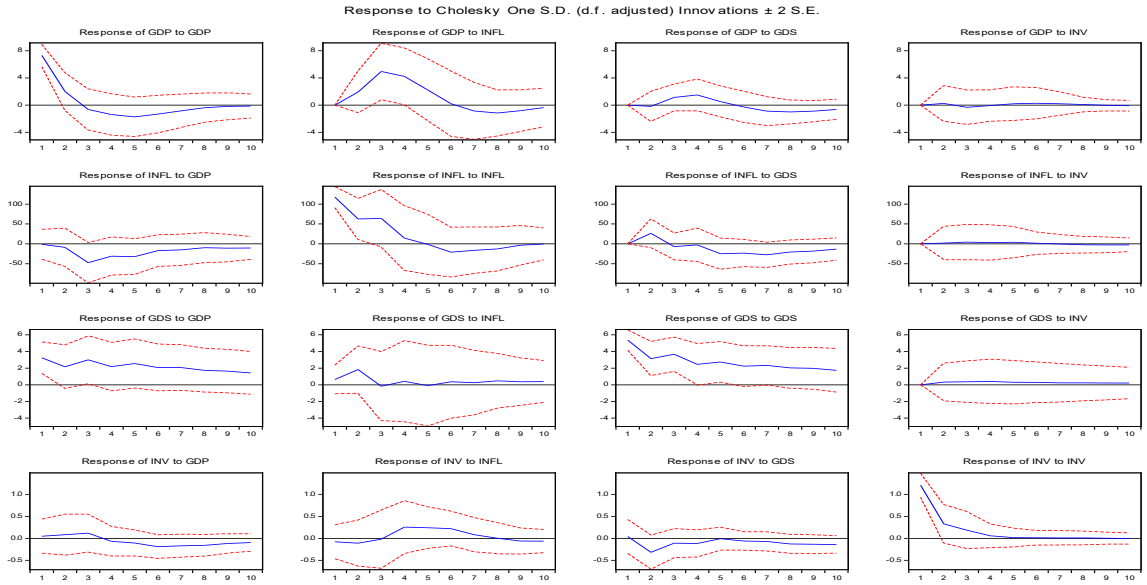

Fig. 3. Impulse Response

Lag length criteria

As noted by Brooks (2008), AIC is efficient yet not dependable while SIC is not viable yet firmly reliable. Moreover, Diebold (2017) and Greene (2003) put forward that the AIC has the flaw of overfitting a model as time increases to infinite while the SIC has the result of under-parameterizing models in small samples. In this manner, utilizing universal insight, trade-off between consistency and efficiency is preferable. Considering the recently referenced conflicts, we use both AIC and SIC ways of choosing the right lag length for the model. When the AIC results conflict with the results from SIC criteria, the study chooses a lag length two which is chosen by SIC and HQIC. This is supported by the findings from Koehler and Murphree (1988) who show that when AIC and SIC yield conflicting results, SIC is a better option. Therefore, lag length 2 which is chosen by the SIC and HQIC is used in this study.

Table 4
Lag length criteria

Lag	AIC	SC	HQ
0	-2.780084	-2.698388	-2.747098
1	-9.696388	-9.279911	-9.564440
2	-9.851788	-9.369601*	-9.620880*
3	-9.862243*	-9.045276	-9.532375

Variance decomposition

To find out how much of variance in each endogenous variable is accounted for by its own equation and other equations in the vector autoregressive system, this study employed variance decomposition. Presented in Table 5 are the variance decomposition results.

Table 5
Variance decomposition

Period	S.E.	GDP	GDS	INFL	INV
1	7.303901	100	0	0	0
2	7.820517	93.70116	0.005385	6.197268	0.096187
3	9.348017	66.03996	3.331685	30.4508	0.177549
4	10.45489	54.53967	6.287798	39.02704	0.145491
5	10.84955	53.2002	6.37407	40.2541	0.171626
6	10.93917	53.80461	6.322908	39.64044	0.232046
7	11.04467	53.36342	7.010052	39.36187	0.264661
8	11.15811	52.39793	7.911273	39.42634	0.264453
9	11.22593	51.79402	8.589446	39.35445	0.262088
10	11.25072	51.58285	8.903378	39.24526	0.268518
Variance Decomposition of GDS					
Period	S.E.	GDP	GDS	INFL	INV
1	6.3125	0	73.51119	26.48881	0
2	7.61401	3.595955	69.86706	26.3479	0.189085
3	8.97567	3.033065	66.55581	30.10205	0.309068
4	9.576784	2.683593	65.2176	31.64264	0.45616
5	10.28946	2.500144	63.47241	33.5461	0.481347
6	10.74271	2.303103	62.65584	34.52439	0.516671
7	11.19157	2.122312	62.10099	35.25594	0.520754
8	11.51947	2.045428	61.85975	35.56179	0.533033
9	11.81002	1.959867	61.73129	35.76929	0.539556
10	12.03123	1.911793	61.65484	35.88295	0.550416
Variance Decomposition of INFL					
Period	S.E.	GDP	GDS	INFL	INV
1	117.4515	0.009796	1.393624	98.59658	0
2	136.0253	0.438732	7.206466	92.33491	0.01989
3	157.9933	9.369588	5.34452	85.20135	0.084544
4	161.7024	12.60123	5.104382	82.17165	0.12274
5	166.7973	15.54817	7.036215	77.23987	0.175744
6	170.6064	15.87402	9.004698	74.94629	0.174991
7	174.2352	15.96333	11.47821	72.39051	0.167945
8	176.1979	15.90242	12.79067	71.12822	0.178696
9	177.5114	16.04765	13.66986	70.086	0.19649
10	178.315	16.2451	14.07857	69.4606	0.215727
Variance Decomposition of INV					
Period	S.E.	GDP	GDS	INFL	INV
1	1.212156	0.167622	0.069298	0.472518	99.29056
2	1.302531	0.54563	6.33327	0.701601	92.4195
3	1.325745	1.314364	6.806989	0.67877	91.19988
4	1.358	1.498082	6.887677	4.508773	87.10547
5	1.383802	2.021102	6.654251	7.421132	83.90352
6	1.415624	3.719978	6.417023	9.680684	80.18232
7	1.429834	5.03597	6.470654	9.891855	78.60152
8	1.444213	6.153061	7.085442	9.712934	77.04856
9	1.45631	6.68832	7.886261	9.651373	75.77405
10	1.467626	7.01564	8.766016	9.607364	74.61098
Cholesky Ordering: GDP GDS INFL INV					

In the short run, the 100% focus error variance in GDP can be explained by itself, according to the results in Table 5 and other variables have no strong effect. Inflation strongly affects both short run and long run variation starting in the second period and continuing through the end of the period. Inflation has a greater impact on GDP than GDS and investment, with 39.2% and GDS with 8.9% impact whereas investment constitutes 0.23%. Variance decomposition of GDS is showing that in the short term GDS variance can be described by itself to a degree of 73.5% with no effect from other variables. Inflation has a significant impact on both the short run and the long run from the second period until the end of the period variance. GDS contributes 61.7% with inflation having a higher contribution of 35.9% compared to investment with 0.55% and GDP with 1.9%. In the short term, 98.59% of the focus error variance in inflation can be explained by itself and other variables have no bearing effect. GDP strongly affects both short run and long run variation from the second period to the end of the period. Inflation contribution is 69.46%. GDP contribution is 16.24% and investment contribution is 0.22%. Considering investment in the short run, 99.29% of the focus error variance can be explained by itself whereas other variables have no effect. Inflation strongly affects both the short run and long run variation from the second period to the end of the period

with 9.6%. GDP contribution is 7%. In conclusion, inflation has a bigger overall impact on GDP, GDS and investment, GDP has a strong impact on inflation.

Table 6
Long run ARDL Results

Variable	Coefficient std. error	Std. Error	t-statistics	Prob
INFL	-6.7253	1.01611	3.0421	0.0052*
GDS	-2.0442	1.425859	0.0024	0.0072*
GDP	4.5204	1.0351	0.3202	0.4310
INV	0.6825	0.558744	0.70462	0.0024

Table 7-Short run ARDL Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
GDP(-1)	0.079247	0.187488	0.422678	0.6761
GDP(-2)	-0.573314	0.194817	-2.942836	0.6019
GDS	0.579048	0.192282	3.011445	0.0059
GDS(-1)	0.062967	0.250464	-0.2514	0.036
GDS(-2)	0.138022	0.22842	0.604247	0.0511
GDS(-3)	0.116679	0.255694	0.456323	0.6521
GDS(-4)	0.55284	0.26164	-2.112979	0.4048
INFL	-0.015621	0.011149	-1.401037	0.0135
INFL(-1)	-0.027707	0.015362	1.803617	0.0034
INFL(-2)	0.04132	0.014356	2.878291	0.8001
INV	1.047968	0.99468	1.053573	0.0322

From the presented results, the GDP lagged period has a positive influence on the current period. In the case of GDS at level and at lag 1 positively influence GDP but the second lagged period has a negative influence on GDP. At level and first lag, GDS jointly influence GDP. This is evident from statistically significant coefficient of saving (and F-test) and the coefficient of the lagged variables. This finding is consistent with Carroll-Weil hypothesis (Carroll and Weil, 1994), which states that saving typically follows, rather than precedes, economic growth. However, in the long-run, the negative and statistically significant coefficient of the variables in the economic growth function provides evidence that saving affects economic growth. This finding not only supports the central idea of the Lewis's (1955) traditional theory that increasing saving would accelerate economic growth and the endogenous growth models' advocacy that higher saving boosts steady-state output in the economy (Harrod, 1939; Solow, 1956) but it is also consistent with Kalebe (2015), who concluded that saving precedes and drives some short-term and long-term economic growth in Lesotho. Policies aimed at enhancing economic growth in Zimbabwe should stimulate and spur meaningful saving levels. The relationship is reversed in the short run versus the long run between saving and GDP growth. This can be explained by the fact that in the short-term households save more if their income temporarily increases (as per the permanent income hypothesis), whereas the effect of increased saving on productivity takes longer to be realized.

The results further reveal a distinct short-run and long run relationship between savings and GDP. This empirical evidence also supports the growth model proposed by Harrod- Domar, which indicates that higher saving is critically important to maintain a higher level of economic growth. This is because higher saving increases availability of funds for investment and leads to production of more goods and services and consequently increase the level of output (Sothan, 2014). This finding is consistent with Seshaiah and Sriyval (2005) and İyidoğan and Balikçioğlu (2010), who found dependency of investment on saving in India and Turkey, respectively. This result suggests that domestic savings is channeled to finance investment in Zimbabwe. Thus, financial sector policies aimed at accelerating domestic savings are critical in influencing higher GDP through investment. This analysis shows the link between saving and GDP in Zimbabwe.

Investment positively influences GDP at level. The empirical results indicate a short-run and long –run relationship between investment and economic growth, which feeds back into GDP growth in the long-run. The short-run and long-run relationship between investment and economic growth is supported by the statistically significant coefficient of investment at 5% and 1% level of significance, respectively. This finding is consistent with the results of Musimbi (2023) provides evidence of investment-led growth. The results also support the Harrod-Domar models and new growth theories, which reconfirm the view that investment is an engine of long-run economic growth. This is due to the fact that investment creates and enhances productive capacity, stimulates economic activities, reduces trade and transaction costs and thereby enhances the country's competitiveness in addition to providing employment opportunities (Sahoo et al., 2010). Therefore, policymakers should formulate macroeconomic policies aimed at enhancing investment in Zimbabwe in order to achieve higher and sustainable economic growth. This result implies that in the long-run investment and economic growth mutually influences each other, which suggests that a higher level of investment leads to economic growth.

At 1 percent level of significance, inflation has a negative effect on GDP. At level and in the first lagged period CPI also has a negative influence on GDP at current period but at two lagged periods is not significant. Based on Wald test CPI at level, lag 1 can jointly influence GDP. So in the short run the rising of inflation can negatively affect GDP. The negative relationship between inflation and GDP is a central tenet of the Phillips curve theory, which posits an inverse correlation between the rate of inflation and the level of unemployment and, conversely, the rate of economic growth (Samuelson and Solow, 1960; Phillips, 1958). This relationship is grounded in the notion that high inflation rates erode the purchasing power

of consumers, leading to a decline in aggregate demand and, consequently, a slowdown in economic activity and output (Mandeya, 2022). The study finds that the current period CPI and its first lagged value have a negative and statistically significant influence on the country's GDP, suggesting that the adverse effects of inflation on economic activity persist in the short run. However, the analysis also reveals that the second lagged period of CPI is not statistically significant, implying that the impact of inflation on GDP diminishes beyond the first lagged period. This finding is consistent with the literature that suggests the short-run Phillips curve relationship may not hold in the long run as economic agents may adjust their expectations and behavior in response to persistent inflationary pressures (Dash 2018). The Wald test results further confirm the joint significance of the current period CPI and its first lagged value in influencing GDP, underscoring the importance of addressing inflationary pressures in the short run to mitigate their adverse effects on economic growth in Zimbabwe (Gashe, 2017).

Table 8
Toda and Yamamoto causality test

Direction of causality	Wald test statistics	P-value
INFL does not Granger Cause GDP	-0.442380	0.029
GDS does not Granger Cause INFL	3.233183	0.1986
GDP does not Granger Cause GDS	3.411970	0.6062
INV does not Granger Cause GDP	0.522397	0.0714
GDP does not Granger Cause INV	0.148920	0.9282
INFL does not Granger Cause GDS	0.411970	0.00216
INV does not Granger Cause INFL	0.077182	0.9621
INFL does not Granger Cause INV	0.025198	0.0375
INV does not Granger Cause GDS	3.652372	0.1610
GDS does not Granger Cause INV	0.109777	0.0466
GDP does not Granger Cause INFL	5.981929	0.0802
GDS does not Granger Cause GDP	0.594713	0.7428
GDS does not Granger Cause INFL	3.233183	0.1986

From Table 5, we conclude that there is a bidirectional causal effect between Inflation and GDP. Thus, at 5% level of significance, inflation has a negative causal effect on GDP. Inflation in Zimbabwe has had a significant impact on the country's Gross Domestic Product (GDP). Hyperinflation of 2008 in Zimbabwe resulted in the collapse in the demand for the local currency, resulting in a decline in economic activity and a decrease in GDP. These findings are consistent with Nyoni and Bonga (2017) and Makochekanwa (2020) who suggested a unidirectional causality running from inflation to GDP growth, indicating that inflation has a causal impact on the country's economic growth. Secondly, the causal relationship between inflation and domestic savings is unidirectional which only runs from inflation to gross domestic savings. This means that at a 5% significance level, inflation has a causal effect on Zimbabwe savings rate. This suggests that, when the value of the currency is eroded by inflation, people are less likely to hold their savings in the local currency as it may lose its real value over time. This can result in a decrease in the overall level of gross domestic savings in the country.

Thus, when the real return on savings is low, people may be less inclined to save, as the opportunity cost of consuming the available income may be perceived as higher. These findings affirmed from Abou El-Seoud (2014) argue that high inflation can also erode the value of existing savings, as the real purchasing power of the saved funds diminishes over time. Another causality rum from inflation to investment as witnessed by the probability value which is less than 5%. This implies that high and persistent inflation in Zimbabwe can create economic uncertainty and instability, which may discourage both domestic and foreign investors from committing their resources to long-term productive activities. When the general price level is volatile and unpredictable, investors may be hesitant to make investment decisions, as they cannot accurately forecast the future returns on their investments. Supporting evidence emanates from Iyer (2018) who suggest that high inflation in India resulted in a decrease in the availability of credit, as lenders may become more cautious about extending loans in an environment of high and volatile inflation. This can make it more difficult for investors to obtain the necessary financing for their projects, leading to a decline in investment levels.

The results further reveal a distinct causal flow from saving to investment without reaction in the opposite direction. This means that changes in the savings rate of individuals and households lead to corresponding changes in the level of investment in the economy, but investment levels do not directly influence savings. The unidirectional relationship from saving to investment implies that the availability of saved funds is a crucial determinant of the level of investment. When savings rates decline, as Carroll and Weil, (1994) suggests may happen in the face of high inflation, the pool of capital available for investment purposes also shrinks. Businesses and entrepreneurs, who rely on this pool of savings to finance new projects, expand operations, and invest in technology and innovation, will face constraints in their ability to channel resources towards productive investment activities. This one-way causal relationship, as outlined in the Carroll-Weil hypothesis, highlights the importance of maintaining a robust savings culture within an economy. A strong savings base provides the necessary foundation for sustained investment and consequently, economic growth.

4. Conclusion and policy recommendations

This study examined the causal relationships between inflation, Gross Domestic Product (GDP), domestic savings, and investment in Zimbabwe using Toda-Yamamoto causality tests and the Autoregressive Distributed Lag (ARDL) approach with secondary data spanning from 1990-2022. The study concludes that GDP growth in Zimbabwe is positively influenced by its own past values, suggesting persistence in economic growth. Regarding the relationship between saving and GDP, the findings support the Carroll-Weil hypothesis, with gross domestic saving (GDS) having a positive influence on GDP in the short run but a negative influence in the long run, indicating that saving typically follows rather than precedes economic growth. The analysis also reveals that investment has a positive impact on GDP both in the short and long run, consistent with the Harrod-Domar and new growth theories that view investment as an engine of economic growth. Additionally, the results show that inflation has a negative impact on GDP in the short run, but this effect diminishes in the long run in line with the Phillips Curve theory and the idea that high inflation can erode purchasing power and dampen economic activity. Additionally, the causal relationship between inflation and domestic savings is unidirectional, running from inflation to gross domestic savings. This implies that when the real return on savings is low due to high inflation, people may be less inclined to save, as the opportunity cost of consuming the available income may be perceived as higher. Furthermore, the analysis reveals a causal flow from inflation to investment, indicating that high and persistent inflation can create economic uncertainty and instability, which can discourage both domestic and foreign investors from committing resources to long-term productive activities. The results also show a unidirectional relationship from saving to investment, highlighting the importance of maintaining a robust savings culture within the economy, as a strong savings base provides the necessary foundation for sustained investment and economic growth. The Government of Zimbabwe can leverage the synergies between savings, investment, and inflation management to foster sustained economic growth and development, in line with the national Vision 2030 and the principles of devolution. Operationalizing National Development Strategy 1 can help harness the savings required for much-needed investment in the economy. Developing policies to attract savings and reduce the cost of saving, as well as promoting long-term savings over transactional savings, can increase the country's overall savings base. The treasury and the Zimbabwe Investment House should implement policies and incentives to stimulate meaningful savings levels among households and businesses. This could include introducing tax incentives for savers, improving access to savings products, and strengthening the financial sector's capacity to mobilize domestic savings.

The government's Vision 2030 and the principles of devolution provide an opportunity to strengthen the role of subnational governments in driving economic growth and development. The Ministry of Finance and the Zimbabwe Investment House should work closely with provincial and local authorities to align investment and savings mobilization strategies with the specific needs and priorities of different regions, fostering more inclusive and sustainable growth.

Broadening the scope of the Central Bank's operating licenses and delineating the financial institutions' scope to minimize services overlap can lead to greater financial deepening, which can increase the availability of financial products and services. This can help mobilize more savings from previously unbanked groups like MSMEs, women, youth, and the rural population.

There is a need to develop policies that attract savings and interventions to reduce the cost of saving, with policies being consistent and predictable as a confidence-building measure. Banks should disclose important performance indicators to the regulator and the public to promote transparency and enhance market discipline. Banking institutions need to reduce the cost of maintaining a savings account while increasing returns on savings, and regulatory authorities should develop a framework to reward savers. Long-term savings should be promoted over transactional savings, as the country's new-normal circumstances where foreign capital and FDI have become unreliable necessitates the development of measures to build a long-term savings base.

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