

Impact of Covid-19 on Remittance Inflow in Bangladesh: Using VECM model

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Abstract

Bangladesh is a prominent remittance-receiving country. Meanwhile, various challenges have been encountered in the inflow of these massive remittances, notably the ongoing COVID-19 pandemic, which has brought significant adverse impacts on remittance. This paper assesses how covid-19 affects remittance inflow in Bangladesh, using quarterly time series data from 2004 to 2020. Applying a VECM approach, we forecast future remittance inflow that shows more fluctuations than the pre-covid period. Remittance growth can be reached at its peak (9.41%) on the forth quarter of year 2021. After that, there can be a fall of remittances untill the third quarter of 2023. While it shows a recovery from forth quarter of 2023. We estimate a long-run equation by the Fully Modified Least Squares method, and the results show that exchange rate and petroleum price have a significant positive impact on remittance inflow. On average, a 1% increase in the exchange rate and petroleum price led to an increase in the remittance inflow by 6.91% and 23.72% respectively. It is expected that the findings of the study will help policymakers to reconsider the policies focusing on remittances for productive investment areas.

Keywords: Bangladesh, Covid-19, Remittance Inflow, Fully Modified Least Squares (FMOLS), Forecasting with VECM

1. Introduction

Remittance is one of the influencing driving forces in Bangladesh's economy. A strong correlation between remittance and development status of an economy is undeniable. Remittance plays an important role in the economic growth of

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Bangladesh by enhancing foreign exchange reserves, stabilizing balance of payment, and increasing national savings. In 2019, Bangladesh received over \$18 billion, estimated at about 5.6% of GDP, from 10 million expatriates working all over the world. However, due to Covid-19, Bangladesh experienced a 25% percent decline in remittance inflows in May 2020 compared to the same period in 2019 (Bangladesh Bank, 2020). Our overseas job market and remittance inflow are getting down because of the Covid-19 pandemic. Due to the pandemic, migrant workers are laid-out or received low wages or no payment at all, that negatively affects our remittance inflow. Workers are in dilemma whether they can return to their work place on time because by the time most of the countries in the world have imposed a shutdown or travel bans. Most of the Bangladeshi workers work in Middle East countries. Bangladesh receives the largest remittance from Saudi Arabia(KSA) (21%), followed by United Arab Emirates(UAE) (14%), the United States(US) (12%), Kuwait & the United Kingdom(UK) (7%), & Malaysia (7%), Bangladesh Bank (2020). These countries are still under lockdown or maintaining social distances. Development expenditure of those countries have been cut down to aid in the recovery of the economy from the initial effect of the Covid-19.

The Bureau of Manpower Employment and Training (BMET) data shows that every year around 600,000 Bangladeshis have left their homeland to seek their fortune abroad. World Bank predicts that as an immediate impact of Covid-19, we may see a 20% reduction in total global remittance in 2020, and the amount will be \$400 billion compared to \$500 billion in 2019. According to Bangladeshi Wage Earners' Welfare Board, we have 1.20 crore migrant workers working across the world, and Bangladesh ranks eight globally in terms of receiving remittance. From Bangladesh Bank data in 2019, around US \$18 billion was remitted to our country by migrant workers. Due to Covid-19, in January,2020 remittance inflows declined by 3.14 percent from that of December, and the amount of remittance in January was \$1.63 billion. In March, the remittance inflow was only \$1.29 billion, which is 12.84 percent lower than that of February and was the lowest remittance inflow in the last 15 months.

This paper forecasts how Covid-19 affects the future remittance inflow and its determinants such as exchange rate, CPI, petroleum price, host countries' GDP growth, and host countries' unemployment rate.

The rest of the paper is presented as follows. The next section reviews the existing empirical literature. It is followed by the methodology of this study in section 3. The empirical results are given in section 4. Along with discussion is included in section 5 and Finally, Section 6 concludes the research and suggests some policy recommendations.

2. Literature Review

A limited number of papers have been consulted to find the effect of Covid-19 on remittance inflow. For example; as an initial impact of Covid-19 pandemic in Myanmar, there can be 50% and 30% decline in international remittance and domestic remittance income respectively. As a result, around 200,000 households will fall into poverty that were not poor before the shock (Diao & Mahrt, 2020). The

fall in oil prices and the global economic recession would be the possible economic impacts of the pandemic for the overseas Filipinos and their remittances. About 0.3 to 0.4 million Filipino workers who work in abroad can be affected that can cause a decline in cash remittance by 3 to 6 billion comparing 2019 with 2020 (Ang & Opiniano, 2020). As coronavirus spreads all over the world, over 666,000 workers returned home between January and March (Abdur Rahim Harmachi, 2020). Welsh (2020) explains the Covid-19 breakout is anticipated to cause a drastic fall in remittances. Remittance dependent sectors would be the hardest hit by the recession. Another study finds the impact of the Covid-19 pandemic on the remittances inflow in Bangladesh. They explain their view with scenario analysis where they use three possible scenarios of (10%, 30%, and 50%) decline of remittances (Das & Sutradhar, 2020). Others study find how macroeconomic variables determine the remittance inflow in Bangladesh. There is a negative relationship between inflation and remittance inflow, and a significant relationship with domestic interest rate, GDP, and exchange rate (Hasan, Mohammad Monirul, 2008). Barua et al (2007) used panel data from 1993 to 2005 to determine how macroeconomic variables influence remittance inflow in Bangladesh. They find a positive correlation between domestic currency devaluation and remittance inflow. Higgins et al (2004) find host countries unemployment rate and exchange rate are important determinant of remittance inflow. A rise in price of crude oil in GCC countries have a positive impact on remittance inflow in remitting countries (Naufal & Termos, 2009). The reviewed literature shows the role of remittances on developing and emerging countries.

The main objectives of the study is to forecast the future remittance inflow in Bangladesh and also provide short run and long run association among the variables linked with remittance inflow in Bangladesh. Also, by capturing the estimated potential impacts of Covid-19 on remittance inflow, policy interventions are recommended.

3. Methodology

3.1 Data Sources and Variables

The sources of data are Bangladesh Bank quarterly reports, Bangladesh Bureau of Statistics (BBS), OPEC Reference Basket (ORB) monthly report, and World Development Indicators, World Bank. The study used quarterly time series data from 2004 to 2020. Remittance from eight countries, namely Kingdom of Saudi Arabia(KSA), Kuwait, United Arab Emirates(UAE), Singapore, Bahrain, Qatar, Oman, & Malaysia have been taken since they account for over 70% of Bangladesh's total remittance inflow.

Table 1: Dependent Variable and Independent Variables

Dependent Variable	Independent Variables
Remittance inflow(RMI)	Consumer price index (CPI)
	Exchange Rate (EXR)
	Petroleum Price (PP)
	Host countries GDP growth rate (GDPHC)
	Host countries Unemployment rate (UNR)

3.2 Model Specification and Estimation Methods

3.2.1 Model Specification

The long run relationship among consumer price index (CPI), exchange rate (EXR), petroleum price (PP), host countries' GDP growth (GDPHC) and host countries' unemployment rate (UNR) on remittance inflow (RMI) will be examined by the following equation:

$$RMI_t = \alpha_0 + \alpha_1 CPI_t + \alpha_2 EXR_t + \alpha_3 PP_t + \alpha_4 GDPHC_t + \alpha_5 UNR_t + \varepsilon_t \dots \quad (1)$$

Here, the long run elasticities of remittance inflow is shown as α_1 , α_2 , α_3 , α_4 , and α_5 with respect to CPI, EXR, PP, GDPHC, and UNR respectively. α_0 is the constant term in this equation and ε_t represents the stochastic error term.

3.2.2 Estimation Methods

Unit Root Test

We used popular ADF test to check whether there exists a unit root problem or not, along with Phillips and Perron(PP) test. The formation of the ADF test with trend and intercept is shown below:

$$Z_t = K_0 + K_1 t + \delta Z_{t-1} + \sum_{j=1}^m \Phi_j \Delta Z_{t-j} + u_t \dots \dots \dots \quad (2)$$

Here, Z represents independent variable [consumer price index (CPI), exchange rate (EXR), petroleum price (PP), host countries' GDP growth (GDPHC), and host countries' unemployment rate (UNR)]. If $\delta = 0$, then the variable is of integrated order of one, I(1). For the selection of the appropriate lag length we used the Akaike Info Criterion(AIC) and Schwarz Info Criterion(SBIC).

Test of Cointegration

To show the long run association among the variables we will apply the Johansen and Juselius(JJ) test. The description of the Johansen and Juselius(JJ) test is given below:

$$\Delta Z_t = B_0 + \Pi Z_{t-p} + \sum_{j=1}^p B_j Z_{t-j} + v_t \dots \dots \dots \quad (3)$$

Where integrated order of endogenous variables I(1) is denoted by Z_t , the constant terms of the vector is shown as B_0 , the matrix of coefficients is written as B , the residuals of vector is v_t , and the lag length is indicated by p. The rank of Π (say r) determines the long run association among Z_t . The variables are not cointegrated in level form when $r = 0$, then we can transform equation (1) to a VAR model which have p^{th} order. There are $(n \times r)$ matrices of α and β such that: $\Pi = \alpha\beta'$ when $0 < r < n$. Here α is used to measure the strength of the cointegration relationship. The cointegration vector is represented by B and $\beta'Z_t$ of integrated order of (0), even if Z_t is of integrated order of (1).

Causality Analysis

We use the Engle and Granger test procedure. The Granger causality test with the augmented formation have error correction term (ECT) when there is a cointegration

relationship and the vector error correction (VEC) framework used. The specifications are shown below:

$$\begin{aligned} \Delta RMI_t = & \sum_{i=1}^k \alpha_{11i} \Delta RMI_{t-i} + \sum_{i=1}^k \alpha_{12i} \Delta CPI_{t-i} + \sum_{i=1}^k \alpha_{13i} \Delta EXR_{t-i} + \\ & \sum_{i=1}^k \alpha_{14i} \Delta PP_{t-i} + \sum_{i=1}^k \alpha_{15i} \Delta GDPHC_{t-i} + \sum_{i=1}^k \alpha_{16i} \Delta UNR_{t-i} - s_{11} ECM_{1,t-1} - \\ & s_{12} ECM_{2,t-1} - s_{13} ECM_{3,t-1} - s_{14} ECM_{4,t-1} + \varepsilon_{1t} \dots \dots \dots \end{aligned} \quad (4)$$

$$\begin{aligned} \Delta CPI_t = & \sum_{i=1}^k \alpha_{21i} \Delta RMI_{t-i} + \sum_{i=1}^k \alpha_{22i} \Delta CPI_{t-i} + \sum_{i=1}^k \alpha_{23i} \Delta EXR_{t-i} + \\ & \sum_{i=1}^k \alpha_{24i} \Delta PP_{t-i} + \sum_{i=1}^k \alpha_{25i} \Delta GDPHC_{t-i} + \sum_{i=1}^k \alpha_{26i} \Delta UNR_{t-i} - s_{21} ECM_{1,t-1} - \\ & s_{22} ECM_{2,t-1} - s_{23} ECM_{3,t-1} - s_{24} ECM_{4,t-1} + \varepsilon_{2t} \dots \dots \dots \end{aligned} \quad (5)$$

$$\begin{aligned} \Delta EXR_t = & \sum_{i=1}^k \alpha_{31i} \Delta RMI_{t-i} + \sum_{i=1}^k \alpha_{32i} \Delta CPI_{t-i} + \sum_{i=1}^k \alpha_{33i} \Delta EXR_{t-i} + \\ & \sum_{i=1}^k \alpha_{34i} \Delta PP_{t-i} + \sum_{i=1}^k \alpha_{35i} \Delta GDPHC_{t-i} + \sum_{i=1}^k \alpha_{36i} \Delta UNR_{t-i} - s_{31} ECM_{1,t-1} - \\ & s_{32} ECM_{2,t-1} - s_{33} ECM_{3,t-1} - s_{34} ECM_{4,t-1} + \varepsilon_{3t} \dots \dots \dots \end{aligned} \quad (6)$$

$$\begin{aligned} \Delta PP_t = & \sum_{i=1}^k \alpha_{41i} \Delta RMI_{t-i} + \sum_{i=1}^k \alpha_{42i} \Delta CPI_{t-i} + \sum_{i=1}^k \alpha_{43i} \Delta EXR_{t-i} + \\ & \sum_{i=1}^k \alpha_{44i} \Delta PP_{t-i} + \sum_{i=1}^k \alpha_{45i} \Delta GDPHC_{t-i} + \sum_{i=1}^k \alpha_{46i} \Delta UNR_{t-i} - s_{41} ECM_{1,t-1} - \\ & s_{42} ECM_{2,t-1} - s_{43} ECM_{3,t-1} - s_{44} ECM_{4,t-1} + \varepsilon_{4t} \dots \dots \dots \end{aligned} \quad (7)$$

$$\begin{aligned} \Delta GDPHC_t = & \sum_{i=1}^k \alpha_{51i} \Delta RMI_{t-i} + \sum_{i=1}^k \alpha_{52i} \Delta CPI_{t-i} + \sum_{i=1}^k \alpha_{53i} \Delta EXR_{t-i} + \\ & \sum_{i=1}^k \alpha_{54i} \Delta PP_{t-i} + \sum_{i=1}^k \alpha_{55i} \Delta GDPHC_{t-i} + \sum_{i=1}^k \alpha_{56i} \Delta UNR_{t-i} - s_{51} ECM_{1,t-1} - \\ & s_{52} ECM_{2,t-1} - s_{53} ECM_{3,t-1} - s_{54} ECM_{4,t-1} + \varepsilon_{5t} \dots \dots \dots \end{aligned} \quad (8)$$

$$\begin{aligned} \Delta UNR_t = & \sum_{i=1}^k \alpha_{61i} \Delta RMI_{t-i} + \sum_{i=1}^k \alpha_{62i} \Delta CPI_{t-i} + \sum_{i=1}^k \alpha_{63i} \Delta EXR_{t-i} + \\ & \sum_{i=1}^k \alpha_{64i} \Delta PP_{t-i} + \sum_{i=1}^k \alpha_{65i} \Delta GDPHC_{t-i} + \sum_{i=1}^k \alpha_{66i} \Delta UNR_{t-i} - s_{61} ECM_{1,t-1} - \\ & s_{62} ECM_{2,t-1} - s_{63} ECM_{3,t-1} - s_{64} ECM_{4,t-1} + \varepsilon_{6t} \dots \dots \dots \end{aligned} \quad (9)$$

Thus,

$$ECM_{1,t-1} = RMI_{t-1} - b_{11} GDPHC_{t-1} - b_{12} UNR_{t-1} - c_1 \dots \dots \dots \quad (10a)$$

$$ECM_{2,t-1} = CPI_{t-1} - b_{21} GDPHC_{t-1} - b_{22} UNR_{t-1} - c_2 \dots \dots \dots \quad (10b)$$

$$ECM_{3,t-1} = EXR_{t-1} - b_{31} GDPHC_{t-1} - b_{32} UNR_{t-1} - c_3 \dots \dots \dots \quad (10c)$$

$$ECM_{4,t-1} = PP_{t-1} - b_{41} GDPHC_{t-1} - b_{42} UNR_{t-1} - c_4 \dots \dots \dots \quad (10d)$$

Here, the estimated parameters are a_{ji} , s_{ji} , and b_{ji} . The one year lagged error term from the long run cointegration equation is denoted by $ECM_{i,j}$. By assumption, finite covariance matrix and zero mean ε 's are serially independent. To determine the direction of causality, the F-test has been applied.

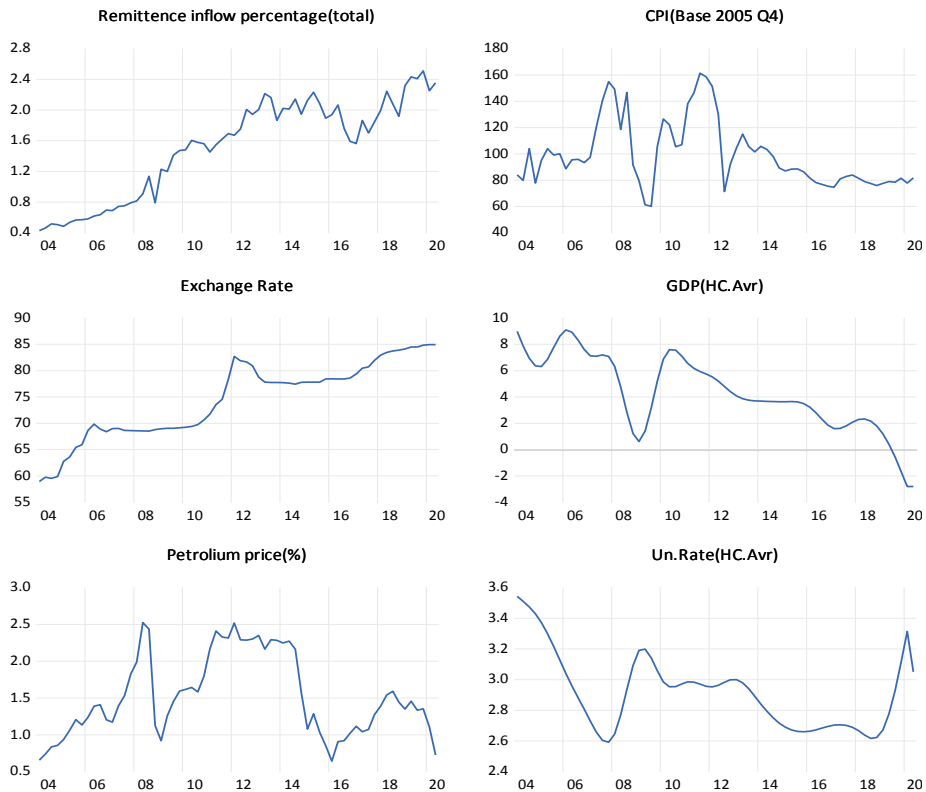
Long Run Equation

To find out the presence of a long-run relationship among variables various modern econometric techniques can be used. In the study, the Fully Modified Least Squares (FMOLS) method is used to find out the relationship between remittance inflow and other variables. Philips and Hansen(1990) developed the FMOLS approach for evaluating co-integrating relationship that has a combination of I(1). The resulting FMOLS coefficients are asymptotically unbiased and efficient. To accomplish the central efficiency, the FMOLS method is used to assess the long-run cointegrating

petroleum price US\$ per barrel (converted as percentage) ranges from 0.6425 to 2.5226. In the same way, host countries GDP growth rate ranges from -2.8088% to 9.0925%. Lastly, host countries unemployment rate ranges from 2.5916% to 3.5420%.

From **Figure 1**, it is evident that remittance inflow is showing a fluctuation over time and it increases in the first and second quarter of 2020 as the initial impact of Covid-19 workers lost their jobs and sent their savings to their family. The exchange rate has experienced a slight but continuous increase over time. CPI shows a fluctuation over time; from 2004 to 2012Q1 fluctuates more rapidly, and after the first quarter of 2012 it shows only slight fluctuations. GDP growth rate (host countries' average) shows negative growth in the first and second quarter of 2020. Petroleum price shows a downward trend from year 2019Q4 to the first two quarters of 2020. Unemployment rate shows a slight fluctuation over the history of the host countries, and it increases highly in year 2018 to 2019 and the first quarter of the current year as the pandemic hit those countries, but the rate slows down in the second quarter of the year as countries started recovering from this pandemic.

Figure 1. Time series plots of the variables, 2004–2020



Data Source: Bangladesh Bank, BBS, OPEC, World Bank (Authors' Calculation)

4.2 Unit Root and Test Result

From the Augmented Dickey Fuller (ADF) and Phillips and Perron (PP) unit root test results shown in Table 3 (Appendix), we cannot accept the null hypothesis (H_0) of the unit roots at the 1% level of significance. All the variables are free from unit root problem at its first difference or I(1).

4.3 Co-integration

Table 4 (Appendix) shows the results of Johansen cointegration test. As we find cointegration among the variables, we can say that there exists a long run relationship among the variables.

4.4 Short Run and Long Run Causality

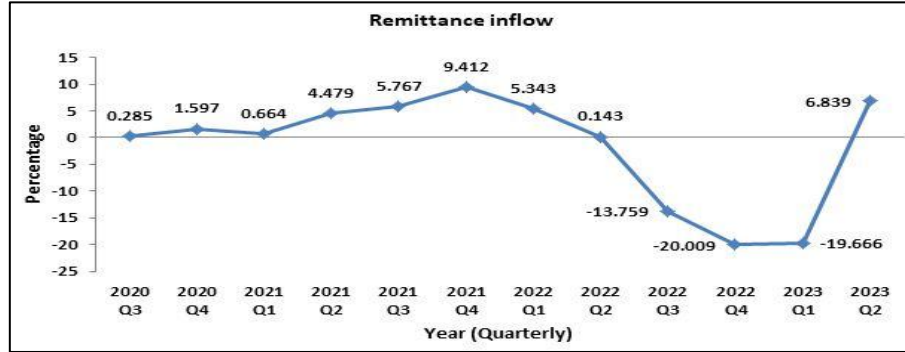
The lagged explanatory variables of the VECM model are shown in Table 5 (Appendix). The significance of short run and the long run causal relationship is shown by the F-statistics and t-statistics for the coefficient of Error Correction Term (ECT) respectively. The result shows short run unidirectional causalities between consumer price index and remittance inflow and between host countries' unemployment rate and remittance inflow. Short run unidirectional causalities exist from EXR, GDPHC, and UNR with CPI. There exists unidirectional causality between host countries' unemployment rate and host countries' GDP growth. There also exists unidirectional causalities between consumer price index and petroleum price and between exchange rate (EXR) and petroleum price (PP). In the long run, from the value of t-statistics we can see that the coefficient of Error Correction Term (ECT) of remittance inflow, CPI, host countries GDP growth, petroleum price, and UNR is significant at 1%, 5%, and 10% levels respectively.

4.5 Long Run Estimation Result

From the estimated results (Table 6 (Appendix)), a significant long run positive relationship exists between exchange rate (EXR) and petroleum price (PP). CPI and host countries' GDP growth have negative but insignificant impact in the long run. Host countries Unemployment rate (UNR) has a positive but insignificant impact in the long run. Keeping other independent variables constant, an average 1% increase in PP led to an increase on the RMI by 23.72 percent. Keeping other independent variables constant, an average 1% increase in EXR (home currency depreciation) led to a rise in the RMI by 6.91 percent.

4.6. Forecasting

The graphical representation of the forecasted series is shown in Figure 2. Fluctuation in remittance growth is observed between 2020Q3 (0.285%) and 2021Q1 (0.664%) before moving upward until 2021Q4 when it reaches the peak at 9.4%. Then it starts declining until it hits the lowest level in the recent years, forecasted at negative 19.7% level in 2023Q1 before it picks up to 6.9% in 2023Q2. The forecasted value of the remittance in Bangladesh actually shows better representation of the actual remittance inflow in Bangladesh.

Figure2: Forecasting Remittance Inflow by using VECM model

Data Source: Authors' Calculation

4.7 Diagnostic tests result

The result of diagnostic tests for the normality, serial correlation, and heteroscedasticity is shown in Table 8 (Appendix). It shows that the residual of the model passes the diagnostic test of homoscedasticity and serial correlation (LM tests), normality (JB test). The diagnostic test results of our model suggest that the VECM model of this paper is relatively well specified.

5. Discussion

In our study, future expected remittance inflow shows a rise of 0.66% to 9.41% comparing 2021Q1 with 2021Q4. The possible cause could be due to pandemic migrant workers sending more remittance in a formal way (e.g., bank to bank) rather than an informal way (e.g., through private, unrecorded channels). It will decrease in 2022Q1 to 2023Q1. By this time, we expect the pandemic situation will be better off, so that remittance inflow in a formal way can be decreased and, on the other hand, remittance inflow in an informal way can be increased because of transfer cost difference. It starts to recover in 2023Q2 with a growth rate of 6.84%. The remittance inflow in Bangladesh is predicted to increase by correlating the original series (1996-2016) and forecasted series (2017-2026) (Hassan, Siraj-Ud-Douhah, & Sathi, 2020). This study finds that remittances and inflation rate is positively related. Due to the Covid-19 crisis, the remittance workers are sending larger amounts of money to meet the needs of their families. The reason could be that they are sending their last savings before they exit. But there is an uncertainty whether this trend will continue in the future. Unemployment rate of the considered countries is a significant factor of remittances (Pozo & Higgins, 2004). Devaluation of domestic currency has a positive impact on remittance inflow (Barua, Majumder, & Akhtaruzzaman, 2007). Remittance will increase by 3.06% if host countries GDP increases by 1% (Hasan, Mohammad Monirul, 2008). Naufal & Termos (2009) shows the relationship between remittance and oil price in the Gulf Cooperation Council countries. An increase in oil price caused more inflow of remittance, and the elasticity is around

0.40. From our study, we can say as exchange rate depreciates more remittance will inflow because when they convert their dollars into taka they will have more money in their hands. When host countries' GDP grows they need more workers to do more economic activities and that creates an external demand for migrant workers, so there exists a significant relationship between host countries' GDP growth rate and remittance inflows. A rise in unrefined oil price also raises the aggregate demand of the oil exporting countries resulting in increased demand for expatriate workers that leads to more remittance inflow (Naufal & Termos, 2009). Most studies found that in oil-exporting countries currency appreciate due to rise in oil price and in oil-importing countries currency depreciate for the same reason (Göcekli & Peker, 2016).

6. Conclusion and Policy Recommendations

Our paper analyzes how Covid-19 will exert influence on future remittance inflow in Bangladesh. The study has found that future expected remittance mostly depends on the length of this pandemic. When comparing 2021Q1 to 2021Q4, it shows a rise of 0.66% to 9.41%. Following that, it will fall in 2022Q1 through 2023Q1. Then, in 2023Q2, it starts to recover with a 6.84% increase. Exchange rate (EXR) and remittance inflow (RMI) have a long run relationship. As exchange rate (EXR) depreciates, remittance inflow increases because when migrant workers convert their dollar into taka they have more money in their hands, which helps to improve their livelihoods. A long run relationship exists between petroleum price (PP) and remittance inflow (RMI). If the exchange rate increase by 1% then the predicted remittance inflow increases by 6.91%. Furthermore, if petroleum prices increase by 1%, then the remittance is predicted to change by 23.72%. Our research indicates a unidirectional causal association between the consumer price index and remittance inflow, as well as the unemployment rate in host countries and remittance inflow, in the short run.

Some policy recommendations of this paper can be pointed out. To uphold the increasing trend of remittance in the future, the practice of giving 2% money incentives on inflow remittances should be continued by the government. Emergency on the healthcare system will increase demand for healthcare workers. Migration strategies should concentrate on skill training for nursing, medicine, hospitality, health technology and management. Now that this is a global crisis, Bangladesh and other labor-sending countries should negotiate with the labor-receiving countries so that they don't deport the undocumented migrants, but integrate them as a sign of global solidarity. Government should take a three-step measure, Safety, Survive, and Sustain (3'S) to cope with the pandemic situation in the short, medium and long-term impact of Covid-19. More specifically, to cope with the impact of Covid-19 the government should engage in diplomatic efforts for keeping remittance channels open at the regional and global levels. It is anticipated that it will safeguard the country from poverty and inequality in the future.

References

- Abdur Rahim Harmachi. (2020, April 02). Coronavirus pandemic hits Bangladesh remittance stream hard. *bdnews24.com*. Retrieved from <https://bdnews24.com/economy/2020/04/02/coronavirus-pandemic-hits-bangladesh-remittance-stream-hard>
- Ang, A. P., & Opiniano, J. (2020). Possible Economic Impacts of Falling Oil Prices, the Pandemic, and the Looming Global Recession onto Overseas Filipinos and their Remittances. *Ateneo de Manila University, Working Paper Series 202005, Department of Economics, Ateneo de Manila University.*, 1-10. doi: 10.13140/RG.2.2.36528.10245
- Bangladesh Bank. (2020, February). *Wage Earner's Remittance Inflows: Selected Country Wise (Monthly)*. Retrieved October 12, 2020, from BB Web site: <https://www.bb.org.bd/econdata/wagermidtl.php>
- Barua, S., Majumder, M. A., & Akhtaruzzaman, D. M. (2007). Determinants of Workers' Remittances in Bangladesh: An Empirical Study. *Working Paper Series: WP 0713*, 1-26. Retrieved October 12, 2020, from <http://ssrn.com/abstract=1398690>
- Das, B. C., & Sutradhar, S. R. (2020). The Impact of COVID-19 Pandemic on the Inflow of Remittances: Perspective of Bangladesh. *Munich Personal RePEc Archive*, 1-22. Retrieved October 12, 2020, from <https://mpra.ub.uni-muenchen.de/101083/>
- Diao, X., & Mahrt, K. (2020). Assessing the Impact on Household Incomes and Poverty of Declines in Remittances Due to COVID-19. *International Food Policy Research Institute (IFPRI)*, 1-12. doi:<https://doi.org/10.2499/p15738coll2.133752>
- Göcekli, S. G., & Peker, O. (2016, May). The Relationship between Crude Oil Prices and Exchange Rate: The Case of Turkey. *Researchgate*. Retrieved from <https://www.researchgate.net/publication/296637606>
- Harmachi, A. R. (2020). *Coronavirus pandemic hits Bangladesh remittance stream hard*. Retrieved October 12, 2020, from BASUG Web site: <http://www.basug.eu/coronavirus-pandemic-hits-bangladesh-remittance-stream-hard/?fbclid=IwAR1kDoidAUU5E97wopKVtbkgztlSnqqgPtvKeMDbK5Dymk74vgBr4x8zB8c>
- Hasan, Mohammad Monirul. (2008, February 1). *The macroeconomic determinants of remittances in Bangladesh*. Retrieved October 13, 2020, from ResearchGate: <https://www.researchgate.net/publication/48376136>
- Hassan, M. Z., Siraj-Ud-Douhah, M., & Sathi, S. N. (2020). Forecasting the Remittance inflow Based on Time Series Models in Bangladesh. *International Journal of Science and Business*, 4(1), 13-23. doi:DOI: 10.5281/zenodo.3592656
- Naufal, G., & Termos, A. (2009). The Responsiveness of Remittances to the Oil Price: The Case of the GCC. *IZA Discussion Paper No. 4277*, 1-24. Retrieved October 12, 2020, from <https://ssrn.com/abstract=1434611>
- Pozo, S., & Higgins, M. L. (2004). Exchange-Rate Uncertainty and Workers' Remittances. *Applied Financial Economics*, 14, 403-411. doi: 10.1080/09603100410001673630
- Welsh, T. (2020, April 6). *COVID-19 could tank remittances, accelerate digitization*. Retrieved October 12, 2020, from Devex Web site: https://www.devex.com/news/covid-19-could-tank-remittances-accelerate-digitization-96924?fbclid=IwAR1U04ycBF3IGfY4Rr6an5OkBtOB4YqUTbVdzwmVGSwV2U_9Cvzm9Yik4

Appendix

Table 3: Unit root test results

Note: Figures in parentheses () and brackets [] are p-values and t-statistics, respectively. (*)

denotes significant at 1% level, (**) denotes significant at 5% level, (***) denotes significant at 10% level.

	ADF Statistics		PP Statistics	
Level				
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
Remittance Inflow	-1.1763	2.5012	-1.1563	-2.5012
Exchange rate	-1.5778	-2.9188	-1.6124	-2.5546
CPI	-2.7543***	-3.1288***	-2.8621***	-3.3112***
Petroleum price	-2.4894	-2.4500	-2.1712	-1.9987
Host countries GDP growth rate	-1.7779	-3.8996	-1.0432	-2.4714
Host countries Unemployment rate	-2.2621	-4.4829	-2.7175***	-2.1803
First Difference				
	Intercept	Intercept & Trend	Intercept	Intercept & Trend
Remittance Inflow	-10.4883*	-10.4352*	-10.7501*	-10.7153*
Exchange rate	-4.9335*	-4.9498*	-4.9682*	-4.9836*
Inflation rate	-7.8492*	-7.8161*	-8.0818*	-8.0657*
Petroleum price	-6.3166*	-6.4916*	-5.6972*	-5.8015*
Host countries GDP growth	-4.9639*	-4.7890*	-3.2182**	-3.2503**
Host countries Unemployment rate	-4.7027*	-4.3498*	-3.2205**	-3.0797**

Note: Figures in parentheses () and brackets [] are p-values and t-statistics, respectively. (*) denotes significant at 1% level, (**) denotes significant at 5% level, (***) denotes significant at 10% level.

Table 4: Results of Johansen–Juselius co-integration tests

No. of Cointegrating equation (s)	Eigen value	Trace Statistics	Critical value Trace	Max-Eigen Statistics	Critical value (max-Eigen Statistics)
$r = 0$	0.6994	195.8025* (0.0000)	95.7537	74.5312* (0.0000)	40.0776
$r \leq 1$	0.6042	121.2713* (0.0000)	69.8189	57.4644* (0.0000)	33.8769
$r \leq 2$	0.4153	63.8069* (0.0008)	47.8561	27.5843* (0.0083)	27.5843
$r \leq 3$	0.2994	30.5312** (0.0411)	29.7971	22.0622** (0.0369)	21.1316

Note: (*) denotes significant at 1% level, (**) denotes significant at 5% level, (***) denotes significant at 10% level.

Table 5: Short and long run Granger causality test results based on VECM

Dependent variable	Sources of causation (independent variables)						
	Short-run						Long-run
	ΔRMI	ΔCPI	ΔEXR	$\Delta GDPHC$	ΔPP	ΔUNR	ECT
ΔRMI		2.4091 (0.0816) ***	0.6587 (0.5824)	1.8699 (0.1506)	2.4928 (0.0743)	2.3748 (0.0849)** *	-0.3493 [-3.4595]*
ΔCPI	1.8048 (0.1623)		3.3107 (0.0299)* *	8.8711 (0.0001)*	1.5659 (0.2131)	9.8342 (0.0001)*	-1.3917 [-4.8386]*
ΔEXR	0.0566 (0.9821)	0.5377 (0.6593)		0.4923 (0.6897)	1.6582 (0.1918)	0.5196 (0.6713)	-0.1077 [-1.4136]
$\Delta GDPHC$	0.4122 (0.7451)	0.8940 (0.4529)	0.2713 (0.8457)		0.4867 (0.6935)	2.9430 (0.0448)**	-0.0675 [-1.7568]***
ΔPP	0.2459 (0.8637)	2.8033 (0.0524) ***	3.1769 (0.0346)* *	1.6611 (0.1912)		0.8375 (0.4809)	-0.4639 [-2.2749]**
ΔUNR	0.6638 (0.5793)	0.1452 (0.9321)	0.6619 (0.5805)	1.6635 (0.1906)	0.5882 (0.6264)		-0.1721 [-2.3570]**

Note: 1. Figures in parentheses () and brackets [] are p-values and t-statistics, respectively. (*) denotes significant at 1% level, (**) denotes significant at 5% level, (***) denotes significant at 10% level.

2. (RMI \leftarrow CPI), (RMI \leftarrow UNR), (CPI \leftarrow EXR, CPI \leftarrow GDPHC, CPI \leftarrow UNR), (GDPHC \leftarrow UNR), (PP \leftarrow CPI, PP \leftarrow EXR).

Table 6: Long Run Equation Estimation Result [Method: Fully Modified Least Squares (FMOLS)]; Dependent Variable: RMI

Variables	Coefficients	P-value
CPI	-0.0024	0.4266
EXR	0.0692*	0.0000
PP	0.2372***	0.0800
GDPHC	-0.0291	0.3256
UNR	0.2077	0.4362

Note: (*) denotes significant at 1% level, (**) denotes significant at 5% level, (***) denotes significant at 10% level.

Table 7: Forecasted remittance value (as %) in Bangladesh for the period 2020Q3-2023Q2

Period	Forecasted value
2020Q3	0.2855
2020Q4	1.5971
2021Q1	0.6643
2021Q2	4.4790
2021Q3	5.7667
2021Q4	9.4125
2022Q1	5.3432
2022Q2	0.1432
2022Q3	-13.7587
2022Q4	-20.0093
2023Q1	-19.6657
2023Q2	6.8394

Table 8: Diagnostic Tests

Equation	Remittance Inflow(RMI)
Normality test	0.5857 (0.7461)
Autocorrelation LM test	0.6224 (0.6051)
Heteroscedasticity test	1.0348 (0.4530)

Notes: p-values of the tests is shown in parentheses.