Do Oil Shocks Matters For The Inflation Rate In Bangladesh?

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Abstract-

- ***Background/ Objectives:***

In recent years oil prices have fluctuated extremely. Bangladesh is an oil-importing country and it has strong volatility of oil prices impacts on its economy. Especially oil shocks have a crucial role on several macroeconomic indicators mainly inflation rates in Bangladesh. This paper estimates the effects of oil price changes on inflation for Bangladesh.

- ***Methods/ Statistical analysis:***

In this paper, we use the co-integration approach and vector error correction model to investigate the oil shocks impacts on the inflation rate in Bangladesh. Time series yearly relevant variables from different sources are introduced on the model for the analysis. The Stata and R-Studio software were applied in this paper.

- ***Findings:***

The result shows that there is a negative relation between the consumer price index in Bangladesh and global oil prices. This is contradicted to the normal belief but the short-run adjustment coefficient c1 is statistically significant and the sign of the coefficient is positive which means that the long-run equilibrium is not stable when there are any shocks in the short-run. For these results, the proper initiative should take to subsides on the oil price to the domestic market to make inflation consumer-friendly. Another finding from the control variable broad money supply which has positively influenced the consumer price index and statistically significant.

- ***Improvements/Applications:***

This finding will encourage policymakers, monetary authorities, and academicians to formulate more supportive policies and strategies to respond to oil price shocks more precisely.

Indexed Terms- Global oil price, Inflation, Consumer price index, Unit root, Co-integration, VECM.

I. INTRODUCTION

Oil price fluctuation does impact badly on inflation cause the maximum world production of consumer goods is directly or indirectly involved in oil. Such a change is price can cause a greater impact on the market mechanism. It can change the price of the product. The price stability of the national economy is one of the key matters of national well-being. Maintaining various market price unpredictability for goods and services allows getting constancy in output and stock management. The further production process is at risk when the price volatility rate is high. In most cases central and reserve banks, targeting inflation rate through different transmission channels of monetary policy such as interest rate policy to affect the real sector. In some countries, most often emerging ones or those being transitory, cost inflation prevails. In this case, various shocks affect consumer prices rate. These are changes in budget spending, dependence on the imported goods and services, tax and fiscal policy, dependence on the currency rate, monopolistic or oligopolistic (including cartels) market structure make the national economy inelastic and at the same time sensitive to negative shocks in costs. Such disorganization of the market economy may be even deepened when the country largely depends on imported oil. Oil has diverse uses such as transportation, energy production, consumer good production, etc. So there is a possibility of an oil price

effect on the goods and services markets of an economy.

II. LITERATURE REVIEW

We refer to the related literature on the paper. A bunches of statistical reviews of the link between oil prices and macroeconomic variables are presented in this paper. Alexander bass (2019), a Russian researcher, found that oil prices, exchange rates, and consumer inflation are co-integrated in the long run. The results also show that there is a statistically significant relationship between changes in world oil prices, CPI, and exchange rate. Nabila Asghar et al (2015) investigate the long-run pass-through of world oil prices to domestic inflation using monthly data from January 2000 to December 2014 in Pakistan. The results of the study describe that the long-run inflation rate in Pakistan is significantly affected by international oil prices and exchange rates. Furthermore, the oil price has a positive relationship with inflation, contrary nominal exchange rate has a negative relationship with the inflation rate in Pakistan. Lutz Kilian (2014) proposed an empirical study that provided evidence that a major component of oil price fluctuations is explained by oil demand shocks connected with the global business, while oil supply shocks sometimes play a major role. Additionally, the demand and supply factors, financial factors of oil future trade provide an alternative transmission channel of expectations on the oil price. Komain Jiranyakul (2015) uses monthly data to inspect the impact of oil price shocks on the national inflation rate from 1993 to 2013 in Thailand. Both the linear and nonlinear co-integration tests were applied to examine the long-run relationship among price level, industrial production, and the real price of oil. The results of the study showed there is a positive relationship between an oil price shock and domestic inflation in the short-run. H. C. Basnet and K. P. Upadhyaya (2015) analyzed the impact of oil price shocks on inflation, real output, and the real exchange rate in five ASEAN countries using a structural VAR model. The co-integration tests indicate that the macroeconomic variables of these countries are co-integrated and share common trends in the long run. The impulse response functions reveal that oil price fluctuation does not impact the five ASEAN economics in the long run and much of its effect is absorbed within five to six quarters. Gelos and Ustyugova (2017) estimate country-by-country augmented Phillips curves using data from both developing and developed countries for the period between 2000 and 2010. Different from other studies, their analysis proposes that only significant factors explaining cross-country differences are the high fuel concentrations and preexisting inflation levels in the effects of food and oil price shocks. Implementation of monetary policy, including the presence of inflation targeting regimes, does not seem to be a major determinant of the degree of pass-through. Burakov (2017) a Russian researcher ratifies the existence of a long-term relationship among oil prices, emigration, and economic growth. He found that there is direct causality between oil prices and economic growth, as well as between economic growth and emigration in the short-run. By this means, the presence of transmission in the form of an indirect channel of oil prices' shocks on migration decisions of households is confirmed. Most of the study reveals that dependency on the volatility of oil prices can cause a sharper decline in oil prices may lead to a rise in consumer prices. As well as Most of the researchers use monthly data for the analysis some use quarterly data but nobody uses yearly data in this context. Also, no study is noticed about this issue in Bangladesh.

III. METHODOLOGY

- Model for the analysis

Our aiming variable is inflation. Here the consumer price index is the dependent variable. The other three variables are respectively global oil price (Brent), the exchange rate of Bangladesh, the broad money supply of Bangladesh these variables are used as the exogenous variable.

So the functional form of the model is,

Cpi = f (gopb, exr, bms)…….. (1)

Where,

Cpi= consumer price index

Gopb=global oil price (brent) in USD per barrel

Exr= exchange rate of Bangladesh

Bms=broad money supply of Bangladesh in USD

The linear natural log form of the model is,

$\ln cpi_t = \beta_0 + \beta_1 \ln gopb_t + \beta_2 \ln exr_t + \beta_3 \ln bms_t + u_t$.....……(2)

The vector error correction model for the analysis

$$\Delta\, cpi_t = \beta_0 + \sum_{i=1}^{n} \beta_i\, \Delta cpi_{t-i} + \sum_{i=0}^{n} \alpha_i\, \Delta gopb_{t-i} + \sum_{i=0}^{n} \gamma_i\, \Delta exr_{t-i} +$$

$\sum_{i=0}^{n} \delta_i \Delta bms_{t-i} + \varphi z_{t-1} + u_t$ …… (3)

$cpi_t = \beta_0 + \beta_1 gopb_t + \beta_2 exr_t + \beta_3 bms_t$ ……(4)

$z_{t-1} = ECT_{t-1} = cpi_{t-1} - \beta_0 - \beta_1 gopbt\text{-}1 - \beta_2 exr_{t-1} - \beta_3 bms_{t-1}$ ……... (5)

This model will show us the short-run and long-run effects on our model. Z term is the error correction term which has some coefficient but the first coefficient which must be negative and statistically significant to determine the stable equilibrium. Here Δ mean the change, subscript t means the time, where i=1,2,3……. β_0, β_1, β_2, β_3 are the estimator and u_t is the error disturbance term. △ denotes the change.

- Data collection

Oil producers extract crude, petroleum oil from the mine. Major oil-producing countries are the USA, KSA, and some other Arabian countries such as Qatar, Iran, Oman, Iraq, etc. If there is any problem (say, over-extraction, demand fall) in an oil-producing country then it will impact badly on the world economy. We collect crude oil price (Brent) USD per barrel data from U.S. energy information administration (EIA). This is world market data. The variable consumer price index is collected from the WDI database the base year is 2010 in the context of Bangladesh. As the consumer price index is another measure of inflation or inflation is measured from the consumer price index so this variable is chosen instead of inflation. Another variable broad money supply is also collected from the World Bank database in the context of Bangladesh where the unit of the data is taka. And the Bangladesh exchange rate per USD official data is collected from the World Bank database also. All the variables are collected in the yearly format. And we collect the time series data from 1992 to 2018. The observation is 27 in the analysis.

- Model estimation procedure

First, we check the stationarity of the variable as if the mean and variance of the variable remain constant over time. Then select the appropriate lag length for the analysis through the different estimation criteria. After selecting the lag to determine the existence of at least one cointegrating equation using the most usual Johansen co-integration test. If we have the cointegrating equation then we run the vector error correction model. Afterward, some residuals test is done to make sure the residuals have no problems. Another estimation impulse response function is also performed later in the analysis.

Table: 01 Unit root test

Variable	At level	t statistic	prob	At first difference	t statistic	prob
Lncpi	Has unit root	0.4948 (5% critical value -2.98)	0.9830	Has not unit root	-3.8976 (5% critical value -2.98)	0.0067
Lngopb	Has unit root	-1.06979 (5% critical value -2.98)	0.7120	Has not unit root	-4.2274 (5% critical value -2.98)	0.0031
Lnexr	Has unit root	-2.6562 (5% critical value -3.00	0.0975	Has not unit root	-3.8616 (5% critical value -2.99	0.0075
Lnbms	Has unit root	0.1167 (5% critical value -2.98	0.9609	Has not unit root	-4.1435 (5% critical value -2.98	0.0038

Source: Author's own calculation

We have done ADF test to find out the stationarity among variables. ADF Unit root test is the most convenient method to find the stationarity of the data. From the table, we see that none of the above variables are stationary at level but at first differences at the chosen level of significance.

- Lag length selection

According to the Akaike, Schwarz, and Final prediction information criteria appropriate lag length can be chosen. For the model here we have chosen the appropriate lag length based on the Akaike Information Criteria. In these criteria, the optimal lag is 3.

- Johansen co-integration test

Johansen co-integration is done using the appropriate lag length to find out the cointegrating equation among the variables. There must be at least one cointegrating equation among the variable to run the vector error correction model. In this testing procedure, we have found 4 cointegrating equations among the variables.

Table: 02 Johansen co-integration test

Hypothesized no. of CE(s)	Eigenvalues	Trace statistics	0.05 Critical values	Prob**
None*	0.8073044	85.74979702	47.85612715	0.00000144
At most 1*	0.6373431	47.87699457	29.7970733	0.0001672
At most 2*	0.5622427	24.5481363	15.49471287	0.00166610
At most 3*	0.2143308	5.548049081	3.841465500	0.0184946

Source: Author's own calculation

Trace test indicates there are four cointegrating equations at the 0.05 level. They are statistically significant at the chosen level of significance. Here the * indicates a 95% significance level. This result indicates that the variables have a long-run relationship. This is the validation of the vector error correction model.

- Vector error correction model (VECM)

The VECM is now applicable as there is a cointegrating equation among the variables. If there is no co-integrating equation, then we can use the ARDL model to find the relationship. As we have four co-integrating equation, so we can apply vector error correction techniques. The VECM shows the long-run and short-run association among the variables. Here we will find an ECT coefficient which is the short-run adjustment coefficient. If this coefficient is negative and significant it means that the long-run coefficient will be adjusted or converges to the equilibrium at the spin of the coefficient.

Table: 03 Vector error correction model

Ln cpit-1	Ln gopbt-1	Ln exrt-1	Ln bmst-1	C
1.0000	6.601916	-1.684302	-2.605575	51.94885
	(0.39833)	(2.28985)	(0.46367)	
	{16.5738}	{-0.73}	{-5.61947}	
	[2.064*]	[2.064**]	[2.064**]	

Source: Authors' calculation

$\ln cpi_{t-1}$= -51.95 - 6.602 $\ln gopb_{t-1}$ +1.68 $\ln exr_{t-1}$+2.61 $\ln bms_{t-1}$

The result generated from the VECM indicates that in the long run for a percentage increase in the global oil price (brent) will decrease the consumer price index by 6.602 percent and this is significant at a 5% level of significance. Again 1% increase in the exchange rate will increase the consumer price index by 1.68% which is not statistically significant. And a 1% increase in broad money supply will increase the consumer price index by 2.61% and this is statistically significant. On average "ceteris paribus". Tactfully the interpretation is true under the condition of 'other things remain constant'.

Table: 04 Short-run speed of adjustment coefficient

	Coefficient	Std. Error	t-statistic	Prob.
C(1)***	0.0123136	0.0031520	3.9065954	0.00025...
C(2)	-0.232059	0.2329288	-0.996268	0.32340...
C(3)***	-0.812712	0.2560367	-3.174200	0.00244...
C(4)**	-0.045660	0.0174548	-2.615937	0.01141...
C(5)**	-0.050746	0.0224963	-2.255756	0.02801...
C(6)*	0.2932664	0.1613234	1.8178786	0.07443...
C(7)	-0.025418	0.1262344	-0.201355	0.84115...
C(8)	-0.143754	0.0945082	-1.521081	0.13386...
C(9)	-0.144808	0.08738 15	-1.657195	0.10307...
C(10)	0.1655348	0.0381084	4.3437865	5.94426...
C(11)**	-0.101243	0.0410958	-2.463588	0.01685...
C(12)**	6.6978626	3.0369149	2.2054824	0.03154...
C(13)	5.046313	3.3381955	1.5116889	0.13623...
C(14)	0.342008	0.2275756	1.5028358	0.13850...
C(15)	-0.033687	0.2933069	-0.114853...	0.90897...
C(16)	-0.621754	2.1033271	-0.29560	0.76862...
C(17)	2.8894960	1.6458386	1.7556375	0.08461...
C(18)	1.7729920	1.2321945	1.4388897	0.15574...
C(19)	1.0662802	1.1392771	0.9359270	0.35332...

C(20)**	-1.172223	0.4968556	-2.359283	0.02182...

Source: Authors' calculation

The adjustment coefficient is unsatisfactory in this analysis. It shows that the long-run equilibriums are not stable. As the sign of c(1) is positive and also statistically significant indicates that when there is any shock in the economy, the long-run equilibrium doesn't stand still and it diverges from the equilibrium at the speed of 1.23 %.

Table: 05 Residuals test

Theory	Name of the test	Null Hypothesis H0	Test statistic	Prob.	Decisions
Normality Assumption of Residuals	Jarque-Bera test	Residuals are normally distributed	5.2975	0.7252	H_0 cannot be rejected at any chosen level of significance
Serial Correlation	Breusch-Godfrey Serial Correlation LM test (lag 3)	There is no serial correlation	20.3752	0.2037	H_0 cannot be rejected at any chosen level of significance
Heteroscedasticity of the variance	White Heteroscedasticity (no cross term) Chi-squares test	Homoscedastic variance	184.9294	0.3849	H_0 cannot be rejected at any chosen level of significance

Source: Authors' calculation

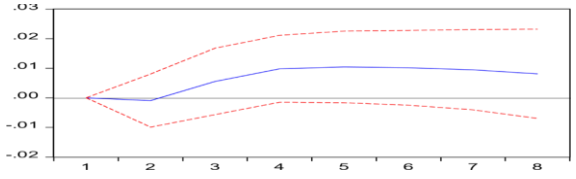
From table 05, it is evident that there is no serial correlation among the residuals and the residuals are normally distributed. Here also evident that the variance of the residuals is homoscedastic.

- Impulse Response function

An impulse response is the feedback of any outcome system in response to some outward change IRF that illustrates the reaction of the system as a function of time.

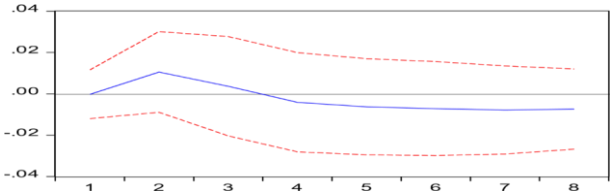
Response to Cholesky One S.D. Innovations ± 2 S.E.

Figure1. Response of LN_CPI_ to LN_OPB_



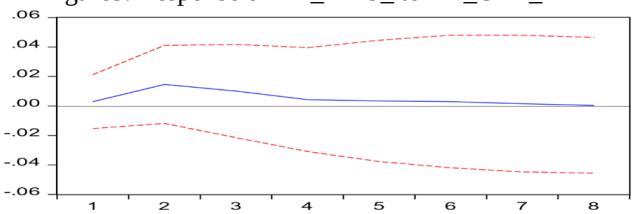
Source: Compiled from data

Figure2. Response of LN_EXR_ to LN_OPB_



Source: Compiled from data

Figure3. Response of LN_BMS_ to LN_OPB_



Source: Compiled from data

In the above figure, 01 to 03 red line is the 95% confidence interval. The blue line is the location of the responses. In the 01, we see the standard deviation shock to lngopb initially there has no remarkable impact on lncpi but it exists on the negative portion of

the period after that from the period 2 to 4 the response gradually increases at an increasing rate. But from the period 4 to 6 the response remains stable after period 6 it is decline gradually. But all the period it remains at the positive portion the graph meaning that if there is any shock to lngopb will have a positive impact on lncpi in the short run and long run. Figures 2 and 3 will be interpreted as the above explanation.

CONCLUSION AND RECOMMENDATION

From the analysis, it is clear that inflation is statistically impacted by the global oil price. Theoretically, we know that the money supply causes inflation which is also statistically proved by the analysis. But we do not find the satisfied adjustment coefficient to make sure the long-run coefficient is a stable equilibrium. But in the impulse response function shows us there is a positive impact on the CPI due to the rise in the gopb. As inflation is an important variable that measures the economic well-being so it is prudent to the policymaker to stable the price by taking proper initiative, and planning when its determinants are shocked. Should take to subsides on the oil price to the domestic market to make inflation consumer-friendly.

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Year	brent oil price (Dollars per Barrel)	Broad money supply (Local currency unit -taka)	consumer price index	exchange rates (taka per dollar)
1992	19.32	297274000000.00	35.54589	38.95076
1993	17.01	328530000000.00	36.61753	39.56726
1994	15.86	392048000000.00	38.56329	40.21174
1995	17.02	439677000000.00	42.53447	40.27832
1996	20.64	486873000000.00	43.54557	41.79417
1997	19.11	534308000000.00	45.85592	43.89212
1998	12.76	595294000000.00	49.70884	46.90565
1999	17.9	687394000000.00	52.74441	49.0854
2000	28.66	820385000000.00	53.90914	52.14167
2001	24.46	1173131000000.00	54.99119	55.80667
2002	24.99	1343240000000.00	56.82381	57.888
2003	28.85	1532211000000.00	60.04499	58.15004
2004	38.26	1748702000000.00	64.60092	59.51266
2005	54.57	2025231000000.00	69.1531	64.32748
2006	65.16	2434644000000.00	73.83149	68.93323
2007	72.44	2764498000000.00	80.55531	68.87488
2008	96.94	3218075000000.00	87.7263	68.59828
2009	61.74	3869555000000.00	92.48412	69.03907
2010	79.61	4685213000000.00	100	69.64929
2011	111.26	5477734000000.00	111.3952	74.1524
2012	111.63	6409569000000.00	118.3212	81.86266
2013	108.56	7361378000000.00	127.2312	78.10324
2014	98.97	8510505000000.00	136.1268	77.64141
2015	52.32	9777918000000.00	144.5589	77.94691
2016	43.64	11410611000000.00	152.5291	78.46809
2017	54.13	12978360000000.00	161.2265	80.43754
2018	71.34	14471672000000.00	170.1642	83.4662