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The relationship between inflation and GDP with reference to oil based economy

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Abstract
This study attempts to scientifically focus on the relationship between Saudi Arabia's GDP and inflation rate from 1969 to 2020. To link GDP and inflation rate, the study used various econometric models, including Ordinarily Least Square (OLS). The unit root test (ADF test) and normality tests (Jarque-Bera) use to confirm the accuracy of the data in this study. The study elaborates several literature reviews in which scholarly research papers are referenced in various parts and sections of the study, thereby focusing research gaps and allowing the investigation to proceed. Using the OLS model, the results reveal no significant association between GDP and inflation rate in Saudi Arabia throughout the period studied.

Keywords: GDP, Inflation Rate, Economy, Unit root, Purchasing power

Introduction

Gross Domestic Product (GDP) growth rate gauges the national income and output of a country's economy. It estimates overall expenditure for the final worth of the services and articles produced within a certain period in a country. The primary way in which a country's economy can gain its monetary value is by using GDP objectives. Increased economic growth to end poverty and unemployment while ensuring a sustainable environment and a high quality of life. Saudi Arabia objected to fast economic growth and low inflation; whether the relationship between inflation and economic growth is much discussed in macroeconomics.

Gross Domestic Product (GDP) is a measure of economic advancement (GDP). It assesses the market values of the end goods of a country over a certain period: GDP = Consumption + Government Net Export + Export — the GDP defined by its officials' monetary, tax, and other economic policies. Many variables harm GDP, including inflation. The GDP-inflation link is complex. A favorable correlation between inflation and GDP is seen in conflicting studies focused on emerging countries. A negative correlation between inflation and GDP show in various study projects undertaken for industrial and developed countries.

The price increase has led to inflation. Increasing inflation will reduce the buying capacity of cash, lower consumption, and lower GDP. High inflation makes investments unworkable because future unsureness is generating, and because exports are becoming pricey, the balance of payments could influence. GDP is therefore decreasing more. GDP seems adversely linked to inflation. However, multiple studies show that there can also be a beneficial correlation. For example, the Phillips curve shows that high inflation is correlated with low unemployment, which is good for economic growth.

In a relatively sluggish economy, salary and unemployment increases are usually low, resulting in growing job demand. People's purchasing power is rising because of low unemployment and an increase in income. As a result, demand for products and services is growing, and total price levels are increasing.

However, the country's central bank can boost its interest rates to reduce inflation if the GDP rate of progress climbs too quickly. This can imply that money is more costly. Industries are also liable for expansion and recruiting borrowing. In short, the country's central bank will aim to extract some money out of the economy to reduce consumer spending and limit growing prices generally. The decrease in purchasing power will result in a demand collapse, resulting in a loss in production and GDP.

Literature Review

There are many reasons for growth where total demand rises quicker than total supply, thus mounting the cost of products and projects. The patchiness of total demand and supply is related to the government's shortage, the leeway of bank's loan charges, and the augmentation of outside demand.

Sarel (1997) [26] endeavors an alternative empirical analysis of the problem and also settles that inflation affects growth only if it breaches a specific "threshold" rate of inflation but not otherwise. He concludes that the inflation threshold of about 8% for a pooled sample of many countries, including Saudi Arabia, serves an excellent standard benchmark for the sample as a whole. Since the standard threshold is an estimate from a pooled sample, it may not be appropriate for a specific country if taken in separation. Therefore, a requirement to have yet another empirical valuation of the problem of outcome is inflation initiates to erode economic growth in a given economy. Kearny and Chowdhury (1997) [24] show no causality correlation between inflation and economic growth in 40% of the countries, bidirectional causality in about 20% of countries, and unidirectional relationship countries. The relationship between inflation and economic growth tested for industrial and developed countries where a negative relationship between inflation and economic growth. On the contrary, in developing countries, a positive relationship was found between inflation and economic growth. Ghosh and Phillips (1998) [7], studying the relationship between inflation and economic growth for 145 countries, found an encouraging affiliation between inflation and economic growth when inflation is small, yet this relation turned negative for high inflation.

They often emphasized in more recent economic history (Mervar, 1999) [18] that economic growth is an endogenous result of the economic system. Based on the evaluation of regressions performed for many countries (Mervar, 1999) [18], growth concomitant with the subsequent fiscal prerequisites: great level of reserves and outlay, well-educated labor force, and other arrangements that allowed abridgment of existing technology gaps. Jones and Manuelli (2001) [11] keep an eye on quiet in fiscal drills cum progress to inflationary loads, which demonstrate hardly any regards: fritter away in time and assets by public and establishments while endeavoring to guard their reserves against the extension. This astonishment expected take in a profligate slice of generation assets with a standard reduction in macroeconomic performance. Furthermore, moderated reserve funds attain moderated ventures, which ultimately lessen the growth level. Overall exposure about prospect value levels incapacitates the project and probable inferior capital preparation in the economy. Likewise, the earnings on schemes diminished by inflammation; hence, financial experts may put means into here and now capital instead of creating long haul suppositions. Financial professionals would rather put means into capitals to support expansion (property, value) than the right resources such as plant and gear (Jones and Manuelli, 2001) [11]. It may additionally debilitate the generation limit of the economy, ceaseless work transactions squander assets, and ascend in ostensible wages bringing about the ineffectiveness and lower development.

Ambler (2003) [3] put that more incredible growth discourages strength in universal exchange with swapping accomplices, impelling give off import replacing affairs, bringing about disequilibrium to determine installments in the type of a present record shortage. Diminished outside trade limits in any frugality after some time will restrain a state's capability to exaltation its contemporary record scarcity. Besides, with the unintentional competition in overall markets, profits get-together to the stock portion will shrink. Primarily, belongings will transfer far from the stock part into the non-stock section. Development talks down the honest appraisal of depression (i.e., the sum or rate by which yields or admins lessen in an inducement after a particular stage, usually an only year). For these circumstances, upper aids pronounced fetching about greater valuation compensated on profits. This situation is perhaps working to be bothersome to establishments longing to make diverse thoughts.

Rational about the influence of bulge on economic growth, Hossain *et al*. (2012) [8] place that but elevated increase level that forces financial carrying out or naught growth that deteriorates it, gentle (single digit) expansion rate is the sine qua non for fiscal blossoming. Ignoring that the matter postured by growth is an international genius since it cuts transverse above together formed and escalating frugality; in this way, its controller residues an "evil fantasy" to financial officials all through the domain. In Nigeria, concerns have raised over the diligent ascent in swelling rate with chaperon disintegrating of estimation of naira and general value shakiness. In such a manner, different researchers hold various perspectives on expansion and development relationships, some of which are condensed beneath. Mamo (2012, p.8) [17] states that "inflation and economic growth are the main concern of most countries of the world." Macroeconomists, policymakers, and central monetary authorities of all the nations need to know whether inflation is beneficial to growth or detrimental to growth.

However, investigating ties between economic growth and inflation rate (Mamo, 2012) [17] was also a crucial issue of macroeconomics investigation and strategy. There is no detailed classification of the relationship between economic growth and inflation. There are many controversial issues and findings of this association. Diverse researches (Mamo, 2012) [17] exhibited that the affiliation between fiscal development and price rises might be positive, negative, and neutral.

Barro (2013) [5] viewpoints that the significance of an increase in growth in the short run is inapt, nevertheless defiantly stimuli hopes for routine coziness. Kasidi and Mwakanemela (2013) [13] contend that inflammation adversely shakes progress, concentrating on no long-run link with expansion. Furthermore, Bruno and Easterly (1998) [6] claim that progress cuts entirely during extraordinary development times, containing swollenness in any case, progresses growth when its rate is at fetching miserable stages. It infers great blister does not affect development growth; it stimuli monetary improvement uncooperatively in the wake of achieving specific bounds (i.e., the level at which influence starts). Apart from these studies Sheel et al., (2020)

[27] focus on downstream trend of petroleum supply chain in India and also reflect many challenges while interviewing many petrol stations at various locations in India. In another very interesting study by Alshuwaiee *et al.*, (2020) [2] in their time series study of oil based economy Kuwait and discuss various macroeconomic factors such as GDP, inflation rate, oil prices and their impact on unemployment rate of Kuwait. Where Nurmakhanova (2020) [21] in his time series paper emphasis on the economy of Kazakhstan and discuss the relationship between real GDP, oil prices, exchange rates by employing Bayesian model from 2000 to 2017.

Ruminate a frugality where a specific portion of resources into two divisions, precisely: top stock and currency. Cash kept back for deployment and utilization. A developed growth level could take moderated operation percentage, while speculation may require augmentation since undertaking, ceteris paribus, acquires an advanced yield. On the other hand, with the small return for money, the net yield goes out to be little, and as an outcome of that, project and investment stock level drip. In the upshot, monetary growth drips under lesser exploitation, bring downhearted speculation, and low investment stock. Amidst more incredible inflationary heaviness, there are expected outcomes: First is a growth in the advance proportion because, as devaluation rises, the duty paid on capital lessened.

Objective of the Study

The objective of this empirical study divides into two sections

- First diagnostic and accuracy of residuals from 1962 to 2020 taken by applying ADF and Jarque-Bera test.
- In the second section, the OLS model is applied to ascertain the relationship between GDP and the inflation rate in Saudi Arabia.

Research Gap

To comprehend and study the outcome of GDP on inflation, the literature mentioned above found that the research should undertake with Saudi Arabian perspectives. Thousands of studies contend that there is a strong relationship between inflation and GDP. In order to trace the consequence of the variables, the researchers identified and measured the variables' long-run and short-run causality using an econometric tool known as the Granger causality test, which incorporates a vector error correction model to analyze both time-series causality relationships. A wide range of macroeconomic factors has influenced GDP. Even though it acknowledges that there is a link between GDP growth and inflation, it concludes that inflation will rise due to this GDP growth in Saudi Arabia since it is necessary to find out why the influence of GDP would increase or decrease in inflation.

Research Methodology

This work, conducted in Saudi Arabia, investigates the relationship between the country's GDP and inflation.

Research Model

A vector autoregressive model in time series suggested to predict single and more ever multiple time series variables. This model also predicts the dynamic behavior of multiple variables if they exist. The suggested model is very successful and easy to use for time series data analysis.

$$y1(t) = v10 + v12\ y2(t) + a11\ y1(t-1) + a12\ y2(t-2) + e1(t)$$

$$y2(t) = v20 + v21\ y1(t) + a21\ y1(t-1) + a22\ y2(t-2) + e2(t)$$

This is written to help researchers to know how to run VARs.

$$yt = v + A0\ yt + A1\ yt-1 + A2\ yt-2 + A3\ yt-3 + \cdots + Ap\ yt-p + et$$

Further, y = mx+c, where y is the dependent variable and x is an independent variable. This equation represents a linear relationship between two variables, x, and y. GDP is a dependent variable in the ongoing research, and the inflation rate is considered an independent variable.

Hypothesis (I)

H0:/ GDP growth is normally distributed
H1:/ GDP growth is not normally distributed

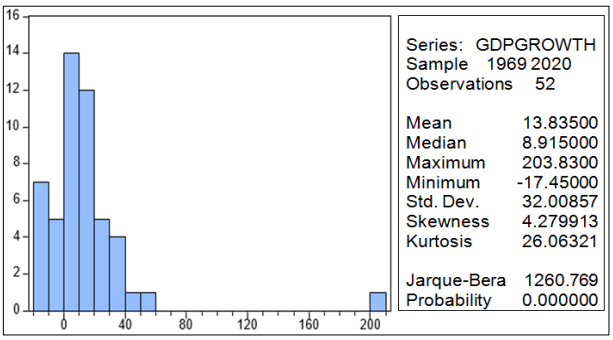

Fig 1

Analysis

To avert any data misalignment, researchers first conduct a diagnostic test commonly known as the Jarque-Bera Test to determine if all residuals taken for study normally distributed or not.

The table above clearly reflects that all residuals, including GDP growth and Inflation rate during the mentioned number of years taken for study, are not normally distributed; hence null hypothesis is rejected at a 5% level of significance.

Since the data analyzed here not normally distributed, and the researchers to find in this study that the ordinary least square method (OLS) of Regression Analysis not seriously required data to be normally distributed. Hence, applying and analyzing the regression method Jarque-Bera test is not required, but other statistics could have applied if data found normally distributed. Nevertheless, as essentials, it is required that all residuals should be virtually free of unit roots either at the level of first difference and so on before applying OLS.

Hypothesis (II)
H0:/ Inflation is normally distributed
H1:/ Inflation is not normally distributed

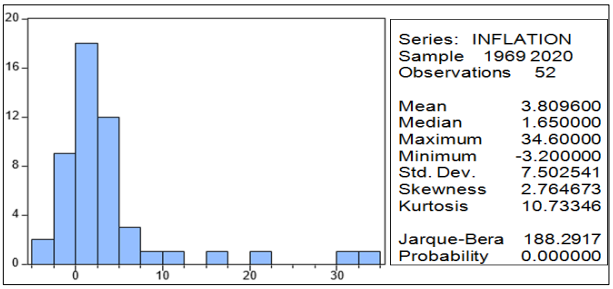

Fig 2

Analysis

The researchers are bound to check if the GDP residual is significantly normally distributed at a 5% level of significance or not. As per the GDP growth data as depicted in the figure from 1969 to 2020 of 52 observations. After applying the Jarque-Bera test, the GDP growth is not normally distributed; therefore, the stationary test is mandatory to check before applying Regression Analysis. Inflation residuals, too, are not found normally distributed here, and further Augmented Dicky Fuller Test (ADF) test to check whether data are stationary or not before applying Regression Analysis.

Hypothesis (I)
H0:/ GDP growth has unit roots
H1:/ GDP growth has no unit roots
Hypothesis (II)

Table 1

Lag Length: 0 (Automatic based on SIC, MAXLAG=10)			
		t-Statistic	**Prob.***
Augmented Dickey-Fuller test statistic		**-5.310229**	**0.0001**
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

*MacKinnon (1996) one-sided p-values.

H0:/ Inflation has unit roots
H1:/ Inflation has no unit roots

Table 2

Lag Length: 0 (Automatic based on SIC, MAXLAG=10) at level			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		**-2.354287**	**0.1598**
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

*MacKinnon (1996) one-sided p-values.

Table 3

Lag Length: 0 (Automatic based on SIC, MAXLAG=10) at Ist difference			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		**-5.165025**	**0.0001**
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values

Analysis

After applying the diagnosing test of Jarque Bera, the researchers have found that residuals for a study like GDP growth and Inflation rate are both found not normally distributed. Hence there will be a need to check whether residuals are stationary or not. Residuals must be stationary and free of unit roots before applying the regression analysis ordinary least square (OLS) method selected.

After applying the hypothesis as mentioned earlier, researchers have found that GDP contains no unit root; hence in such cases, the null hypothesis is accepted at the level. However, in the case of other residual inflation rates, it has been found that inflation has the unit root at the level. Thus null hypothesis is accepted; therefore, researchers have again applied the unit root test at the first difference and found that inflation-free from unit roots and feasible for applying serial correlation test and regression analysis.

Table 4

Breusch-Godfrey Serial Correlation Test:				
F-statistic	0.224790	Prob. F(2,46)		0.7996
Obs*R-squared	0.483944	Prob. Chi-Square(2)		0.7851
Test Equation:				
Dependent Variable: GDP%				
Method: Least Squares				
Sample: 1969 2020				
Included observations: 52				
Pre sample missing value lagged residuals set to zero.				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inflation	0.317704	0.730053	0.435180	0.6655
C	-1.221253	4.974106	-0.245522	0.8071
RESID(-1)	-0.081159	0.164133	-0.494473	0.6233
RESID(-2)	-0.104691	0.181005	-0.578386	0.5658
R-squared	0.009679	Mean dependent var		1.81E-15
Adjusted R-squared	-0.054907	S.D. dependent var		28.34187
S.E. of regression	29.10956	Akaike info criterion		9.656629
Sum squared resid	38978.85	Schwarz criterion		9.809590
Log likelihood	-237.4157	Hannan-Quinn criter.		9.714877
F-statistic	0.149860	Durbin-Watson stat		2.009677
Prob(F-statistic)	0.929257			

Table 5

Dependent Variable: GDP				
Method: Least Squares				
Sample: 1969 -2020				
Included observations: 52				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
Inflation	**1.982758**	**0.545255**	**3.636389**	**0.0007**
C	6.281483	4.551340	1.380139	0.1739
R-squared	0.215985	Mean dependent var		13.83500
Adjusted R-squared	0.199651	S.D. dependent var		32.00857
S.E. of regression	28.63557	Akaike info criterion		9.586355
Sum squared resid	39359.81	Schwarz criterion		9.662836
Log likelihood	-237.6589	Hannan-Quinn criter.		9.615479
F-statistic	13.22332	Durbin-Watson stat		2.091633
Prob(F-statistic)	0.000673			

Discussion and Conclusion

After applying various hypotheses to ascertain residuals 'normally distributed and ensuring residuals free from unit roots. Researchers applied other data analysis tools of serial correlation models known as the Breusch-Godfrey Serial Correlation LM Test and the ordinary least square method. Initially, no serial correlation was found amongst our study GDP growth and inflation rate at a 5% level of significance as probabilities, $p>0.05$; hence we accept the null hypothesis in that case. After that researcher has applied OLS and interpreted the result as mentioned below-

This study has finally focused on Regression Analysis, where GDP growth is a dependent variable, and the Inflation rate is independent.

Researchers have mustered the courage to take only 49 years of data reasonably enough and found viable this continuing research and analyzed these residuals by using the ordinary least square method (OLS). C in the table mentioned above shows the coefficient and demonstrated positive value as required, further followed by the standard error significantly less, making the study feasible. R square in the table above has shown the value of 0.215985, i.e., 21.5% that is slightly less significant but not affecting much-desired results during interpretations. Adjusted R squared is again noticed more or less, giving a similar outcome t as noticed in the forecast of R squared values in this study.

Since observations are reasonably large enough as required for any time-series data, log-likelihood in the table is moving towards zero as it should tend to move in this analysis. In this analysis, the researchers have analyzed Durbin-Watson statistics and found it as per requirement and close to 2 required to ascertain that residuals are free from serial correlation problems.

Conclusion

Utilized rigorous statistical methods including the Breusch-Godfrey Serial Correlation LM Test and Ordinary Least Squares (OLS) to analyze the relationship between GDP growth and inflation rate over 49 years of data. The findings indicate no significant serial correlation, supporting the validity of the applied models. The coefficient for inflation rate in the OLS regression was positive and statistically significant, affirming its impact on GDP growth. Although the R-squared value of 21.5% suggests a moderate explanatory power, the analysis meets the criteria for time-series data with satisfactory Durbin-Watson statistics, ensuring the residuals are free from serial correlation issues.

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