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Asymmetric effects of inflation on economic growth in the Sultanate of Oman

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ABSTRACT

This study examines whether the effects of inflation on Oman's economic growth are symmetric or asymmetric, aligning with Oman Vision 2040's goal of sustained economic growth and controlled inflation. The literature has shown significant variations in assessing the impact of inflation on economic growth. Quarterly data from Q1 2010 to Q4 2022 were analyzed using the linear autoregressive distributed lag (ARDL) and the nonlinear autoregressive distributed lag (NARDL) models to explore whether the relationship between inflation and economic growth in Oman is symmetric or asymmetric. The results reveal that inflation and economic growth in Oman are nonlinearly cointegrated. Inflation has asymmetric effects: rising inflation positively impacts economic growth while decreasing inflation negatively affects it. This asymmetry holds in both the short- and long-run. The study concludes that inflation's impact on Omani economic growth is asymmetric, with increases in it having a stronger positive effect than decreases. These findings enhance our understanding of the dynamics between inflation and growth in Oman, an area where nonlinear studies have been underrepresented. The insights from this study can guide policymakers in shaping inflation control strategies that support economic growth, aligning with Oman Vision 2040's objectives for sustainable development.

Contribution/ Originality: The results of such research provide valuable insights for policymakers in the Sultanate of Oman to achieve Oman's Vision 2040, specifically regarding maintaining sustainable economic growth and controlling inflation levels. There is only one Omani study in this regard, but it assumes that the effects are linear, which is inaccurate.

1. INTRODUCTION

All economies aspire for robust and sustained growth rates while keeping inflation low and stable; therefore, understanding inflation and its fluctuations is one of the main objectives of macroeconomic strategies to ensure price stability (Boujelbene, 2021; Fountas, 2010; Iyke & Ho, 2019). The question of how inflation affects economic growth has always been so controversial that macroeconomic studies and discussions regarding this topic have continued until today. The main points of disagreement are whether inflation positively or negatively impacts economic growth, since economic theories differ in their assessment of these effects (Karahan & Çolak, 2020; Mandeya & Ho, 2021) and whether that impact is linear or nonlinear, or, in other words, has the increasing and decreasing inflation a similar impact on growth (Boujelbene, 2021; Hossain, Acet, Ahmed, & Majumder, 2021). The problem is that these studies had conflicting results and did not reach consensus. For example, Ngoc (2020); Omay and Kan (2010); Khalili, Peykarjo, Hojabr Kiani, and Memarnejad (2023) and Mandeya and Ho (2021) assumed the inflation's effect on growth

was negative, while Hossain et al. (2021); Pollin and Andong (2006) and Hussain and Saaed (2019) concluded a positive effect. Another issue with these studies is that some conclude a linear inflation's impact on economic growth (Hussain & Saaed, 2019; Mandeya & Ho, 2021) while others found a non-linear effect without even conducting a symmetry test (Hossain et al., 2021; Karahan & Çolak, 2020; Khalili et al., 2023). Moreover, the results of the studies, regardless of whether they were conducted in developing or developed countries, varied in determining whether the relationship is linear or non-linear, negative or positive, and also varied in determining whether the effect is short-term or long-term. This makes it difficult to determine the nature of inflation's impact on economic growth without a comprehensive study specific to the Omani economy.

Finally, the study of inflation's impact on Omani economic growth is of great importance since the Omani government is trying to achieve the objectives of Oman's Vision 2024, specifically effective economic leadership and a competitive, integrated, and diversified economy, with key performance indicators of (5%) annual economic growth and (2-3%) inflation rate by 2040 (Oman Vision 2040 Implementation Follow-up Unit, 2019). Unfortunately, there is only one study in this regard (Hussain & Saaed, 2019). But this study has forced the nexus of growth and inflation to be linear; besides, it has no recommendations.

Therefore, such a study would be valuable to Oman's policymakers in understanding the complex impact of inflation on growth and in developing effective economic policies that promote sustainable economic growth and manage inflation. After checking for linear effects, we will investigate nonlinearity and determine their direction.

Let's start with an overview of the study variables during the study period. Figure 1 shows the Gross Domestic Product (GDP) and Consumer Price Index (CPI)[1] during the study period (2010 Q1- 2022 Q4). GDP overall was increasing except for the decreasing oil prices at the end of 2014 and during the COVID-19 pandemic. CPI was also increasing steadily during the study period, but with some sudden rises after 2012 and after 2020 due to decreased interest rates (CBO Annual Report, 2014, 2020, 2021).

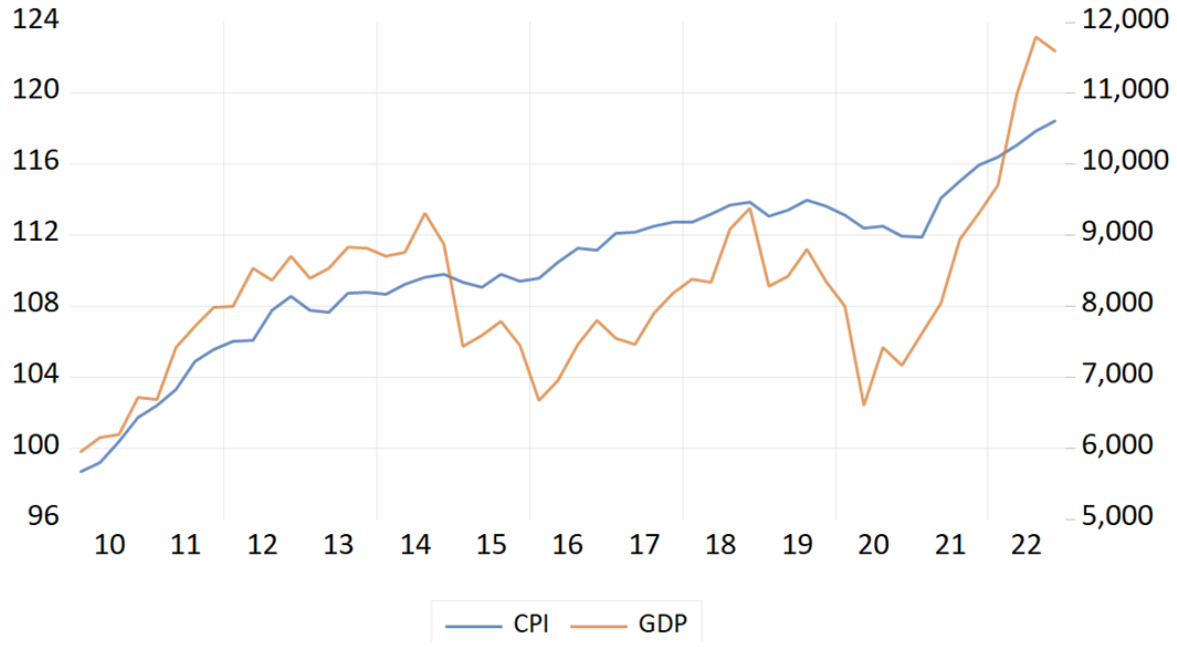

Figure 1. Quarterly gross domestic product and consumer price index (2010Q1-2022Q4).

Figure 2 shows the economic growth (EG) [1] and inflation (INF) during the study period (2010 Q1- 2022 Q4). The study reveals that the Omani economy endures constant fluctuations, with periods of rapid growth and periods of slow growth. The same is true for deflation.

[1]Base year is (2012 = 100).

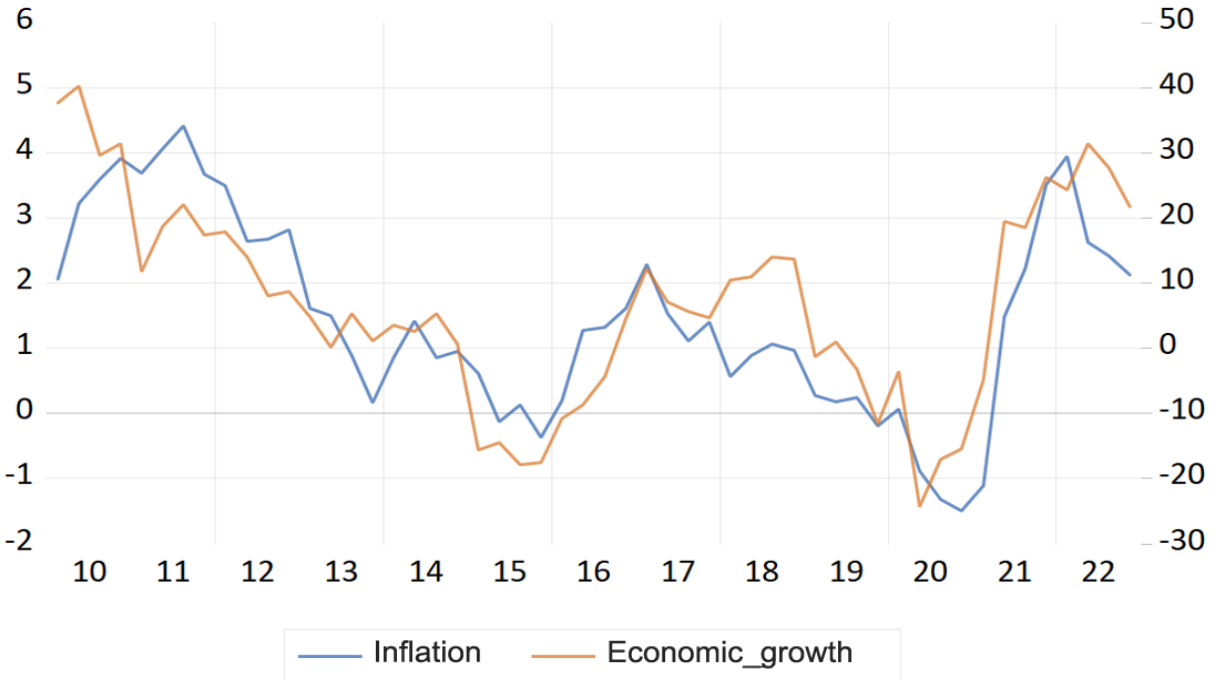

Figure 2. Quarterly economic growth and inflation (2010Q1-2022Q4).

Figure 2 also shows that the nexus between growth and inflation is complicated; sometimes it is positive and sometimes it is negative, but overall, it looks like a positive association. However, in general, inflation has been declining since the beginning of the second half of the period because of the repeated interest rate rises between 2017-2020 (CBO Annual Report, 2017, 2018, 2019, 2020).

This study seeks to add to previous studies by examining inflation's effects on Omani economic growth to answer the questions of whether inflation has any effects on Omani economic growth, whether these effects are linear or nonlinear, and if they are nonlinear, does the positive change in inflation have the same effect as the negative change on economic growth? This study will help policymakers in Oman achieve the objectives of Oman Vision 2040 and maintain sustainable economic growth and a controlled inflation rate (Oman Vision 2040 Implementation Follow-up Unit, 2019).

The literature review constitutes the second section of this study, followed by the data and methodology section, the results section, and finally, the conclusion section.

2. LITERATURE REVIEW

There has been much discussion regarding inflation's impact on economic growth. The literature presents several theories that explore these effects from various perspectives. The classical school posits that inflation adversely affects both short- and long-term economic growth, as the competition between capitalists for employment drives up wages and production costs, leading to higher prices in the economy. Meanwhile, declining profits deter capitalists from expanding their production (Boujelbene, 2021; Mandeya & Ho, 2021). According to the Keynesian school, when inflationary pressures arise because of increasing aggregate demand, there might be a positive inflation effect on economic growth, but it may be negative if supply shocks cause inflation (Karahan & Çolak, 2020; Pollin & Andong, 2006). The new classical school argues that inflation hurts economic growth when it surpasses a certain threshold (Boujelbene, 2021). Empirically, there are several studies with contradictory results in the developing and developed economies; for example, Omay and Kan (2010) and Mandeya and Ho (2021) assumed the inflation's effect on economic growth was linear and negative, while Pollin and Andong (2006) and Hussain and Saaed (2019) concluded a positive linear effect. Moreover, Iyke and Ho (2019); Ngoc (2020); Khalili et al. (2023) and Grier, Henry, Olekalns, and Shields

(2004) found nonlinear negative effects in both the short- and long-run. However, Hossain et al. (2021) and Trejo-García, Valencia-Romero, Soto-Rosales, and Venegas-Martínez (2024) concluded nonlinear positive effects. Furthermore, literature has used multiple techniques, specifically panel data, which can hide each country's specific characteristics, such as (Boujelbene, 2021; Omay & Kan, 2010; Pollin & Andong, 2006; Sarel, 1996). Finally, we found a positive linear effect of INF on EG in South Africa and China, but it was negative in Brazil, Russia, and India.

Many of these studies Omay and Kan (2010) and Pollin and Andong (2006) only focused on long-term effects, highlighting the main gaps in the previous literature. Additionally, many of these studies have only investigated linear inflation's effect on economic growth via ARDL models, completely overlooking the fact that the effects are complex and can be nonlinear, such as (Mandeya & Ho, 2021).

Even the studies that examined nonlinear effects and the NARDL model made numerous mistakes, such as not verifying the appropriate number of lags for the model despite the sensitivity of the topic to the results (Hossain et al., 2021; Khalili et al., 2023). They also did not conduct a symmetry test to ensure that the nonlinear relationship applies to the short-term, the long-term, or both (Iyke & Ho, 2019; Karahan & Çolak, 2020; Trejo-García et al., 2024).

Other studies used the panel data technique, which does not account for the unique characteristics of each economy (Boujelbene, 2021; Judson & Orphanides, 1999; Sarel, 1996). Moreover, a single study conducted in Oman found a positive impact of inflation on long-term growth. However, the study did not account for the possibility of non-linear effects and did not provide any recommendations.

In summary, the literature suffers from contradictory results and incorrect procedures. Furthermore, there is only one weak study in the Omani context. This study will try to fill the gap by studying the linear and nonlinear inflation's effects on economic growth in the Sultanate of Oman.

3. DATA & METHODOLOGY

3.1. Data

This study on the asymmetric effect of inflation (INF) on economic growth (EG) in the Sultanate of Oman uses quarterly data covering 2010 Q1- 2022 -Q4, which was chosen according to the data availability. Data were gathered from the Omani National Centre for Statistics & Information (NCSI) database.

Seasonal fluctuations in the data may affect the accuracy of the analysis; therefore, the method of calculating the rate of change is based on the year-on-year quarterly change [2] to mitigate the influence of seasonal fluctuations (Mandeya & Ho, 2021) since poor seasonal adjustment leads to a poor measurement, and this tends to bias the results (Judson & Orphanides, 1999). Therefore, we measured inflation (INF) using the year-on-year quarterly change in the consumer price index (CPI), and we measured economic growth (EG) using the year-to-year quarterly change in the gross domestic product (GDP).

3.2. Methodology

To address the study questions and to avoid gaps in the literature, the following technique will be used: First, we perform the stationarity test, followed by the Auto Regressive distributed lag (ARDL) method to test. If the inflation's effects on economic growth are linear, and if they are insignificant, we will proceed to perform the Nonlinear Auto Regressive distributed lag (NARDL) method to capture the asymmetric effects. Next, the symmetry test should be performed to check if the long-run and the short-run effects of inflation on economic growth are symmetric or asymmetric, and finally, we should run some diagnostic tests.

The basic economic model of this study is as follows:

$$EG_t = = \beta_0 + \beta_1 INF_t + \varepsilon_t \quad (1)$$

[2] The economic Growth (EG) in Q1 2015 for example can be measured by the change between GDP values in Q1 2014, and Q1 2015 which equals ln (GDP)Q1 2015 – ln (GDP)Q1 2014.

Where: EG represents economic growth, while INF represents inflation, β_0, β_1 are the model coefficients, $and\ \varepsilon_t$ denotes the white-noise error term.

The problem with the previous model is it can only capture the long-run effect of inflation on economic growth, but the short-run effect is crucial in determining a country's long-run growth prospects (Mandeya & Ho, 2021). The ARDL methodology of Pesaran, Shin, and Smith (2001) is very useful as it provides the long-run effect as well as the short-run. Furthermore, it can be used independently of whether the variables are stationary at level I (0), first difference I (1), or a combination of both. The ARDL model of this study has the following equation:

$$\Delta EG_t = \beta_0 + \sum_{i=1}^{n1} \beta_{1i} \Delta EG_{t-1} + \sum_{i=1}^{n2} \beta_{2i} \Delta INF_{t-1} + \vartheta_1 EG_{t-1} + \vartheta_2 INF_{t-1} + \varepsilon_t \quad (2)$$

Where: EG represents economic growth, while INF represents inflation, $\beta_0, \beta_1, \beta_2,$ are the model short-run coefficients, ϑ_1, ϑ_2 are the model, long-run coefficients and ε is the white-noise error term. The natural logarithm (ln) is not used in Equation 2 because EG and INF have negative observations during the study period and (ln) can't be computed.

The hypothesis (H0: $\vartheta_1 = \vartheta_2 = 0$) should be examined against the alternative hypothesis (H1: $\vartheta_1 \neq \vartheta_2 \neq 0$). We should not reject the null hypothesis that there is no cointegration when the F-statistic is less than the lower bound values of the ARDL bounds test (Pesaran et al., 2001). If cointegration is proven, the following error correction model (ECM) should be used to evaluate the short-run association between the variables:

$$\Delta EG_t = \beta_0 + \sum_{i=1}^{n1} \beta_{1i} \Delta EG_{t-1} + \sum_{i=1}^{n2} \beta_{2i} \Delta INF_{t-1} + \delta ECM_{t-1} + \varepsilon_t \quad (3)$$

Where δ is the error correction term coefficient ECM_{t-1}. The model, of course, should be diagnosed and tested for stability. However, if no linear cointegration is proven, we proceed to run the Nonlinear Autoregressive Distributed Lags (NARDL), which can capture the nonlinear inflation's effects on economic growth, in addition to determining whether those effects are symmetric or not. This requires the reformulation of Equation 2, decomposing the effects of the dependent variable into positive and negative effects as recommended by Shin, Yu, and Greenwood-Nimmo (2014). Accordingly, inflation effects in Equation 2 should be decomposed into positive and negative components to generate Equation 4 as follows:

$$\Delta EG_t = \beta_0 + \sum_{i=1}^{n1} \beta_{1i} \Delta EG_{t-1} + \sum_{i=1}^{n2} \beta_{2i} \Delta INF\_POS_{t-1} + \sum_{i=1}^{n3} \beta_{3i} \Delta INF\_NEG_{t-1} + \vartheta_1 EG_{t-1} + \vartheta_2 INF\_POS_{t-1} + \vartheta_3 INF\_NEG_{t-1} + \varepsilon_t \quad (4)$$

Where INF_POS represents the increased inflation's effects on economic growth, and INF_NEG represents the decreasing inflation's effects on growth. The coefficients of this model should be tested for symmetry to check if the long- and short-run inflation's effects on economic growth are symmetric or asymmetric and should also be tested by the same diagnostic tests of ARDL. The following section contains the empirical results of the previous models, which were obtained by using the EViews 13 program.

4. RESULTS

4.1. Descriptive Statistics

To further illustrate Figures 1 and 2, Table 1 presents the descriptive statistics for the data used in the following manner:

Table 1. Descriptive statistics.

Statistical measure	CPI	GDP	INF	EG
Mean	110.172	8,175.197	1.484	7.021
Median	110.825	8,107.860	1.363	5.526
Maximum	118.460	11,792.170	4.417	40.185
Minimum	98.680	5,949.600	-1.487	-24.244
Std. dev.	4.566	1,197.870	1.501	15.394
Skewness	-0.675	0.852	0.121	0.065
Kurtosis	3.185	4.530	2.260	2.412
Jarque-Bera	4.027	11.371	1.312	0.786
Probability	0.134	0.003	0.519	0.675
Sum	5,728.960	425,110.240	77.174	365.114
Sum sq. dev.	1,063.264	73,179,470.942	114.959	12,086.214
Observations	52	52	52	52

Table 1, specifically the maximum, minimum, and standard deviation, demonstrates high fluctuations in economic growth and low volatility in inflation. Inflation on average equals 110 with 10 points above the base value of (2012=100) during the study period.

4.2. Stationarity Test

Since we use time series data, the stationarity test for the variables should be run first before we run the ARDL or the NARDL models. The Perron test (PP) and the Augmented Dicky–Fuller (ADF) test are the tests employed in this study (Dickey & Fuller, 1979; Perron, 1997).

Table 2. Unit root test results.

Stationarity tests	T-test	EG	INF
ADF test at level (0)	With constant	-2.635 no	-1.775 no
	With constant & trend	-2.347 no	-1.255 no
	Without constant & trend	-2.424 **	-1.286 no
ADF test at first difference (1)	T-test	Δ EG	Δ INF
	With constant	-3.418 ***	-4.683 ***
	With constant & trend	-3.806 ***	-4.849 ***
	Without constant & trend	-3.456 ***	-4.737 ***
PP test at level (0)	T-test	EG	INF
	With constant	-2.452 *	-2.017 no
	With constant & trend	-2.108 no	-2.100 no
	Without constant & trend	-2.355 **	-1.410 no
PP test at first difference (1)	T-test	Δ EG	Δ INF
	With constant	-7.555 ***	-5.923 ***
	With constant & trend	-7.876 ***	-5.921 ***
	Without constant & trend	-7.609 ***	-5.983 ***

Note: No represents insignificance, *** represents a 1% significance level, ** represents a 5% significance level, and * represents a 10% significance level.

Table 2 demonstrates that while EG and INF were not stationary at level (0), they were both stationary at the first difference (1), as determined by the ADF and PP tests at a 5% significance level. Therefore, we can use the data from the variables to perform the ARDL and NARDL bounds tests.

4.3. The ARDL Bound Testing Model Results

Before conducting ARDL or NARDL models, the lag number should be specified because the model is sensitive to the number of lags, which if incorrectly selected can bias the results (Chandio, Jiang, & Rehman, 2019). Table 3 shows that the ideal number of lags according to all the criteria is only one lag.

Table 3. Lag order criteria[3].

Lag	LR	FPE	AIC	SC	HQ
0	NA	140.946	10.624	10.702	10.654
1	96.761*	19.397*	8.641*	8.874*	8.7295*
2	3.849	20.978	8.718	9.108	8.865
3	4.840	22.082	8.766	9.312	8.973
4	6.757	22.042	8.760	9.461	9.025

Note: * Denotes each criterion's suggested lag number.

Table 4 includes the ARDL bounds test results. It is shown that the F-Statistics Value of (3.849) is lower than both the lower value (3.860) and the higher value (4.440). This indicates no linear integration between economic growth and inflation in the Sultanate of Oman. This result contradicts the work of Hussain and Saaed (2019) which found a linear cointegration between inflation and economic growth. The reason for the difference may be due to the different nature of the data and the study period, as Hussain and Saaed (2019) used annual data, and the study period was from 1980-2015.

Table 4. ARDL bounds test results.

Dependent variable	Independent variable	Sig. level	F-statistics	Lower value I (0)	Higher value I (1)	Decision
EG	INF	5%	3.849	3.860	4.440	No integration

This result also contradicts the work of Iyke and Ho (2019); Grier and Perry (2000) and Erbaykal and Okuyan (2008) as they confirmed a negative linear effect of INF on EG in Ghana, Turkey, and the USA, respectively. However, this result was consistent with the work of Iyke and Ho (2019) in Ghana, Karahan and Çolak (2020) in Turkey, and Ngoc (2020) in Vietnam, since they confirmed a nonlinear effect. In either case, the relationship between inflation and Omani growth has proven to be non-linear, necessitating testing in a non-linear modeling framework. In the upcoming section, we will implement the NARDL model.

4.4. The NARDL Bound Testing Model Results

We assumed that both the long- and the short-run inflation's effects on economic growth are asymmetric (in the model's inputs) and conducted the NARDL analysis accordingly. Table 5 illustrates the result of the bounds test for the NARDL model. It indicates that the F-Statistics value (5.271) is significant at 5% and higher than both the lower (3.366) and the higher (4.203) values suggested by Pesaran et al. (2001). This confirms the nonlinear cointegration between inflation and economic growth in the Sultanate of Oman.

Table 5. NARDL bounds test results.

Dependent variable	Independent variable	Sig. level	F-statistics	Lower value I (0)	Higher value I (1)	Decision
EG	INF	5%	5.271	3.368	4.203	Cointegrated

The absence of the symmetry test in the literature on INF and EG posed a problem. According to Shin et al. (2014) there are four possibilities: (1) Asymmetry exists in both positive and negative long- and short-run effects(2) only long-run asymmetry (3) only short-run asymmetry (4) Long-run and short-run symmetry see (Bulut & Inglesi-Lotz, 2019; Ho & Saadaoui, 2021). However, we exclude the fourth one because we already proved nonlinearity as

[3]FPE: Final prediction error, HQ: Hannan- Quinn information criterion, LR: Likelihood ratio test, SC: Schwarz information criterion, and AIC: Akaike information criterion.

shown in Table 4. If possibility (1) is realized, then we can confirm the NARDL model and the cointegration between INF and EG, but if (2) occurs, then we need to repeat the NARDL model and the bounds test, considering that the independent variable INF is only asymmetric in the long-run, and finally, if (3) is the case, then repeat the NARDL model and the bounds test, considering that the independent variable INF is only asymmetric in the short-run. The following table displays the results of the coefficients' symmetry test:

Table 6. Symmetry test.

Independent variable	F-statistics	Probability
INF long-run	6.347	0.016
INF short run	5.548	0.023
INF joint	7.111	0.002

Table 6 shows that all columns have a probability below 0.05, indicating the rejection of the symmetry hypothesis in both the long- and short-run. In other words, possibility one is realized, and the positive and negative inflation's effects on economic growth are both asymmetric in the long run and the short run, and we can rely on the results of Table 5 about the cointegration. Accordingly, we can proceed to get the long- and the short-run effects.

Table 7. NARDL long-run results.

Independent variable	Coefficient	Standard error	T-statistics	Probability
@CUMDP(INF(-1))	8.920	1.405	6.351	0.000
@CUMDN(INF(-1))	7.585	1.226	6.187	0.000
C	-1.016	5.075	-0.200	0.842

Table 7 presents the long-run estimates of the model. The coefficient of the positive change equals (8.92), and it is significant with a positive sign, which indicates a significant positive effect of increasing INF on economic growth; when INF increased by (1%), then EG also increased by (8.92%). The negative change is also significant, and the coefficient equals (7.585) with a positive sign, which means that it follows the sign of the negative effects. Accordingly, there is a significant negative effect of decreasing INF on EG. It is shown also that the positive effects (increasing inflation) are more powerful than the negative effects (decreasing INF). This result is consistent with the results of Hossain et al. (2021) in Bangladesh and Trejo-García et al. (2024) in Mexico, but it is not consistent with the negative effects suggested by Iyke and Ho (2019) in Ghana, Ngoc (2020) in Vietnam, Karahan and Çolak (2020) in Turkey, Khalili et al. (2023) in IRAN, and Grier et al. (2004) in the USA.

In summary, INF and EG are cointegrated; INF has significant positive and negative effects on EG, and the positive and negative effects of INF are asymmetric, which means that in the Sultanate of Oman, the increasing INF causes an increase in EG, and decreasing INF hinders EG, but the increasing INF is more powerful.

Table 8. NARDL short-run results.

Independent variable	Coefficient	Standard error	T-statistics	Probability
COINTEQ*	-0.486	0.102	-4.757	0.000
@DCUMDP(INF)	10.390	1.985	5.235	0.000
@DCUMDN(INF)	2.185	2.369	0.923	0.361

The short-run results in Table 8 show that the coefficient of the positive changes of INF is significant and equals (10.39), which indicates that a short-run increase in INF positively affects EG. When INF increases by (1%), EG also increases by (10.39%). This agrees only with the work of Hossain et al. (2021) in Bangladesh but disagrees with several studies Boujelbene (2021); Trejo-García et al. (2024); Khalili et al. (2023); Ngoc (2020); Iyke and Ho (2019) and Sarel (1996) in the north African countries, Mexico, Iran, Vietnam, Ghana, and 87 countries, respectively. The

coefficient of the negative change equals (2.185), but it is insignificant. Then there is no short-run negative effect of INF on EG. This is inconsistent with most literature. Furthermore, the error correction term (ECM_{t-1}) coefficient was negative and significant; this means that variables that deviate from equilibrium in the short run will return to equilibrium by 48.6% each year. Furthermore, the value of R^2 of 48.5% indicated that the selected NARDL model fits well. The summary for the short-run estimates is as follows: INF and EG are cointegrated in the short run. Positive INF changes increase EG, but the negative changes in INF do not affect EG in the short run. Accordingly, short-run effects are also asymmetric. Furthermore, we need to test the model using the following tests in Table 9.

Table 9. Results of the diagnostic tests.

Test	Statistics	Probability
Jarque-Bera normality	4.927	0.086
Ramsey RESET F- statistics (1, 40)	0.716	0.402
Breusch -Godfrey serial correlation LM F- statistics (2, 39)	0.401	0.672
Heteroscedasticity F-statistics (8, 41)	1.252	0.295

All of the significance levels in Table 9 for the diagnostic tests were higher than 5%. This means that the residuals follow a normal distribution, the model doesn't have any specification errors, there is no serial correlation problem, and the errors' variance is the same across observations.

Finally, the test of the cumulative sum of recursive residuals (CUSUM) and the test of the cumulative sum of squares recursive residuals (CUSUMQ) were used to assess the short-run coefficient stability. Referring to Appendix 1, Figures A1 and A2, the two figures validated the model estimates' stability test because the blue line stays within the limits of the 5% significant level in both figures, demonstrating the model's correct specification.

5. CONCLUSION

This study considered the differences in the statistical methodologies used in previous studies and the contradictory results of these studies, the unique nature of the oil-dependent Omani economy, as well as the great interest of the Omani government to achieve the goals of Oman Vision 2040. This study tried to identify whether inflation affects economic growth, to determine if these effects are linear or nonlinear, and to verify if the effects are symmetric or asymmetric. The study used quarterly data from 2010 Q1 to 2022 Q4, the ARDL model, and the NARDL model to determine the effects of inflation on economic growth in the Sultanate of Oman. We worked according to a correct methodology that involves first examining the linear relationship through an ARDL model after performing static tests and making sure the number of lags is appropriate for the model. The NARDL model was then used after a symmetry test proved that the link between growth and inflation in the short and long term was not linear. Unlike most of the previous literature on NARDL (Grier et al., 2004; Iyke & Ho, 2019; Khalili et al., 2023; Ngoc, 2020). This analysis demonstrated that inflation had a positive nonlinear and asymmetric influence on economic growth in Oman in both the short-run and the long-run due to the reasonable inflation rate during the study period, which supports the new classic theory. Empirically, this result is only consistent with Hossain et al. (2021). The findings of this study demonstrate the complicated nexus between inflation and economic growth in Oman and the unique nature of the Omani economy as an oil-dependent economy where oil prices positively affect both inflation and economic growth. The findings also show that low inflation rates throughout the research period (the highest quarterly rate was 4.417, see Table 1) were beneficial and helped to drive economic development, but this might alter if high inflation rates occur in the future. The non-linear effects of inflation on economic growth indicate an asynchronous relationship between inflation and economic growth, since high inflation may not coincide with an increase in economic growth, but it may be delayed or preceded for a variety of reasons, such as Oman being a major importer of consumer goods, which may increase its vulnerability to global inflation regardless of economic growth within the Sultanate. The increase in oil prices supports the Omani government's spending and stimulates

growth, but this increase may be reflected after a while by higher prices of imported global commodities. Finally, increased oil prices may benefit some sectors and harm others at the same time. It makes sense that rising inflation would have more powerful effects than decreasing inflation, as rising inflation often results from increased aggregate demand in the economy. This implies that companies would immediately boost their production and investment. On the other hand, multiple factors such as slower demand, higher supply, or tighter monetary policy may cause low inflation. In this case, it can be difficult for companies to regain confidence quickly and start investing again, slowing economic growth.

The inflation rate was low because of the stable monetary policy of the Omani government regarding fixed interest rates and credit facilities. Economic growth has always increased with reasonable increases in inflation because lowering interest rates in some periods increased inflation but also encouraged individuals and businesses to borrow and invest, and because the Omani government continues to raise its expenditures despite the increasing deficit since the low oil price crisis at the end of 2014 (Al Shehab, 2023). The government policies regarding stimulating foreign investment in turn helped to raise economic growth rates. We must also note that the introduction of value-added tax (VAT) in 2020 (VAT, 2020) contributed to higher prices but increased growth at the same time (as shown in Figure 2) due to higher government spending capacity. Accordingly, researchers recommend that decision-makers maintain reasonable levels of inflation to sustain economic growth. Policymakers should gradually raise interest rates and expand credit facilities in monetary policy, increase government investment spending in fiscal policy, and continue to encourage foreign direct investment (FDI) if inflation rises to high levels for domestic or global reasons. The Omani government should increase efforts related to economic diversification and reduce dependence on oil because oil prices affect economic growth and inflation at the same time. Oman's human capital must be developed through training, education, and infrastructure support to stimulate economic growth. Finally, this study couldn't address the preferred inflation threshold for the Omani economy because it was low during the study period and whether economic growth may in turn affect inflation in the Omani context. This would be a beneficial suggestion for future studies with updated data.

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Appendix 1. Stability diagnostics (Recursive estimates).

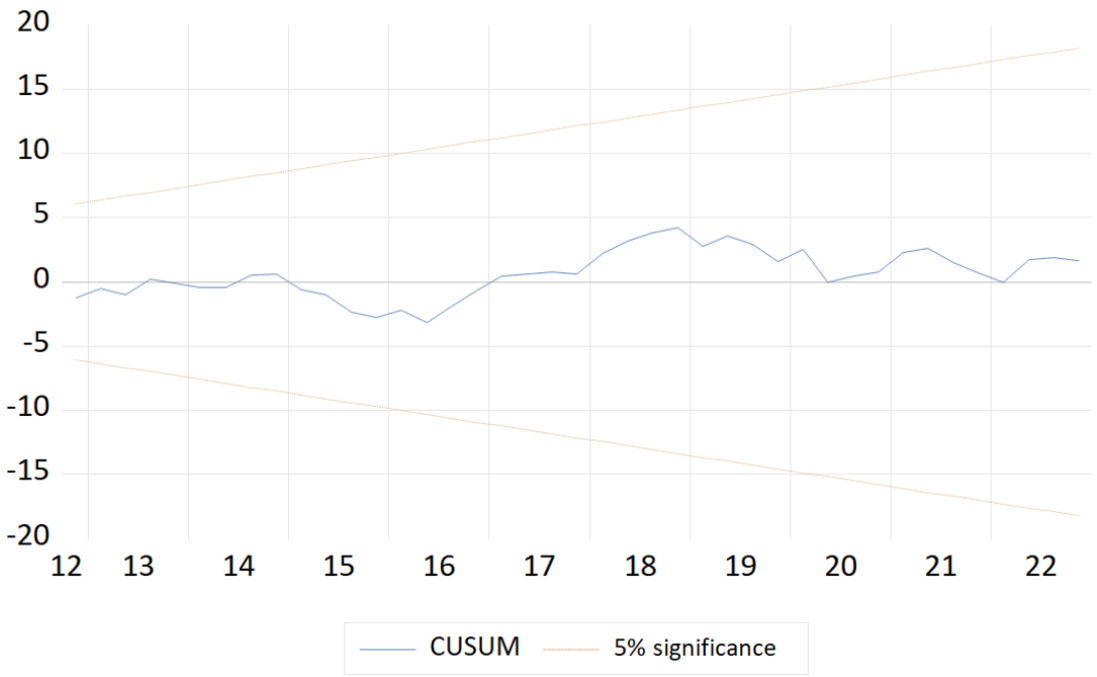

Figure A1. The cumulative sum of recursive residuals (CUSUM) test.

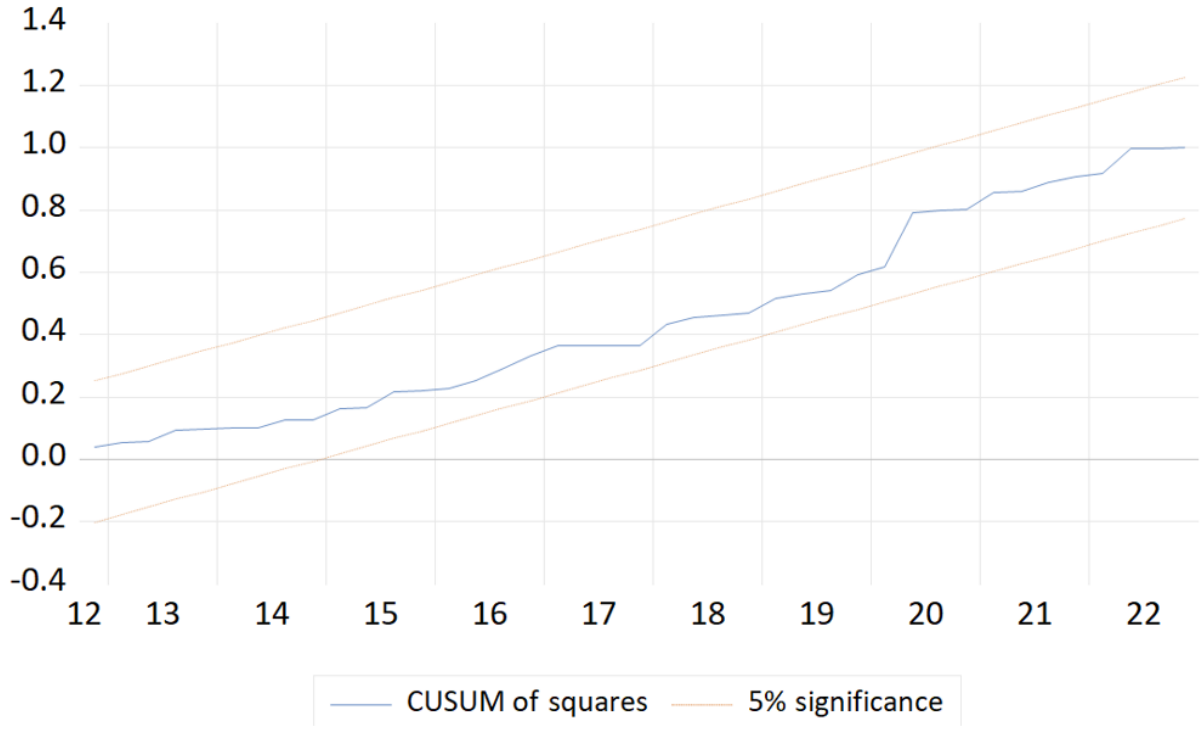

Figure A2. The cumulative sum of squares of recursive residuals (CUSUM of squares) test.