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The Gibson Paradox: An Empirical Examination for the Bangladesh Economy

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Abstract: The subject matter of this article is to pursue the existence of positive dependency between inflation and interest rate, known as "Gibson Paradox" which is in conflict to our traditional theory where a negative association ship between interest rate and inflation exists. Suitable ARDL technique is used to check the dynamics among variables with a view to confirming long run relationship between variables. Unit root test with various diagnostic tests empirically reveals Gibson Paradox is not valid for Bangladesh for short run and long-run both but they provides negative relationship with long term dependency by supporting the traditional theory. ECM shows about 42.26% is corrected each year form short-divergence to long-term equilibrium. It will contribute to the existing literature by using modern econometric techniques between inflation rate and interest rate during period 1986-2019.

Keywords: Gibson Paradox, Interest rate, Inflation, Unit root test, ARDL

1. Introduction

By studying over two hundred years of UK data Gibson in 1923 able to present pragmatic evidence that shows a positive association between price level and interest rates but this same results without empirical evidence was first presented by Tooke in 1844.This finding challenges and rejects the classical macroeconomic theory which predicts rate of interest is determined independently without affecting price level. Keynes strongly believed that the term "Gibson's paradoxes" was long-term interest rates and general price level changes. Since this relationship has no strong theoretical foundation this phenomenon becomes a controversial subject for further study. But Friedman and Schwartz (1982) rejected Fisher's findings because the distributed lags were estimated to be too long. John Maynard Keynes (1930) asserted that if demand for loans increased that could results to increase interest rate with a higher level of aggregate prices. Friedman and Schwartz (1982) had used data by covering Gold standard era and provide empirical evidence in the light of Gibson paradox and concluded that this was a paradox following the gold standard period. In 1980s, however, Dwyer (1984) concluded that Gibson Paradox may not hold over the time period throughout countries. Corbae and Ouliaris (1989) study found spurious results of Gibson paradox by examining the data of US and UK for the period 1920-1987. This disputed Gibson Paradox was rejected at the prior of 1990s, as it doesn't satisfy the time series properties. Recent empirical studies on this subject, however, continue to produce mixed results. In the last four decades, Klein (1995) discovered evidence to back up the Gibson paradox.

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The correlation suggested by monetary theorist should have been changes in the rate of interest and inflation that is the level of price. Central banks set monetary policy on this basis, and now that the gold standard is no longer in use, people who have studied the dilemma are likely to conclude that it is no longer relevant. There is no such link, according to empirical studies that is, instead of resolving Gibson's paradox, the Neo-Keynesian and monetarist schools have chosen to disregard it and 90s econometric techniques also rejected the Gibson paradox as data produced failed to satisfy the properties hold in time series. This appears to be a plausible explanation for today's lack of interest in the subject, which many expert economists are ignorant of.

Gibson's paradox is based on 200 years of long-run empirical evidence, from 1730 to 1930, when Arthur Gibson found that fluctuations in the yield on British Government Consols 2.5 percent Stock were positively connected with wholesale price levels. The Gibson paradox has not been investigated previously in Bangladesh as far as our knowledge. Validity of Gibson Paradox checking after fifty years of independence in Bangladesh is necessary since it may yield crucial insights for policymakers when they enact or design policies that will benefit the country. If this relationship continues, we will be able to claim supply-side dominance for our country. This paper therefore addresses the research gap of no previous study in Bangladesh with a view to contributing existing literature.

2. Literature Review

Friedman and Schwartz showed in 1982 that the relationship between Gibson paradox in the United States in their monetary trends which are unequivocally and clearly established for the period 1880-1914 during the operation time of Gold Standard.By investigating their work, Lee and Petruzzi (1986) by using the data for Great Britain (1800–1981) and the United States (1730–1980) supported the inference; the study again carried out when gold standard was in effect which did not lead to any definte conclusions. Further study carried out by Benjamin Klein (1975), Barsky and Summers (1988), Mills (2008) and Dowd and Harrison (2000) provide documentation that, with the end of the gold era, the statistical correlation of prices to nominal rates changes substantially. Chung, Chen, Jevons and Lee (1990) confirmed the evidence of the dynamic structural shift of their associationshipresulting from a shift of monetary standard. Ibrahim and Williams (1978), Benjamin Klein (1975) and Dwyer (1984) demonstrated significant changed resulted in nominal yields and price levels following the end of the gold standard. Chung, Chen, Jevons, and Lee discovered the dynamic relationship between structural changes in prices and interest rates resulting from monetary standard changes in 1990.Shiller & Siegel (1977) tried to investigate this correlation between prices and interest rates, which has been a Gibson Paradox (GP) for the last quarter of a millennium. Spectral methods used to confirm the correlation of prices and long-term rate of interest rate(the Gibson Paradox)for very long-term swings, but suggested a substantial short-term correlation of interest rates alone, which we referred to as the Kitchin phenomenon. Previous clarifications of these interactions also neglected to differentiate between interest rate and cycle times. Their findings deny Irving Fisher's explanations of "price expectation" and the velocity of money explanations from Sargent-Wickseell. H. Summers & Barsky (1988) contribute a new aspect of learning to grasp the Gibson paradox (GP), which decreases the equilibrium

relative price of gold caused by real rate of return in the economy with the nominal price of gold anchored by the government, forcing the price level to rise. The system attempted to balance gold allocation between monetary and nonmonetary purposes. Dowd and Sampson (1993) used the Johansen cointegration technique to analyze the impact of gold reserves and interest rates on the gold standard price. It concludes that there are two balanced relationships between gold stock, price level, and interest rate, and that conventional Gibson's paradoxical conclusions are mis-specified. Based on fresh data from Chinese monetary history Cheng, G. Kesselring, and Brown (2013) concluded that the Gibson paradox (GP) existed throughout China's silver-cored metallic standard period. Abdullah (2013)attempted to establish empirical correlations among gold prices, IR and commodities prices. He claimed that the value and purchasing power of US dollar and UK pound. Theirfindings about purchasing power are the associations to its real interest rate and exchange rate so that changes in prices are the result and not the cause. Caporale & Škare, (2014) adopts a non-linear multivariate system to analyze the paradox of Gibson in the Netherlands over the period 1800-2012. In specific, the methods used are SSA (singular spectrum) and MSSA (multichannel singular spectrum). In the Netherlands over the past 200 years, it is demonstrated that gold price fluctuations or shifts in monetary policy regimes cannot consider for the actions of the prices of government bonds and yields. Ogbonna (2014) examines the presence of a substantial long-term relationship between price levels and nominal interest rates and examines the potential causal correlation between interest variables for the periods from 1970 to 2012, by using quarterly data on Nigeria. To evaluate the number of co-integrating vectors and to check the existence and direction of causality between price levels and nominal interest rates in Nigeria, the co-integration method proposed by Granger causality and Johansen (1988, 1991) that lends credence to the Gibson Paradox in Nigeria, which suggests that price levels and nominal interest rates are trending in the same direction over time and in a positive direction. When the ADL models were used to quantify the degree of long and short-term causality between interest variables, the results showed that they have a very strong causal relationship in the long run. Suggesting supply side dominates the CPI in Nigeria, rather than demand side. So, Policy attempts to reduce inflation while retaining a high nominal interest rate may therefore prove ineffective in Nigeria as both shares a significant positive correlation.

3. Methodology of this study

Source and Description of Data

We will use yearly time series data generated by the World Bank Development Indicator (WBDI) for the period 1986-2019 to investigate the Gibson paradox for Bangladesh. We'll use the lending interest rate (percentage) or IR, and the consumer price index (CPI) to measure inflation. If there are positive correlations between IN and IR, which is the objective of this research, we may conclude that the Gibson paradox (GP) is valid for Bangladesh, but if it doesn’t hold, it indicates the support of traditional validity in the context of Bangladesh. If we convert all of the variables to log form, we can estimate elasticities that is a more convenient way to explain the model. For econometric analysis, we will use the statistical packages of EViews 9.0.

The nature of the variables is given below.

Table 1: Variables Description

Variables	Nature
LIR	Natural log of Interest rate
LIN	Natural log of Inflation rate

Source: WDI

Nelson and Ploser (1982) showed that time series produced spurious results which is misleading to our objective if there exist unit root problems. So, before running ARDL, it is necessary to check the unit root problem to analyze the validity of the model. Numerous tests are used to find the unit root problem among them widely used approach is Augmented Dickey-Fuller (ADF) test. The cointegration of variables can be tested using a variety of approaches, but the ARDL bounds test is a popular choice because it allows for the combination of I (0) and I (1) series.

4. Results and Discussions

The stationarity of variables will be checked using the ADF unit root test, and the results will be presented in Table 1. Table 1 shows that they are stationarity at the first difference but not at the level, indicating that they are integrated of order I(1) in nature.

Table 2: Results of Unit root test

Variables	H_0 = Time series is non-stationary					
	In level form			In first difference form		
	Test Statistic	Prob*	Result	Test statistic	Prob*	Result
LIR	-1.5425	0.4997	Do not reject	-4.5751	0.0009	Reject
LIN	0.4857	0.9836	Do not reject	-4.2498	0.0022	Reject
Decision	Nonstationary			Stationary		

Source: Software output by using Eviews 9.0

We apply the ARDL bounds test technique to find out the cointegration between LRI and LIN in the context of Bangladesh. The F-statistic is compared to the upper and lower bound to test the cointegration. The F-statistic of the bounds test in table 4 is 7.969346 which is much larger than the 1% critical value of the upper bound of Pesaran et al. (2001) 7.84 so that it can be concluded that LRI and LIN are cointegrated. It can be concluded that the variables under this study are cointegrated, and they have long-term convergence.

Table 3: Results of ARDL Model

Dependent Variable: LRI Selected Model: ARDL(2, 4)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LRI(-1)	0.939498	0.178624	5.259645	0.0000
LRI(-2)	-0.362152	0.168370	-2.150932	0.0427
LIN	0.139344	0.442186	0.315125	0.7556
LIN(-1)	0.825843	0.728555	1.133536	0.2692
LIN(-2)	-0.653826	0.738428	-0.885430	0.3855
LIN(-3)	0.559041	0.728492	0.767395	0.4510
LIN(-4)	-0.961587	0.462619	-2.078571	0.0495
C	1.292019	0.347821	3.714608	0.0012

Source: Software output by using Eviews 9.0

Table 4: ARDL Bounds Test

Significance	F-statistic= 7.969346	
	I(0)	I(1)
10%	4.04	4.78
5%	4.94	5.73
1%	6.84	7.84

Source: Software output by using Eviews 9.0

In the short run, both LRI &LIN are significant at 5% level of significance. The negative value of ECM (-1) with statistically significant model are indicated to show the short-term deviation to long-run deviation, which is about 42.26% that is corrected each year form short divergence to long -term equilibrium which leads to 2.5 years to correct the equilibrium.

Table 5: Short Run Model

Cointegrating Form				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LRI(-1))	0.362152	0.154158	2.349229	0.0282
D(LIN)	0.139344	0.423470	0.329052	0.7452
D(LIN(-1))	1.056372	0.447528	2.360459	0.0275
D(LIN(-2))	0.402546	0.458191	0.878555	0.3891
D(LIN(-3))	0.961587	0.452412	2.125466	0.0450
C	1.292019	0.334537	3.862111	0.0008
ECM(-1)	-0.422654	0.103540	-4.082056	0.0005
ECM = LRI - (-0.2157*LIN)				

Source: Software output by using Eviews 9.0

As LRI and LIN are cointegrated, then we can construct the long-term association ship. Here, LRI is the dependent variable and the explanatory variable is LIN. The LR outcomes are as follows in Table 6. Here the explanatory variable LIN is significant at the given level of significance. The results shows a 1% rise in inflation rate will cause to decrease the interest rate by 0.21%.

Table 6: Long Run elasticities

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIN	-0.215744	0.045619	-4.729308	0.0001

Source: Software output by using Eviews 9.0

Diagnostic Test

It is essential to perform the model diagnoses which includes normality test, serial correlation, heteroscedasticity, stability test etc. For the normality test, it is assumed that if the probability value is greater than 5%, in this case 69% that rejects the null hypothesis thus the residuals are normally distributed. Figure-1 shows the normality plot which is shown below.

The diagnosis in the ARDL model includingnormality tests, serial correlation test, heteroscedasticity test and finally stability test etc. should be monitored. For the normality test, it is assumed that if the probability value is greater than 5% In this case, 69 percent, which rejects the null hypothesis that means that residues are normally distributed. The normality plot below appears in Figure 1by using Eviews.

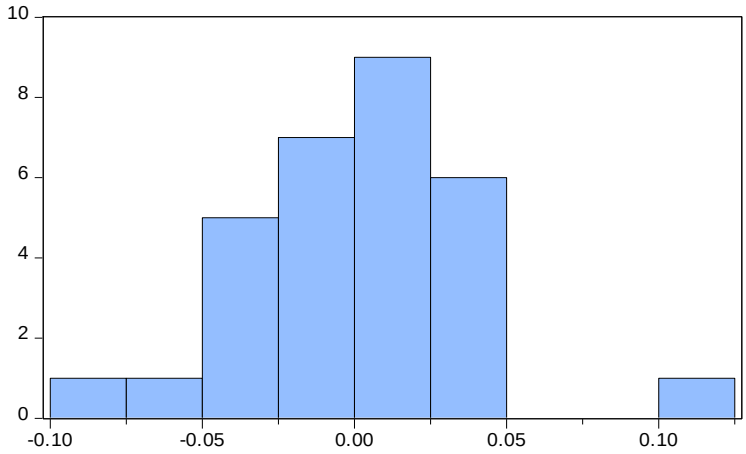

Figure 1: Normality Test

The results of several diagnostic tests are listed in the tables below, from where it is clear that the residuals are not serially correlated (null hypothesis of “no serial correlation” is not rejected at 5% significance level which is 22%), there is no heteroskedasticity problem (null hypothesis of homoscedasticity is not rejected at 5% significance level which is35%). Moreover, the model is correctly specified (null hypothesis of correct specification is not rejected at 5% significance level which is 25%).

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	1.633499	Prob. F(2,20)	0.2202
Obs*R-squared	4.212402	Prob. Chi-Square(2)	0.1217

Source: Software output by using Eviews 9.0

Ramsey RESET Test			
	Value	df	Probability
t-statistic	1.177143	21	0.2523
F-statistic	1.385666	(1, 21)	0.2523

Source: Software output by using Eviews 9.0

Heteroskedasticity Test: ARCH			
F-statistic	0.901860	Prob. F(1,27)	0.3507
Obs*R-squared	0.937354	Prob. Chi-Square(1)	0.3330

Source: Software output by using Eviews 9.0

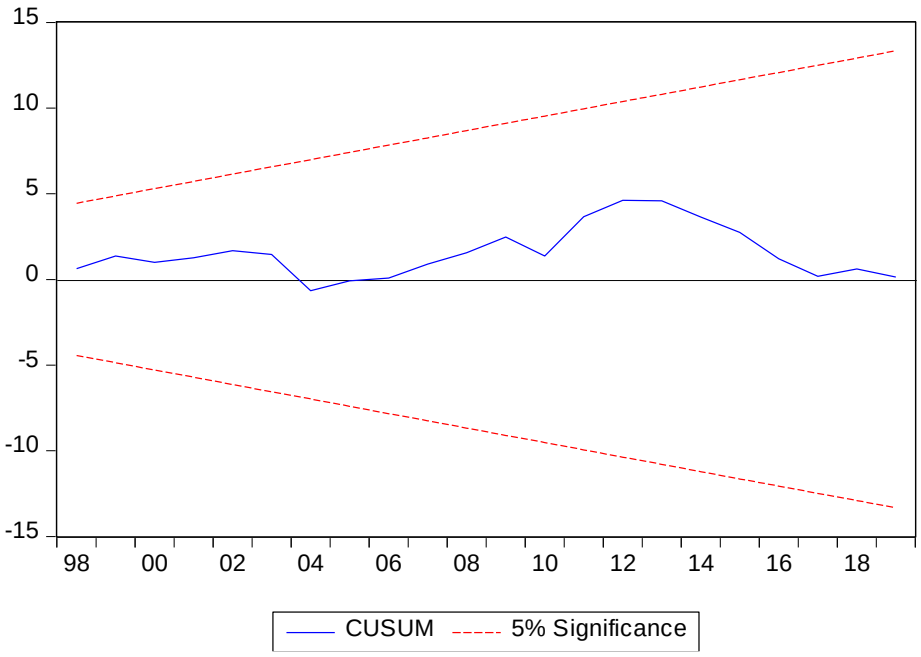

Figure : CUSUM Stability test

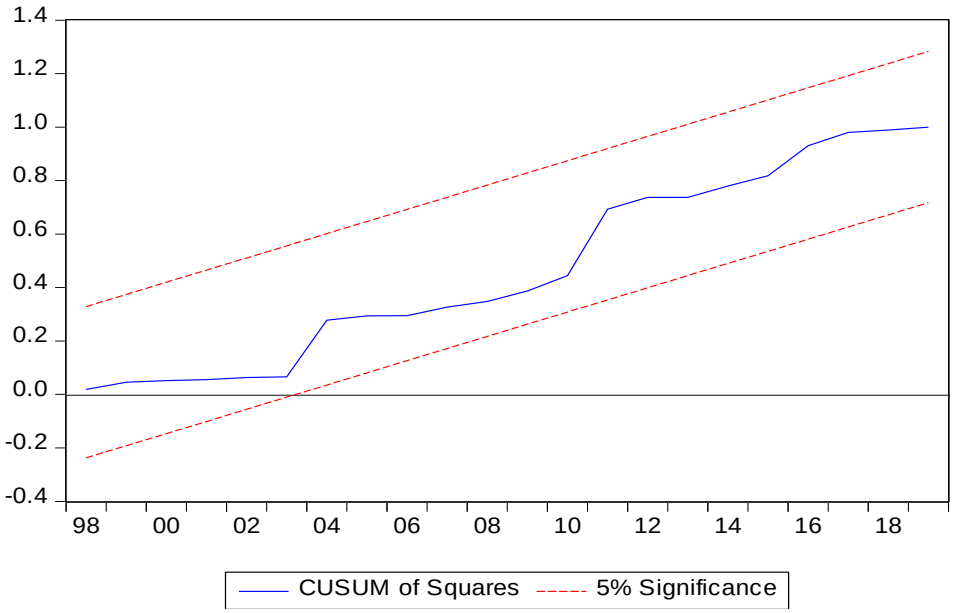

Figure : CUSUM Square Test

5. Conclusions

The study of the relationship between inflation and interest rates for emerging economies, is an endemic feature of today's society which will help the policy makers to formulate their policy in their interest. In an applicability for Bangladesh econometric study found Gibson paradox (GP)is not valid but it supports the traditional relationship which tells us interest rate and inflation rate are negatively related. Empirical results show a 1% rise in inflation rate will cause to decrease the interest rate by 0.21%. ECM shows the speed of adjustment which is 42.22 percent. So, it takes almost 2.4 years to correct the short-run deviations from long-run equilibrium. In the long-run, there exists a negative relations between inflation rate (IN)&and interest rate (IR)which rejects the validity of the Gibson Paradox in the context of Bangladesh. It's worth noting that Covid-19 provides a fresh perspective to our investigation. The Covid-19 event demonstrates how delicate our accomplishment is! Gibson's paradox is especially relevant since it links important policy variables when various policies are considered.Various research show that Covid-19 has the ability to undo all of humanity's advances over the last few decades. As a result of the strong negative connection between CPI or inflation and lending interest, policy attempts to cut inflation while keeping the lending interest rate high may be effective in Bangladesh. As a result, policymakers should consider the Gibson paradox's relevance to Bangladesh when making important decisions.

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