Inflation determinants and its effect on economic growth: The case of Lebanon

[ID]Rasha Saab[1]*, [ID]Hanadi Taher[2]
[1,2]Beirut Arab University, Lebanon; rashasaab_lb@hotmail.com (R.S.) h.taher@bau.edu.lb (H.T.)

Abstract: This study examines the factors influencing inflation and how it affects Lebanon's economic growth using annual data from 1990 to 2022 through the ARDL technique. The current study employs the ARDL model under the Pesaran, et al. [1] testing approach, the Augmented Dickey-Fuller (ADF) test, and additional diagnostic tests to ensure no serial correlation or heteroscedasticity. It also applies CUSUM, CUSUM Square, and Ramsey tests to assess the impact of inflation on Lebanon's economic growth. Under the ARDL assumptions, the study demonstrates that household consumption and government debt have a significant, long-term, positive influence on inflation but do not influence inflation over the short term. Other findings show that the rate of inflation has an adverse effect on both long- and short-term economic growth. Researching inflation and its impact on economic growth is vital to understanding how price levels affect economic stability. Inflation shapes policies, influences investments, affects purchasing power, and determines the long-term sustainability of growth. Accordingly, stable inflation fosters sustained development. The findings guide policymakers in managing consumption and debt to control inflation, while helping central banks curb inflation to support sustainable economic growth in Lebanon.

Keywords: *ARDL, Economic growth, Inflation.*

1. Introduction

Uncertainty and fear are prevalent features when it comes to economic issues like inflation. Inflation as broadly stated, is the continuous rise in the prices of services and products within a specific economy. Inflation reduces the purchasing power of money. Thus, maintaining price stability is one of any economy's top economic goals [2].

Where the source of inflation is the core of the dispute, economists hold different views on the factors that determine inflation. Smith (1776) as cited in Bordo and Rockoff [3] for instance came to a conclusion that inflation is only triggered by increases in money supply. So, as long as the government controls the money supply, there won't be an inflationary environment. According to Keynes, under full employment, inflation is caused when aggregate demand exceeds aggregate supply (Keynes, 1936 cited in Meltzer [4]).

Friedman (1963) as cited in Salami and Kelikume [5] argues that an excess in the quantity of money above the supply of output is termed as inflation.

In fact, debates differ due to different views regarding the best way to combat inflation with the fact that there are variations taking place between advanced and emerging nations. In developing nations, who are mainly, socially polarized, less democratic, have low economic freedom indices, have a history of high political instability, and have high levels of domestic debt to GDP ratio with limited access to finance their internal as well as external debt; they experience as agreed by the majority of economists higher levels of seigniorage and inflation [6].

Regarding economic growth and inflation, there is ongoing discussion on the association between the two. Still in both developed and emerging nations, the fundamental objective of any macroeconomic strategy is to maintain a low one-digit rate of inflation while promoting rapid economic growth [7].

In general, there are four major hypotheses explaining how output and growth are influenced by inflation. As noted by Akinsola and Odhiambo [8] contends that growth is somewhat influenced by inflation, while Tobin [9] argues that inflation promotes long-term growth and Stockman [10] argues that inflation negatively affects growth. Inflation as per Khan and Ssnhadji [11] has an adverse impact on long-term growth, but only if it is over a certain threshold. Still, most central banks and policymakers agree that low inflation or price stability would provide conditions for higher economic growth and that inflation is an obstacle to it.

This study looks at the long-and short-term factors influencing inflation in Lebanon and how it impacts economic growth using annual data for the time span 1990 to 2022. The remaining sections of the paper are as follows: Section 2 summarizes a few research that is more relevant to the field of work along with the hypotheses. In Section 3, the methodology is discussed along with the econometric models. Section 4 presents the discussion of the findings and outcomes. Conclusion is provided in the last section.

2. Literature Review

Numerous factors have been used in literature to explain inflation and are believed to be its corresponding determinants. Mirza and Rashidi [12] provided evidence of the causal linkage between lending interest rate and inflation. The association between deposit interest rate and inflation was noted by Biçen [13]. Al-Mutairi, et al. [14] looked into how taxes, exchange rate, interest rates, and money supply are related to inflation. Munir [15] examined how inflation is affected by real effective exchange rate. George-Anokwuru and Ekpenyong [16] found out how government spending influenced the rate of inflation. Rachman [17] studied the correlation between governmental revenues and inflation rate. Kwon, et al. [18] assessed the correlation between public debt and the rate of inflation.

Numerous research found that inflation and interest rates are positively related [19, 20]. conversely, Hashim, et al. [21] found an adverse correlation between the two variables.

Money supply according to Armesh, et al. [22] and Iya and Aminu [23] influences inflation positively over the long- term. Conversely, Jawo, et al. [24] argue that inflation is adversely influenced by money supply over the short run term. This influence turns positive over the long term whereas Abasimi, et al. [25] found that money supply has no influence on short- and long-term inflation.

Exchange rate is one of the key elements identified by many researchers as affecting inflation dynamics. In real terms, Asad, et al. [26] came to a conclusion that real effective exchange rate and inflation are positively correlated. However, Munir [15] found that real effective exchange rate has an adverse and significant long-term impact on inflation.

Results differ about the correlation between governmental spending and the rate of inflation. Mehrara and Sujoudi [27] noted that inflation is not impacted by governmental spending neither over the long nor over the short run term. This contrasts the findings of George-Anokwuru and Ekpenyong [16] who found that even though there is a short term, positive, but insignificant, correlation between government spending and the rate of inflation, an adverse relation is present over the long term.

The linkage between government revenues and the rate of inflation has not been heavily studied. Maskie and Hoetoro [28] concluded that government revenue boosts the level of inflation by around 1.17%.

The correlation between governmental debt and inflation has been well studied in literature. Kwon, et al. [18] suggested that growing public debt generally leads to higher inflation in nations with significant debt levels. However, Harmon [29] found a positive weak correlation between state debt and inflation. More precisely, Sharaf and Shahen [30] argued that external debt has negligible long-term influence on inflation.

According to Bonsu and Muzindutsi [31] household consumption is thought to be an important factor driving aggregate demand. One addition made by this study is the discussion of the impact of consumer spending on inflation which has not been heavily studied in literature.

Critiques of research on the factors that influence inflation frequently highlight a number of important issues such as methodological issues, the intricacy of the underlying causes of inflation. A prevalent issue is the propensity to overemphasize monetary considerations, which could lead to policy proposals that narrowly concentrate on changing monetary policy either by tightening or expanding it. This may limit the effectiveness of policy responses by ignoring significant non-monetary factors that also contribute to inflation. A more thorough understanding of inflation dynamics requires a more balanced approach that considers both non-monetary and monetary factors [32, 33].

Two hypotheses are developed based on the literature mentioned above:

H_1: *Public debt negatively influences inflation.*

H_2: *household consumption positively influences inflation.*

GDP is the total cumulative production of an economy. It is the aggregate sum of the monetary values of all services and products that an economy generates over a specific time. An increase in production would result in higher salaries, higher spending but lower unemployment all of which could drive up inflation [34].

Gillman, et al. [35] highlighted the inflation-economic growth relationship for 18 APEC and 29 OECD member nations. Inflation-growth interactions were found to be negative. Conversely, upon applying the endogenous threshold auto regressive model, Munir and Mansur [36] reached to a conclusion that as inflation rate is below the level of 3.89%, economic growth is positively influenced by inflation. Beyond this, inflation has an adverse influence.

Vinayagathasan [37] used the concept of dynamic threshold analysis to analyze 32 Asian countries, and a threshold of 5.43% was put under scope. Growth was negatively impacted by rates above this threshold and was unaffected by rates below it.

Odhiambo [38] emphasized both theoretical and empirical evidence related to inflation and economic growth in emerging and developed nations. According to their analysis, inflation's impact on economic growth fluctuates over time and between countries. Results are influenced by the contry specific factors, data set employed and the technique used.

Kırşanlı [39] upon investigating 38 OECD countries from 1972 to 2021 found that inflation adversely affects economic growth, with a 1% increase in inflation reducing economic growth by 0.03% to 0.15% depending on the model used.

Lubeniq, et al. [40] examined the non-linear relationship between inflation and economicgrowth in 20 developing European countries from 1995 to 2022, finding that a 1% increase in inflation adversely impacts economic growth by approximately 0.017%. Hussain [41] in turn added that inflation has a negative and significant impact on Pakistan's economic growth in both the short and long run using data from 1973 to 2022.

Overall, empirical results reported in litrature may generally be divided into four categories or groups: Cameron, et al. [42] asserts that there is no statisticaly significant impact taking place between inflation and economic growth. According to Benhabib and Spiegel [43] inflation promotes economic growth. Referring to Valdovinos [44] inflation has adverse effects. To add, at some point or threshold, inflation begins to affect economic growth [45]. Inlight of the aforementioned hypothesis three is stated asfollows:

H_3: *Inflation negatively influences economic growth.*

In fact, research on the inflation-economic growth relationship frequently encounters several challenges that may result in inaccurate findings. For instance, results may be impacted by the choice of inflation and economic growth measures [46]. Furthermore, many studies do not distinguish between cost-push and demand-pull inflation, where the impact of inflation can have quite different effects on economic growth depending on its source [47].

The inflation-economic growth relationship can vary depending on the time frame analyzed. Short term effects may differ from long-term effects. Many studies overlook this distinction [11].

Inflation-growth dynamics may differ significantly between advanced economies and developing countries, or between countries with different institutional settings and policy frameworks [48].

There is no consensus on the theoretical framework that better explains the inflation-economic growth relationship. Fischer [49] examines different theoretical perspectives on inflation and growth, noting the conflicting views on whether moderate inflation fosters or hampers growth.

These critiques highlight the complexity of studying the inflation-growth relationship and underscore the need for more sophisticated methods, better data and a nuanced understanding of the underlying mechanisms at play.

3. Method

The autoregressive distributed lag (ARDL) testing approach will be employed in this study to put under scope the factors that determine inflation and how it affects economic growth in Lebanon under two separate models. The time frame chosen depends on the data's availability. Time series analysis creates mathematical models that offer plausible interpretations for the sample data [50]. Annual data from 1990 to 2022 is sourced from the world bank and IMF.

According to, Shin, et al. [51]; Pesaran, et al. [1] and Pesaran and Shin [52] ARDL is built on the notion that all variables ought to be integrated at first difference or at level. They might be mutually integrated but never integrated at I(2).This is the main benefit that strengthens the ARDL model and makes it suitable for the current study. Also, a wide range of lag structures can be addressed by ARDL. In contrast to other cointegrating techniques, ARDL is also appropriate for small sample sizes.

Based on Bashir [34]; Mirza and Rashidi [12]; Kia and Sotomayor [53]; Dilanchiev and Taktakishvili [54] and Munir [15] who tested different variables that may have an impact on inflation the model employed is:

$$INF_t = \beta_0 + \beta_1 LEND_t + \beta_2 DEP_t + \beta_3 M_t + \beta_4 EXCH_t + \beta_5 EX_t + \beta_6 REV_t + \beta_7 DEBT_t + \beta_8 CONS_t + \varepsilon_t \text{ (1).}$$

Personal consumption expenditure is used in place of the consumer price index based on McCully, et al. [55]. Based on Fatima, et al. [56]; Yamin, et al. [57]; Okisai, et al. [58]; Shrestha and Kautish [59]; Hicham [60]; Yuliastanti, et al. [61]; Utile, et al. [62]; Dudzevičiūtė, et al. [63] and Pavlic, et al. [64] another model is bult. It has the following specification:

$$EG_t = \beta_0 + \beta_1 LEND_t + \beta_2 DEP_t + \beta_3 M_t \ \beta_4 EXCH_t + \beta_5 EX_t \ \beta_6 REV_t + \beta_7 DEBT_t + \beta_8 CONS_t + \beta_9 INF_t + \varepsilon_t \text{ (2)}$$

The dependent variable of equation (1) is INF which stands for inflation as measured by personal consumption expenditure (PCE). Personal consumption expenditure is defined as nominal consumption over real consumption in constant 2015 USD $\times 100$. The dependent variable in equation (2) is EG which stands for economic growth. It is determined as the percentage change in real GDP which is in constant 2015 USD. β_0 is the intercept in both models. $\beta_1 \ldots \beta_9$ are the coefficients of the models. The following are the independent variables:

(lend) which is the real lending interest rate in percentage, (DEP) which is the real deposit interest rate in percentage, (M) which represents the broad money in constant 2015 USD, (EXCH) which is the real effective exchange rate, (EX) which is the total government expenditure in constant 2015 USD, (REV) which is the government revenues in constant 2015 USD, (DEBT) which is the total debt in constant 2015 USD, and (CONS) which is the household consumption expenditure in constant 2015 USD, ε_t is the error term. Variables excluding interest rates are expressed in logarithmic form.

The ARDL technique will be used in this investigation. The need to look at the ADF unit root test is the first step (Dickey & Fuller, 1981 cited in Chang and Park [65]). Verifying the variables' long-term cointegration is the second step. H_0 which denotes no long-run cointegration, cannot be rejected if the F- statistic is lower than the critical values. The hypothesis is only rejected when the computed F-

statistic exceeds both the lower and upper critical F-values. No conclusion can be made if the F-statistic falls between the two critical values [1, 52].

The third step entails conducting stability and diagnostic tests to assess the models' goodness of fit. The diagnostic analysis checks for heteroscedasticity, serial correlation, and normality distribution of the residuals. As suggested by Brown et al. (1975 cited in Dritsaki and Stamatiou [66]), the test of stability is conducted using CUSUM and CUSUM square tests.

4. Results

Testing the stationarity of the ARDL model is the first step in the analytical process. According to Yule [67] a series is non stationary if having a unit root. The variables' integration order in the model can be established with the use of ADF. ADF is a popular and efficient unit root test for determining whether the model series is stationary (Dickey & Fuller, 1981 cited in Chang and Park [65]).

At the 5% significance level, Table 1 illustrates that, except for DEP and CONS, which are integrated at level I(0, all other variables are integrated at first difference I(1).

Table 1.
Unit root tests (ADF) on the individual series.

Variables	Series			Series in first difference		
	Test statistic	Dickey-Fuller critical value (5%)	P-value	Test statistic	Dickey-Fuller critical value (5%)	P-value
INF	-1.8973	-2.960411	0.3292	-3.0163	-2.963972	0.0447
LEND	-2.6016	-2.957110	0.1031	-8.446	-2.963972	0.0000
DEP	-3.6561	-2.986225	0.0117	-	-	-
M	-2.5323	-2.957110	0.1176	-4.3183	-2.960411	0.0019
EXCH	0.8916	-2.998064	0.9977	-2.413	-2.963972	0.0017
EX	-2.2193	-2.963972	0.2039	-4.4384	-2.963972	0.0015
REV	-0.7587	-2.960411	0.8167	-5.2814	-2.960411	0.0001
DEBT	-2.7706	-2.963972	0.0745	-7.5117	-2.960411	0.0000
CONS	-4.9401	-2.957110	0.0003	-	-	-
EC	-1.9985	-2.963972	0.2859	-5.2144	-2.960411	0.0002

The ARDL model responds to the number of lag order. The model with the lowest Schwartz information criterion (SBIC), and Akaike Information Criterion (AIC) is determined. This is identified by Stock and Watson [68].

Table 2.
Maximum number of lags Inflation Model.

Lag	AIC	SBIC	HQIC
0	5.270660	5.686979	5.406370
1	-16.65112*	-8.741057*	-14.07263*
2	-8.073187	-3.909998	-6.716091

Note: The optimal lag is denoted by * .

Table 3.
Maximum number of lags Economic Growth Model

Lag	AIC	SBIC	HQIC
0	0.765087	1.227664	0.915876
1	-26.83632*	-17.12222*	-23.66977*
2	-14.43535	-9.347005	-12.77667

Note: The optimal lag is denoted by *

The maximum lag when using Hannan-Quinn Information Criterion (HQIC), Schwarz information criterion (SBIC), and Akaike Information Criterion (AIC) is displayed in Table 2. 1 is the optimal lag.

Among other lags, it shows the lowest value (-16.65112 for AIC; -8.741057 for SBIC; -14.07263 for HQIC). Similarly, the optimal lag is also 1 in table 3. Among other lags, it shows the minimum value (-26.83632 for AIC; -17.12222 for SBIC; -23.66977 for HQIC).

The initial step in model estimating is to perform the ARDL regression at the optimal distributed lags based on Akaike and schwarz criterion [68]. Examining the long and short- term correlation among the variables is the second step.

Table 4.
ARDL regression Inflation Model.

ARDL(1, 0, 0, 1, 0, 1, 0, 1, 0) regression						
Sample: 1990-2022	Observations					32
	R-squared					0.9852
	Adjusted R-squared					0.9759
	Root Mean Squared Error (RMSE)					0.0397
	F-statistic					106.0200
Log Likelihood = 65.36	Prob > F					0.0000
inf	**Coefficient**	**Standard err.**	**T**	**P > |t|**	**[Cl 95%]**	
inf						
L1	0.602430	0.150343	4.007031	0.0006	0.307758	0.897102
lend						
L0	0.003396	0.007149	0.475012	0.6395	-0.01062	0.017408
dep						
L0	-0.006094	0.007903	-0.771059	0.4489	-0.02158	0.009396
M						
L0	-0.248520	0.151916	-1.635903	0.1161	-0.54628	0.049235
L1	0.577303	0.211263	2.732632	0.0132	0.163228	0.991378
EXCH						
L0	0.189604	0.104758	1.809921	0.0840	-0.01572	0.39493
EX						
L0	0.005102	0.047873	0.106579	0.9161	-0.08873	0.098933
L1	-0.165189	0.046286	-3.568898	0.0020	-0.25591	-0.07447
REV						
L0	0.394268	0.168314	2.342455	0.0286	0.064373	0.724163
DEBT						
L0	-0.016293	0.078462	-0.207662	0.8374	-0.17008	0.137493
L1	-0.146754	0.096400	-1.522349	0.1444	-0.3357	0.04219
CONS						
L0	0.054027	0.109975	0.491267	0.6281	-0.16152	0.269578

Table 4 shows that public debt (DEBT) does not influence inflation rate at and 10% level. This finding is in line with Osei [69]. Household consumption (CONS) has no impact on inflation. Test of significance using p-value is based on Rao [70]. If the observed value of the selected test statistic surpasses the computed value of the test statistics in the 95% or 99% percentile the null hypothesis (H_0) is rejected.

Table 5.
ARDL regression Economic Growth Model.

ARDL (1, 0, 0, 1, 1, 1, 1, 0, 0, 0) regression						
Sample: 1990–2022	Observations					32
	R-squared					0.9986
	Adjusted R-squared					0.9975
	Root Mean Squared Error					0.0147
	F-statistic					917.4384
Log Likelihood = 94.71	Prob > F					0.0000
EG	**Coefficient**	**Standard err.**	**T**	**P > |t|**	**[CI 95%]**	
EG						
L1	0.274768	0.149575	1.836990	0.0838	–0.040808	0.590344
lend						
L0	0.000767	0.002533	0.302686	0.7658	–0.004577	0.006110
dep						
L0	–0.001440	0.002825	–0.509739	0.6168	–0.007401	0.004521
M						
L0	0.415783	0.124740	3.333187	0.0039	0.152604	0.678963
L1	–0.272844	0.109814	–2.484598	0.0237	–0.504533	–0.041156
EXCH						
L0	–0.078654	0.054913	–1.432336	0.1702	–0.194510	0.037202
L1	–0.098466	0.059767	–1.647491	0.1178	–0.224563	0.027632
EX						
L0	0.041177	0.026301	1.565631	0.1359	–0.014312	0.096667
L1	–0.089422	0.025236	–3.543432	0.0025	–0.142665	–0.036179
REV						
L0	–0.016467	0.067986	–0.242212	0.8115	–0.159904	0.126970
L1	–0.109518	0.044398	–2.466743	0.0246	–0.203190	–0.015847
DEBT						
L0	0.103989	0.040293	2.580842	0.0194	0.018979	0.188999
CONS						
L0	0.357248	0.075052	4.759978	0.0002	0.198901	0.515595
INF						
L0	–0.382326	0.076513	–4.996900	0.0001	–0.543753	–0.220898

In Table 5, while inflation (INF) adversely influences economic growth at 1% level, household consumption (CONS) and public debt (DEBT) positively influences economic growth at 1% and 5% level respectively. Significance test is built on Rao [70].

In Table 6, ADJ to INF has a value of (-0.397570) representing the velocity of adjustment. This number indicates the rate at which the equilibrium distortion takes place. Long run coefficients in the first part of table 6 demonstrates that public debt (DEBT) and household consumption (CONS) influences inflation rate positively at 1% and 5% level respectively. Thus H_1 is rejected while H_2 is accepted. Test of significance using p-values is based on Rao [70].

Table 6.
ARDL short and long-run results Inflation Model.

ARDL (1, 0, 0, 1, 0, 1, 0, 1, 0) regression						
Sample: 1990-2022	Observations					32
	R-squared					0.6694
	Adjusted R-squared					0.6584
Log Likelihood = 55.48	Root Mean Squared Error (RMSE)					0.0397
INF	**Coefficient**	**Standard err.**	**T**	**P > |t|**	**[CI 95%]**	
ADJ						
INF						
L1	-0.397570	0.150343	-2.644414	0.0148	-0.6922	-0.1028
LR						
LEND	0.006790	0.018203	0.373012	0.7244	-0.0288	0.0424
DEP	-0.007942	0.019930	-0.398516	0.7067	-0.047	0.0311
M	3.560058	1.020251	3.489395	0.0175	1.5603	5.5597
EXCH	2.207147	0.428392	5.152170	0.0036	1.3674	3.0467
EX	-0.156059	0.136543	-1.142932	0.3048	-0.4236	0.1115
REV	2.411545	0.478384	5.041022	0.0040	1.4739	3.3491
DEBT	3.319138	0.713847	4.649645	0.0056	1.9199	4.7182
CONS	3.998137	1.020576	3.917530	0.0112	1.9978	5.9984
SR						
LEND						
D1.	0.003396	0.007149	0.475012	0.6395	-0.01062	0.017408
DEP						
D1.	-0.006094	0.007903	-0.771059	0.4489	-0.02158	0.009396
M						
D1.	-0.248520	0.151916	-1.635903	0.1161	-0.54628	0.049235
EXCH						
D1.	0.189604	0.104758	1.809921	0.0840	-0.01572	0.39493
EX						
D1.	0.005102	0.047873	0.106579	0.9161	-0.08873	0.098933
REV						
D1.	0.394268	0.168314	2.342455	0.0286	0.064373	0.724163
DEBT						
D1.	-0.016293	0.078462	-0.207662	0.8374	-0.17008	0.137493
CONS						
D1.	0.054027	0.109975	0.491267	0.6281	-0.16152	0.269578

Similarly, in Table 7, ADJ to Economic growth (EG) showed value of (-0.725232) representing the velocity of adjustment and the rate at which the equilibrium distortion occurs. Long run coefficients and short-term coefficients are also displayed in table 7. Inflation (INF) and public debt (DEBT) adversely affects short-term economic growth at 1% and 5% level respectively. In the long and short -run term, economic growth is positively influenced by household consumption (CONS) at a level of significance of 1%. Test of Significance is based on Rao [70]. At 1% level of significance, economic growth is adversely impacted by inflation in the long-run term. Hence, H_3 is accepted.

Table 7.
ARDL long-run and short-run results Economic Growth Model.

ARDL (1, 0, 0, 1, 1, 1, 1, 0, 0, 0) regression						
Sample: 1990-2022	Observations					32
	R-squared					0.9821
	Adjusted R-squared					0.9786
Log Likelihood = 94.71	Root Mean Squared Error (MSE)					0.0147
EG	**Coefficient**	**Standard err.**	**T**	**P > |t|**	**⌈CI 95%⌉**	
ADJ						
EG						
L1	-0.725232	0.149575	-4.848617	0.0002	-1.0184	-0.43207
LR						
LEND	0.001057	0.003486	0.303263	0.7654	-0.00578	0.00789
DEP	-0.001986	0.003911	-0.507826	0.6181	-0.00965	0.00568
M	0.197094	0.077821	2.532646	0.0215	0.044565	0.349623
EXCH	-0.244225	0.098112	-2.489247	0.0235	-0.43652	-0.05193
EX	-0.066523	0.043762	-1.520097	0.1469	-0.1523	0.019251
REV	-0.173717	0.131786	-1.318173	0.2049	-0.43202	0.084584
DEBT	-0.143387	0.072688	-1.972649	0.0650	-0.28586	-0.00092
CONS	0.492599	0.065149	7.561086	0.0000	0.364907	0.620291
INF	-0.527177	0.102089	-5.163879	0.0001	-0.72727	-0.32708
SR						
LEND						
D1.	0.000767	0.002533	0.302686	0.7658	-0.0042	0.005732
DEP						
D1.	-0.001440	0.002825	-0.509739	0.6168	-0.00698	0.004097
M						
D1.	0.415783	0.124740	3.333187	0.0039	0.171293	0.660273
EXCH						
D1.	-0.078654	0.054913	-1.432336	0.1702	-0.18628	0.028975
EX						
D1.	0.041177	0.026301	1.565631	0.1359	-0.01037	0.092727
REV						
D1.	-0.016467	0.067986	-0.242212	0.8115	-0.14972	0.116786
DEBT						
D1.	-0.103989	0.040293	-2.580842	0.0194	-0.18296	-0.02501
CONS						
D1.	0.357248	0.075052	4.759978	0.0002	0.210146	0.50435
INF						
D1.	-0.382326	0.076513	-4.996900	0.0001	-0.53229	-0.23236

To look over the long run relationship among the variables, the ARDL bound test as a co-integration method is utilized.

Table 8.
Bound test Inflation Model.

H0: No long-run relationships exist					F	4.9505
Third case					t	-7.7946
	10%		**5%**		**1%**	
F test	**I (0)**	**I (1)**	**I (0)**	**I (1)**	**I (0)**	**I (1)**
F	1.95	3.06	2.22	3.39	2.79	4.1
T	-2.57	-4.4	-2.86	-4.72	-3.43	-5.37

Table 9.
Bound test Economic Growth Model

H0: No long-run relationships exist					F	27.36073
Third case					t	-20.45625
	10%		**5%**		**1%**	
F test	**I (0)**	**I (1)**	**I (0)**	**I (1)**	**I (0)**	**I (1)**
F	1.88	2.99	2.14	3.3	2.65	3.97
T	-2.57	-4.56	-2.86	-4.88	-3.43	-5.54

Based on Table 8 and Table 9 results, the F- statistic is (4.9505) and (27.36073) respectively. At 10%, 5% and 1% level, these values exceed the critical values. Thus, H_0 is rejected [71]. Consequently, the variables have long term association.

For diagnosing both the inflation and economic growth models, certain econometric tests including normality, heteroscedasticity and serial correlation are essential. Misspecification test i.e., Ramsey RESET test is also applied. Additionally, when evaluating the models' stability (CUSUM) and CUSUM square tests are represented.

Jarque–Bera normality test is passed by both inflation and economic growth models; where *p-value* in Figure 1 and Figure 2 indicate that H_0 ($the\ distribution\ is\ normaL$) is not rejected at 10% level of significance (Jarque-Bera,1980 cited in Thadewald and Büning [72]).
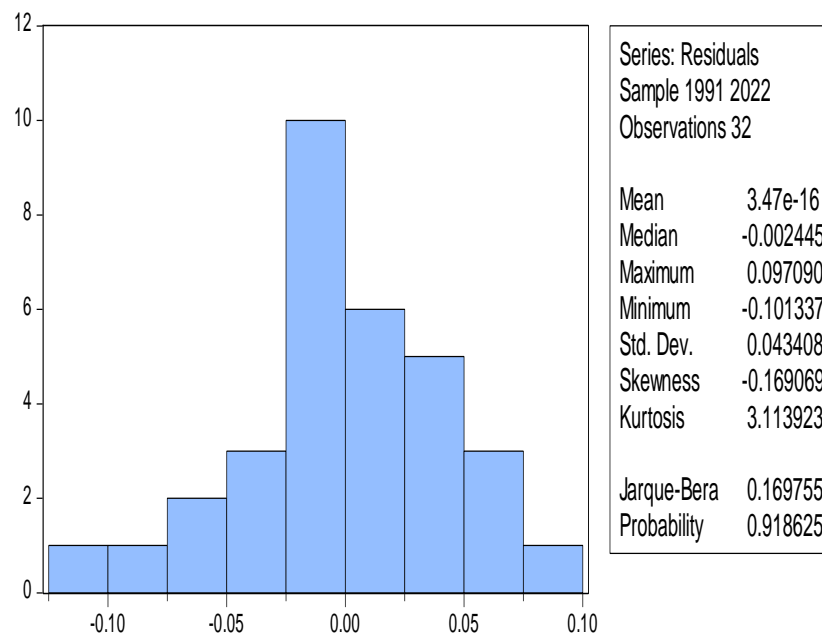
Figure 1.
Normality Test Inflation Model.
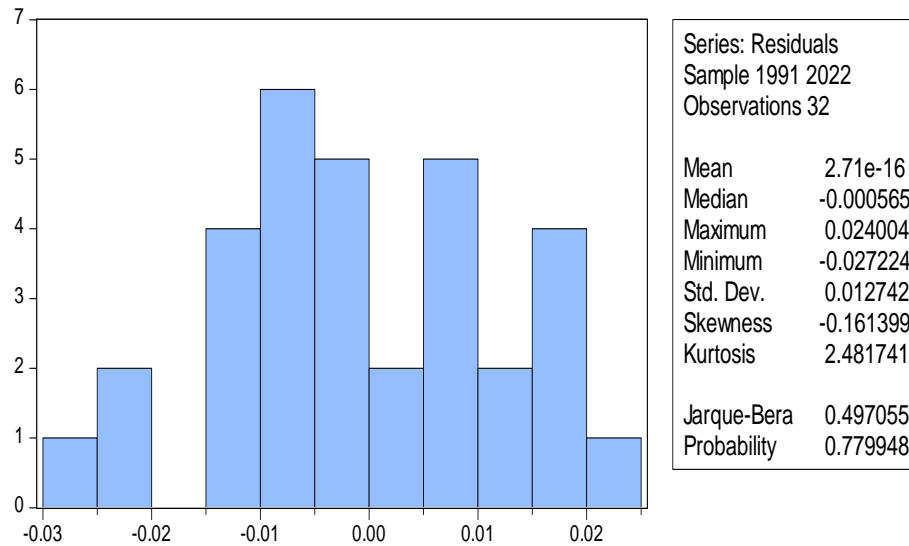
Figure 2.
Normality Test Economic Growth.

Table 10.
Serial Correlation Test Inflation Model.

Breusch–Godfrey Serial Correlation LM Test:			
F-statistic	0.365414	Prob. F (2,20)	0.6984
Obs*R-squared	1.128102	Prob. Chi-Square(2)	0.5689

Table 11.
Serial Correlation Economic Growth Model.

Breusch–Godfrey Serial Correlation LM Test:			
F-statistic	0.767439	Prob. F(2,15)	0.4816
Obs*R-squared	2.970453	Prob. Chi-Square(2)	0.2265

Table 10 and Table 11 show the absence of autocorrelation where *p-value* indicates that H_0 (*the residuals are not correlated*) is not rejected at 10% level of significance (Breusch, 1978; Godfrey, 1978 cited in Uyanto [73]).

Table 12.
Heteroscedasticity Test Inflation Model.

Heteroscedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.678647	Prob. F(28,15)	0.7515
Obs*R-squared	9.60075	Prob. Chi- Square(28)	0.6509
Scaled explained SS	2.857726	Prob. Chi- Square(28)	0.9965

Table 13:
Heteroscedasticity Test Economic Growth Model.

Heteroscedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.582647	Prob. F(9,36)	0.8437
Obs*R-squared	10.37585	Prob. Chi- Square(9)	0.7342
Scaled explained SS	2.16952	Prob. Chi- Square(9)	0.9999

The residuals for both inflation and economic growth models are homoscedastic as shown in Tables 12 and 13. At 10% level of significance, the null hypothesis-that the residuals are homoscedastic fail to be rejected (Breusch and Pagan, 1979 cited in Uyanto [73]).

Table 14.
Ramsey Test Inflation Model.

Ramsey RESET Test			
Specification: INF INF(-1) LEND DEP M M(-1) EXCH EX			
EX(-1) REV DEBT DEBT(-1) CONS C			
Omitted Variables: Squares of fitted values			
	Value	**df**	**Probability**
t-statistic	1.441649	18	0.1666
F-statistic	2.078353	(1, 18)	0.1666
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	0.003262	1	0.003262
Restricted SSR	0.031512	19	0.001659
Unrestricted SSR	0.028250	18	0.001569

Table 15.
Ramsey Test Economic Growth Model.

Ramsey RESET Test			
Specification: ECOG ECOG(-1) LEND DEP M M(-1) EXCH			
EXCH(-1) EX EX(-1) REV REV(-1) DEBT CONS INF C			
Omitted Variables: Squares of fitted values			
	Value	**df**	**Probability**
t-statistic	0.502110	16	0.6224
F-statistic	0.252114	(1, 16)	0.6224
F-test summary:			
	Sum of Sq.	df	Mean Squares
Test SSR	7.81E-05	1	7.81E-05
Restricted SSR	0.005033	17	0.000296
Unrestricted SSR	0.004955	16	0.000310

By conducting the misspecification test, specifically the Ramsey test RESET test, Table 14 shows that the null hypothesis holds true, as the p-value of 0.1666 is above the 10% significance level. This confirms that the inflation model does not have omitted variables and is correctly specified. Similarly, the p-value of 0.6224 in Table 15 is greater than the 10% significance level, further supporting the null hypothesis's validity which indicates that the model is free from omitted variables and is well specified (Hendry, 1995 cited in Fuinhas and Marques [74]).

The model stability tests indicate that the parameters of the ARDL models remain stable throughout the sample period, as shown by the CUSUM and CUSUM squared tests. The critical boundaries are marked by the red lines at the 5% significance level. Both the inflation model and the economic growth model are stable as clearly demonstrated in Figures 3,4,5, and 6 (Brown et al., 1975 cited in Dritsaki and Stamatiou [66]).
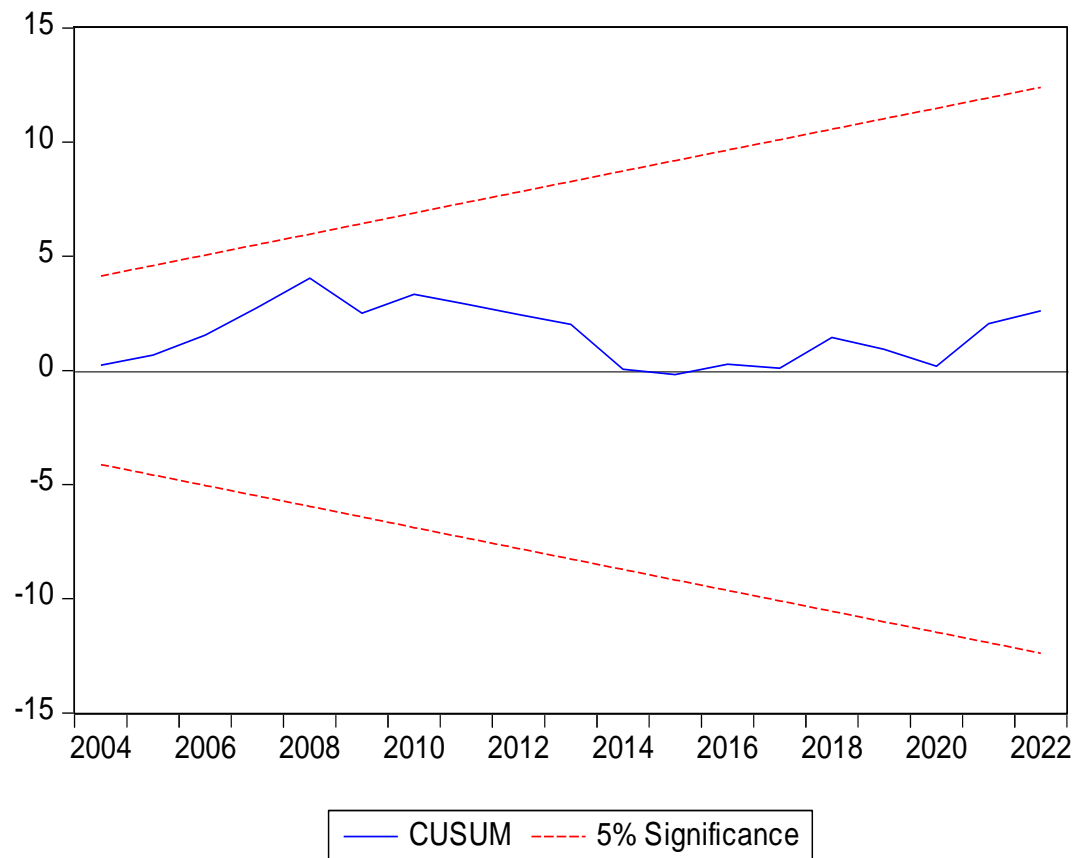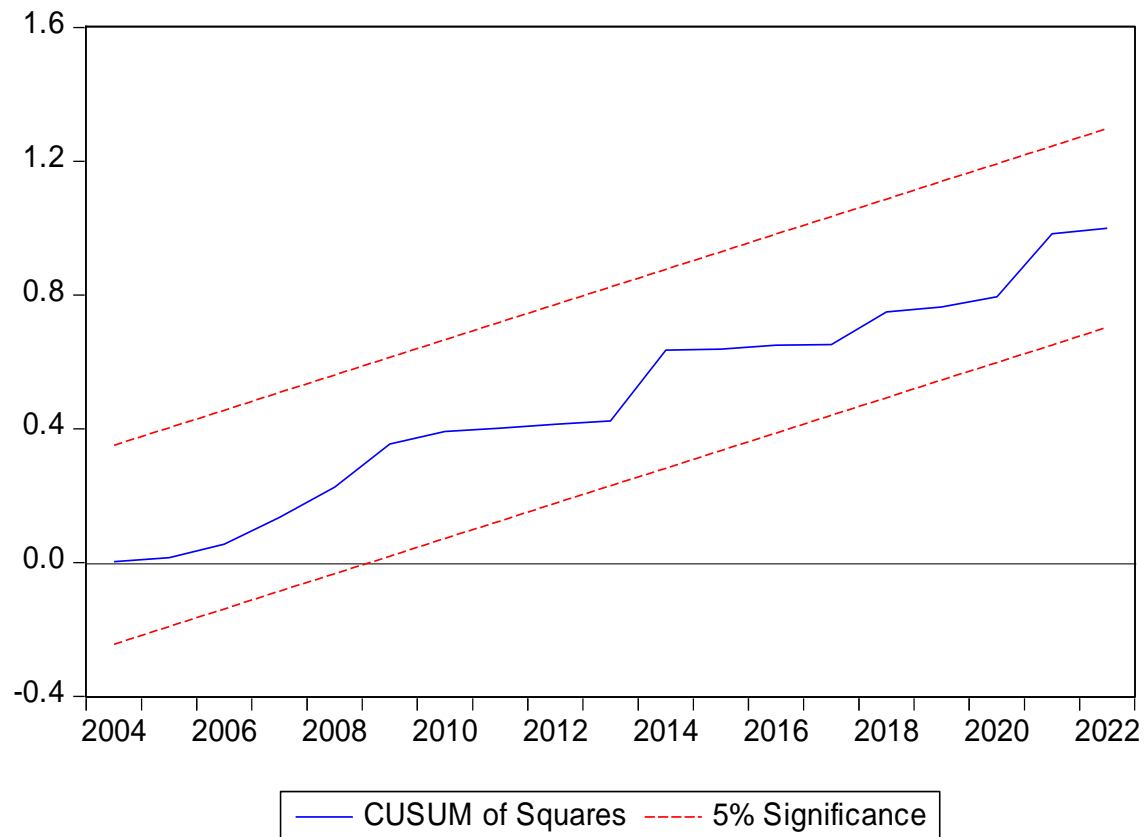
Figure 3.
CUSUM Test Inflation Model.

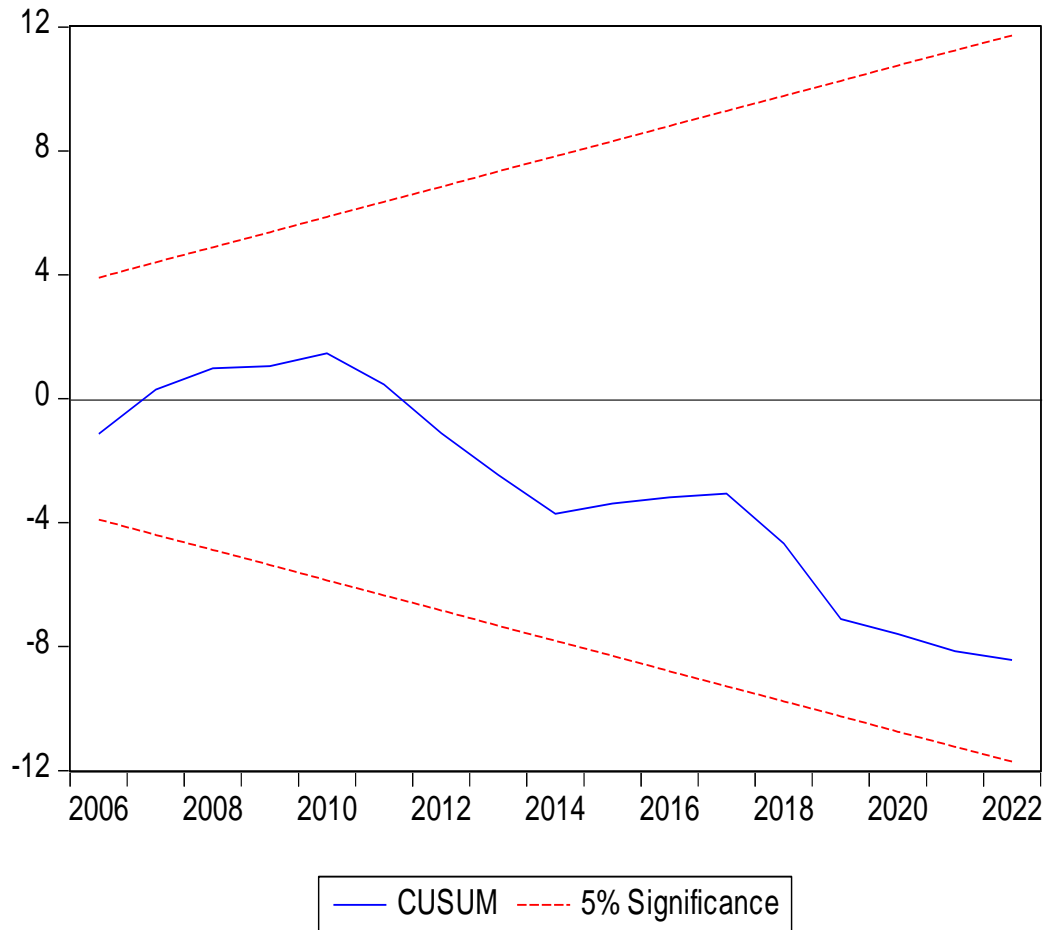**Figure 4.**
CUSUM Square Test Inflation Model.

Figure 5.
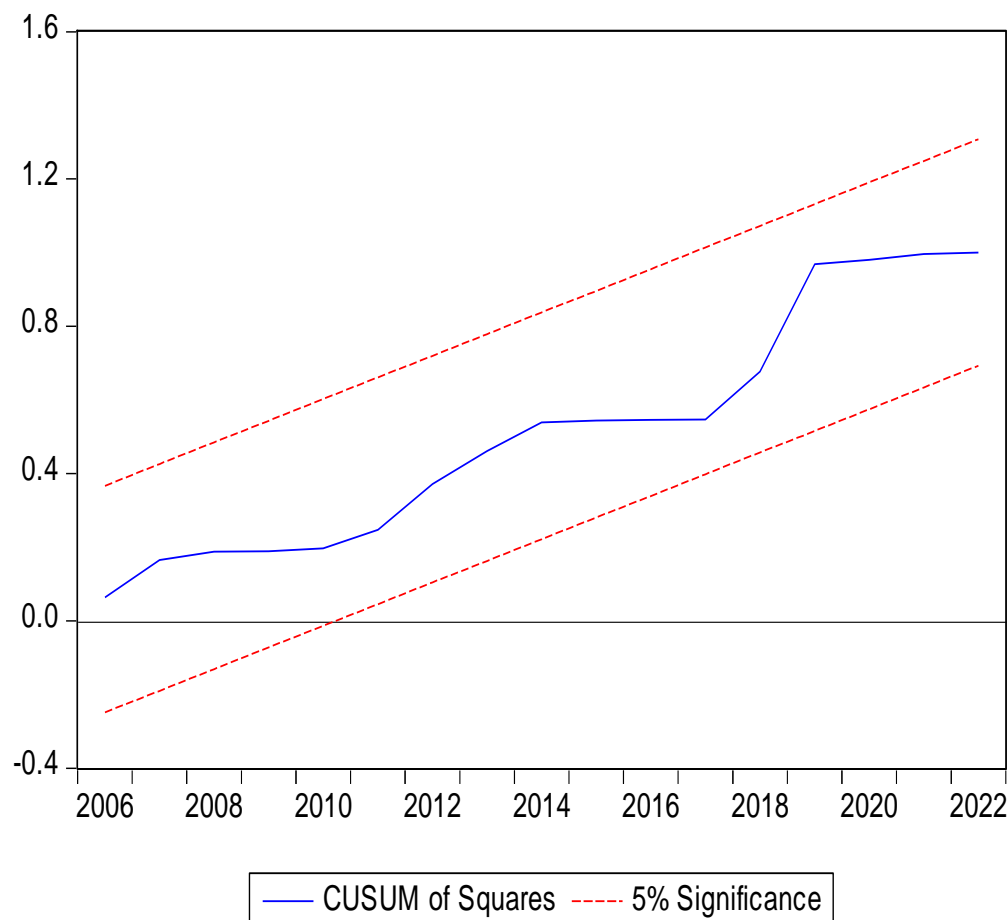CUSUM Test Economic Growth Model.

Figure 6.
CUSUM Square Test Economic.

Empirical studies related to the public debt-inflation relationship showed variations. Some research found that public debt positively influences the rate of inflation [75-81]. Other studies found an adverse correlation between the two [81-83]. In fact, the country mentioned, sample duration and estimation technique all affect the results. This study confirmed earlier research by demonstrating a positive long term co-integrated association between public and the rate of inflation.

According to Keynes (1936) cited in [4] private consumption is one of the three components of effective demand. The excess of effective demand over the level required for full employment is what causes inflation. This study finds that household consumption affects inflation positively. Additionally, this study demonstrates that inflation and economic growth are adversely correlated over the long term. This supports [84].

5. Conclusion

To determine the factors influencing inflation and how they impact economic growth in Lebanon from 1990 to 2022, this study employs the ARDL approach. The first step in the econometric test was to confirm stationarity. Only deposit interest rate (DEP) and household consumption (CONS) were stationary at level. The rest were stationary at first difference.

Under the ARDL assumptions, the study reveals that the long-term effect on inflation from household consumption and public debt is positive and significant. Moreover, governmental debt and household consumption do not have a short-term influence on the rate of inflation. In terms of economic

growth and inflation, the findings suggest that the inflation rate adversely affects both long-term and short-term economic growth. Overall, awareness of the dynamic relation between pricing levels and overall economic stability requires understanding of inflation and its effect on economic growth. The formulating of fiscal or monetary policy is directly impacted by inflation. Excessive inflation lowers consumer purchasing power and adjusts corporate strategies for capital allocation wages and pricing all of which affect future sustainability of economic growth. Low or stable inflation creates an atmosphere that allows for long term economic growth.

Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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