# The Link between Remittance and Economic Growth: An ARDL Bound Testing Approach

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## Abstract

*From the couple of decades remittances have been playing an important role in the Nepalese economy. For people of rural areas even for the urban households, remittance is becoming the major source of livelihood. Therefore, this study considers remittance as a focus variable with an aim to assess the link between remittance and growth. Autoregressive distributed lag (ARDL) model is applied to examine the relationship between remittance and growth. All the variables included in the analysis became stationary after first difference. The result of bound test confirms that the variables are cointegrated. It means the variables have long run relationship. The empirical result reveals that one percent increase in remittance increases the GDP by 0.36 percent in the long run. Similarly, the gross fixed capital formation, secondary school enrolment and the trade openness and per capita GDP have positive relationship. It implies that one percent increase in capital, labor and trade openness increases the per capita GDP by 0.82 percent, 0.46 percent and 0.30 percent in the long run respectively.*

**Keywords:** Autoregressive, equilibrium, bound test, remittance, trade openness, long and short run.

**Gel Classification:** C1, F1, F6

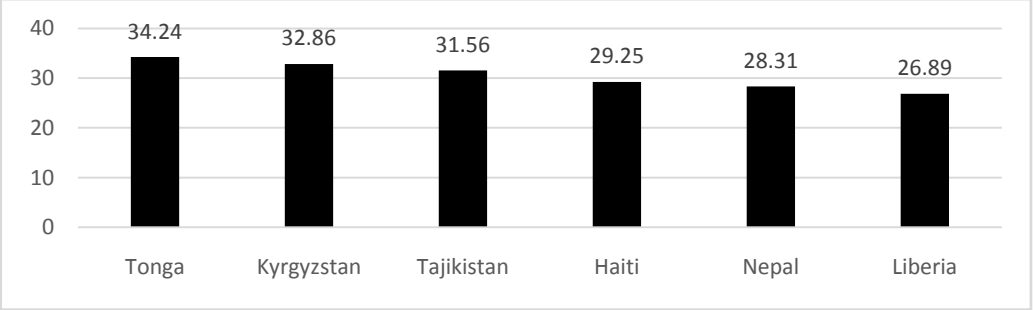
# I. BACKGROUND

Nepal, having a quarter of population below poverty line (CBS, 2011), has per capita income of US$ 835.1 in 2017 (World Bank, 2018a). Before 1990s the livelihood of nearly 85 percent of people was based on the subsistence farming. In 2017, this sector engages 71.74 percent of population (World Bank, 2018b). It shows that Nepali are still dependent on agriculture sector. After 1990, Nepal has adopted open and liberal economic system as a complementation of globalization. It facilitates and encourages labor force diversification. However, deindustrialization limits employment opportunity for the growing number of youths inside the country. Instead, globalization helps Nepalese youths to move outside the country. Among others, Nepal adopts a policy of sending people (labor force) to those foreign countries where the Nepalese labor is being demanded. It allows labor force to go outside the country. This encourages people to migrate from Nepal to foreign land in search of livelihood. Since then, four million youths are migrating abroad in search of better opportunities. It implies that the economy moves (shifts) slowly from subsistence farming to remittance. Remittance share (28.3 percent) (World Bank, 2018c) to GDP exceeds the share of agriculture (27 percent) (MoF, 2018) in 2017. These youths sell their labor to foreigner in low wages because they have no bargaining power to get better paid because of the lack of choice and better skill. Whatever their level of income in foreign land through their work, they send a portion of their income in Nepal to support the livelihood of their family members, simply termed as remittance. Remittances constitute a significant amount of foreign exchange of Nepal in recent years.

## The Size of Remittance

Nepal is the country most reliant on remittances. In 2016 it received an estimated $6.6 billion, which was equivalent to 31 percent of its GDP, according to an analysis of World Bank data (Pew Research Center, 2018). In 2017, there is a marginal increase (4.5 percent) in the volume of remittance which accounted to $6.9 billion (World Bank, 2018d). However, there is a decline in the share of remittance to GDP to 28.3 percent in 2017 from 31 percent in 2016. In terms of the size of the share of remittance to GDP Nepal is fifth in rank in 2017 (Figure 1). The first, second, third and fourth are Tonga (34.24 percent), Kyrgyzstan (32.86 percent), Tajikistan (31.56 percent) and Haiti (29.25 percent) respectively.

**Figure 1: Remittances as percent of GDP in top six countries in 2017**

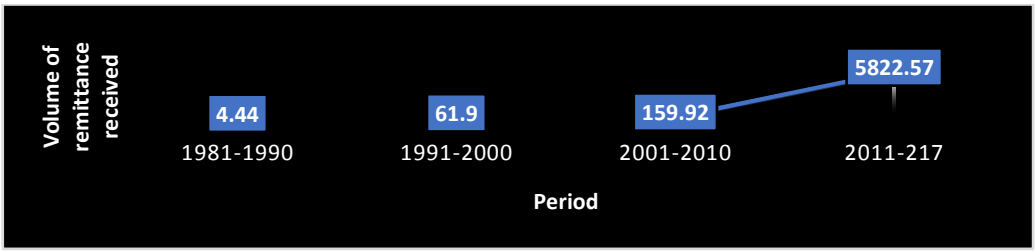



*Source: The Global Economy.com retrieved from (https://www.theglobaleconomy.com/rankings/remittances_percent_GDP/)*

## Volume of Remittance

In terms of the volume of remittances, Nepal received significant amount over the years. It has received $4.44 million in 1980s followed by $61.9 million, $159.92 million and $5822.57 million in 1990s, 2000s and 2010s respectively (Figure 2). The biggest source countries of remittances in 2015 to Nepal are Malaysia ($1.32 billion), USA ($1.10 billion), Qatar ($0.80 billion), Japan ($0.75 billion), India ($0.63 billion) and Saudi Arabia ($0.63 billion) (Subedi, 2016).

**Figure 2: Average volume of remittance by period**



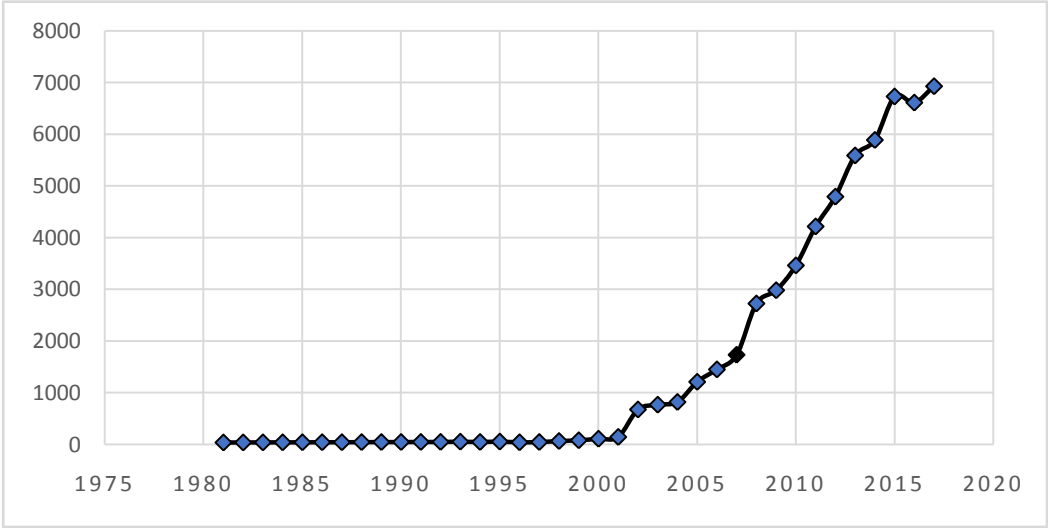

*Source: World Bank*

## The Trend of Remittance

Figure 3 displays the remittance inflows during the period 1981-2017. In the period 1981-2001 remittances have increased steadily from US$ 40 million in 1981 to US$147 million in 2001, at the annual growth rate of 267 percent. Beyond 2001, there is a fast increase in remittance. During the period 2001-2011, remittances grew 27.69 times from US$ 147 million in 2001 to US$ 4217 million in 2011. In the recent period 2011-2017 also, remittances are in increasing trend. It reached US$ 6947 million in 2017, covering 28.3 percent of GDP from US$ 4217 million in 2011, covering 23.3 percent of GDP, increased at the annual

growth rate of 65 percent. This implies that Nepalese economy primarily depends on remittance for the last couple of decades.

**Figure 3: Remittance in US$ million**




*Source: World Bank*

Given that Nepal was able to bring a large volume of remittance in recent years, particularly after 2001. In this light, this paper primarily aims to investigate the short and long run relationship between remittance and economic growth. In other words, this paper examines the impact of remittance on economic growth of Nepal with the help of time series data.

## II. LITERATURE REVIEW

Various empirical studies on the relationship between economic growth and remittance reveal mixed and diverse results. Some studies found positive impact while other found negative one. Few of them relevant to this study are reviewed here.

Khatalan (2012) has conducted a study with an aim to establish the long-run and short-run relationship between worker remittances and economic growth in Pakistan during the period 1976-2010. The findings reveal the existence of a positive and significant association between remittance and economic growth both in the short and long run. Ratha (2007) has found that the impact of remittance for the economy is more significant for low income countries rather than other developing countries. Ahmad et al. (2013) have found positive and significant relation between remittances and GDP of Pakistan. In the same study, they found that FDI has positive but insignificant relation with GDP. Majumdar and Zhang (2016) have undertaken a study to examine the long run impact of remittances on

economic growth in Bangladesh. For this they have applied ARDL model. They found that remittances and economic growth have statistically significant long run positive relationship. For a period of 1980-2012, Kumar and Vu (2014) aimed to examine the relationship between remittances and economic growth in Vietnam. They applied ARDL model and granger causality test. They failed to find long run relationship between remittances and economic growth. However, they found bidirectional causality between economic growth and remittances. Using the cointegration techniques and a vector error correction model (VECM) on the monthly data of merchandise imports, workers' remittance and trade deficit Bhatta (2013) examined the impact of remittances on merchandise import and trade deficit. The study found unidirectional causality from remittance to export and negative impact of remittance to trade deficit. Dhungel (2014) and Dhungel (2016) undertook a couple of studies covering the periods (1974-12 and 1974-13) to investigate the short and long run causality between gross domestic product and remittance using vector error correction model (VECM). These studies found that the unidirectional causality running from the 1) remittance to gross domestic product in the short run, 2) Gross domestic product to remittance in both short and long run and 3) remittances to economic growth in both short and long run. A study undertaken by Kumar and Stauvermann (2014) aimed to examine the impact of remittances on economic growth in Bangladesh during the period 1979-2012. For this purpose, they applied ARDL Model. They found that the impact of remittances on economic growth is positive in the long run. They also found bidirectional causality between economic growth and remittances.

Uprety (2017) has applied Johansen co-integration and error correction methods to examine the impact of remittance on economic growth of Nepal during the period 1976-2013. The study found the long run relationship between the variables under consideration with negative impact of remittance on economic growth. A study conducted by Sapkota (2013) has revealed mixed results. It finds negative impact of remittance on Nepal's tradable sectors via real exchange rate appreciation consistent with Dutch disease and positive impact on poverty and inequality reduction. A study conducted by Tolcha and Rao (2016) has applied ARDL model to examine the impact of remittance on growth over the period 1981-2012. This study found that there is a short run significant impact of remittance to economic growth while the same has negative impact in the long run. Maharjan et al. (2013) have conducted a survey among small farm holders with migrating family members in the Western Mid Hills of Nepal to see the impact on remittances on subsistence agricultural production. They find mixed results. They find negative impact of remittance on a) major subsistence crops and b) labor. They also found positive impact on hired labor and no impact on material inputs. Dahal (2014) examined the impact of remittances on economic growth in Nepal with growth effects of remittances through the entrepreneurship

and manufacturing channels. The finding reveals a positive association between remittance and entrepreneurship and a negative association with manufacturing leading to an inconclusive decision. In a study Bashier (2018) applied the autoregressive distributed lagged (ARDL) model to estimate the import function in Jordon over the period 1975–2016. The finding of this study is that the bounds testing provided evidence of the existence of a long-run equilibrium relationship between the included variables.

However, the conventional wisdom of the positive impact of remittance on economic growth has been criticized as the major portion of remittance has been spent on consumption. It means studies undertaken by several researchers do not support the hypothesis of positive impact of remittance on economic growth. Migrant's remittances have negative impact on growth as a significant proportion of earning is spent on consumption. The rest part of remittance or what is left over from consumption has been spent in housing, land and jewelry. Investment in these sectors as they are considered unproductive does not create employment opportunities and hence does not help to increase the income of the people. The growth effects of remittances are generally small, at times even negative and largely insignificant. The role of workers' remittances and its contribution/effect on economic growth and development find that workers' remittances are seldom utilized into productive and investment uses in the Philippines. There are strong anecdotal evidences that show that most of these resources are used to fund conspicuous consumption (Barajas et al. (2009), Rajan and Subramaniam (2005), Chami et al. (2003), and Ang (2007).

# III. METHODOLOGY

The general objective of this paper is to examine the impact of remittance and other related control variables on economic growth in Nepalese economy. A brief discussion is made to identify the ways and means in the following subsection how this objective is to be achieved.

## Data and Variables

This study incorporates five variables-per capita GDP in US$, a proxy of economic growth denoted by (Y), remittance as percent of GDP denoted by (X), trade openness defined by export plus import as percent of GDP denoted by (Z) gross fixed capital formation as percent of GDP a proxy variable of "capital" denoted by (M) and secondary school enrolment as percent of gross, a proxy of "labor" denoted by (N). The data of all the variables are collected from the World Bank web site, as shown in Table 1. The data (series) of variables (M, N, Y, X and Z) under consideration are expressed in logarithm.

**Table 1: Types of variables and their sources**

| Types of Variables | Symbol | Source of Data |
|---|---|---|
| Gross fixed capital formation as percent of GDP | M | World Bank |
| Secondary school enrolment percent of gross | N | World Bank |
| Per capita GDP (US$) | Y | World Bank |
| Remittance as percent of GDP | X | World Bank |
| Trade as percent of GDP | Z | World Bank |

## Feature of Variables

Table 2 represents the summary of the characteristics of variables. The sample size is 28 covering the period 1990-2017. The mean value of X (remittance as percent of GDP) is 1.86 with the standard deviation of 1.4. It indicates that the mean value is scattered by 1.4. Similarly, the mean value is 3.66, 3.84 and 6.82 and 3.87 with standard deviation of 0.15, 0.46, 0.54 and 0.15 of M (gross fixed capital formation as percent of GDP),N (secondary school enrolment as percent of gross, Y (GDP per capita) and Z (trade as percent of GDP) respectively. The deviation from the mean of the series X is greater than the deviation from the mean of the series M, N, X and Z.

**Table 2: Summary or feature of variables**

| Variable | Mean | Median | Standard deviation | Skewness |
|---|---|---|---|---|
| M | 3.66 | 3.05 | 0.15 | 1.34 |
| N | 3.84 | 3.81 | 0.24 | 0.46 |
| X | 1.86 | 2.46 | 1.40 | -0.23 |
| Y | 6.82 | 5.61 | 0.54 | 0.41 |
| Z | 3.87 | 3.85 | 0.15 | -0.54 |

## Graphical Representation of Data

Figure 4 displays the insight view of data at their level. Data series of all the variables M, N, X, Y and Z are non-stationary. In such a case, data are to be tested by applying specific standard tests to make them stationary. If such data used to estimate the relationship between the variables would produce misleading results. Therefore, it is essential to convert them into stationary. One way of making them stationary is to convert them into first difference. Figure 5 displays the insight view of stationary series after first difference of all the variables under consideration.

**Figure 4: Graphical representation of data on their level form**

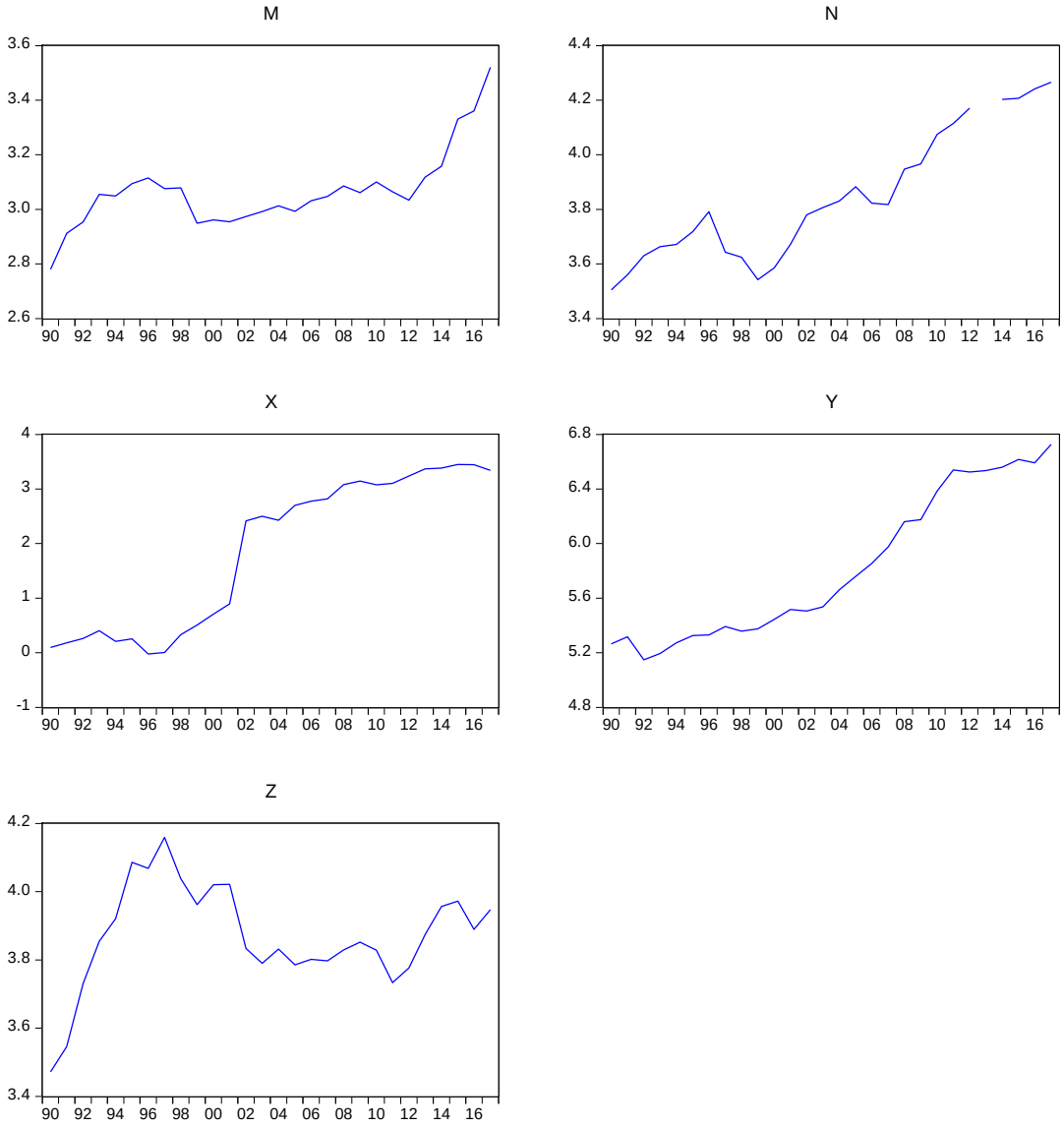
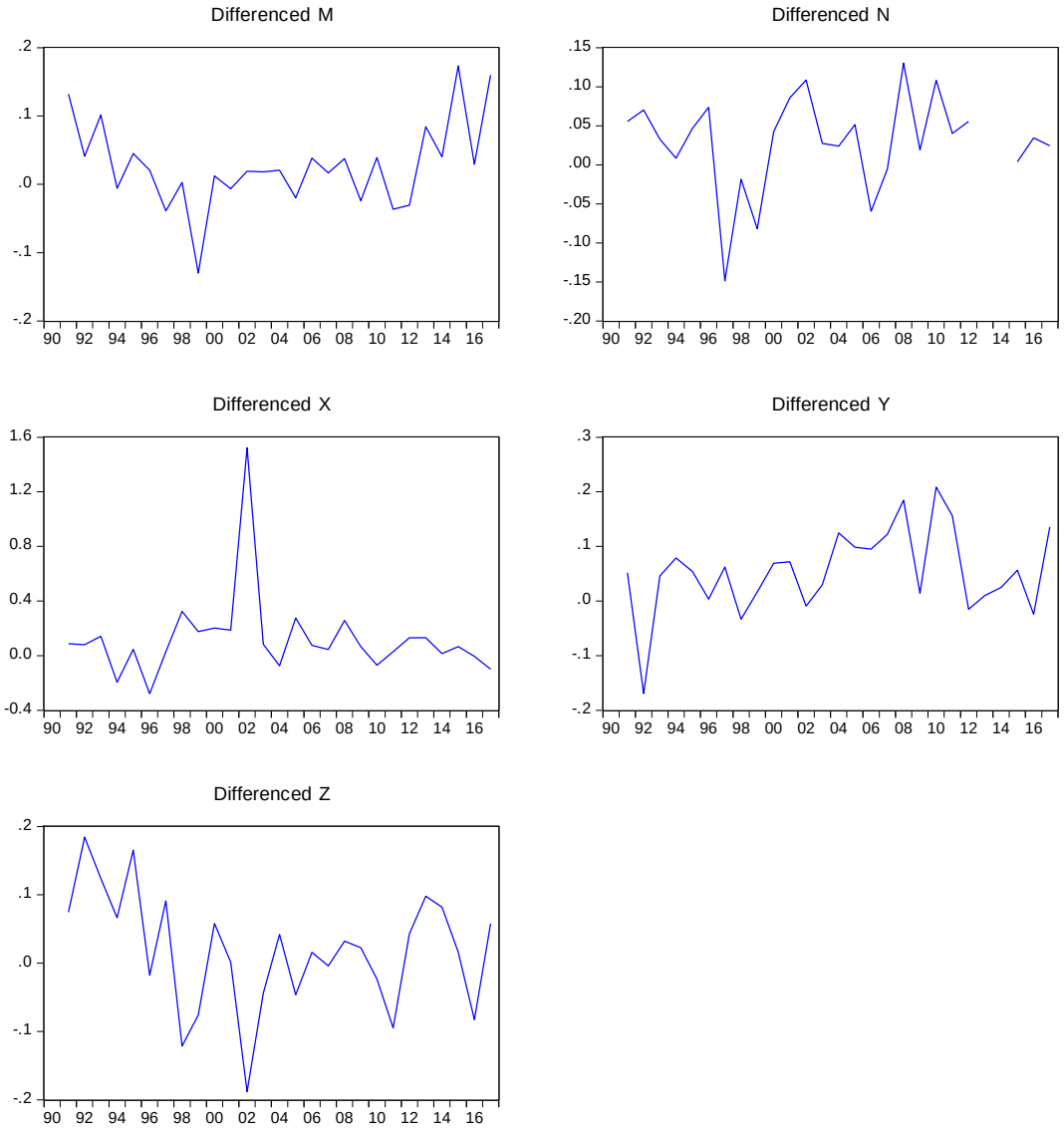


**Figure 5: Graphical representation of data on first difference**




# IV. THE MODEL

This study assumes that economic growth (Y) as a function of gross fixed capital formation (M), secondary school enrolment (N), remittances (X) and trade openness (Z) where, M,N and Z are control variables that have substantial effect on Y along with X. The functional form of this statement in an equation can be expressed as follows.

$$Y = f(M, N, X, Z) \ldots\ldots\ldots (1)$$

The transformation of Equation (1) is as follows.

$$Y_t = b_0 + b_1 M_t + b_2 N_t + b_3 X_t + b_4 Z_t + \varepsilon_t \ldots\ldots\ldots (2)$$

Where, $b_i$ (i = 0, 1, 2, 3 and 4) are the parameters to be estimated and ε is error term.

## Unit Root Test

Cointegration test requires the order of integration to apply not in the strict sense but in a flexible manner. Unit root test determines the order of integration of each variable (Y, M, N, X and Z). In other way to say the same that it is necessary for the underlying variables to be tested for stationarity. For this to achieve, the two-conventional test-Augmented Dickey Fuller (ADF) and Phillips & Parron (PP) are employed. These tests determine the order of integration I(0) or I(1) or both as the necessary condition to apply the ARDL bound testing. The null hypothesis is that underlying variables contain unit root against the alternative hypothesis underlying variables do not contain unit root. It is assumed that all the underlying variables should not be I(2).

## Cointegration

Several methods are available for investigating the cointegration among which pesaran, et al (2001) developed ARDL bounds testing approach to cointegration. This approach is applicable irrespective of the order of integration such as I(0) or I(1). The unrestricted error correction method used to examine the short and long run relationship as specified in model (3). In case the calculated F-statistics exceeds the upper critical bound (UCB), then the series are cointegrated, and if it is below the lower critical bound (LCB) there is no cointegration. If the calculated F-statistics is between the UCB and the LCB, then decision about cointegration is inconclusive. The critical bounds are taken from Pesaran and Pesaran (1997).

$$\Delta Y_t = a_0 + \sum_{i=1}^{p} a_{1i}\,\Delta Y_{t-i} + \sum_{i=1}^{q} a_{2i}\,\Delta M_{t-i} + \sum_{i=1}^{q} a_{3i}\,\Delta N_{t-i} + \sum_{i=1}^{q} a_{4i}\,\Delta X_{t-i} + \sum_{i=1}^{q} a_{5i}\,\Delta Z_{t-i} + a_{11} Y_{t-1} + a_{12} M_{t-1} + a_{13} N_{t-1} + a_{14} X_{t-1} + a_{15} X_{t-1} + e_{1t} \quad \ldots\ldots\ldots (3)$$

Where, Δ = difference operator, $a_0$ is the constant, $a_{1i}$, $a_{2i}$, $a_{3i}$, $a_{4i}$ and $a_{5i}$ (i=0,1, 2---n) are the short run coefficient and $a_{11}, a_{12}, a_{13,} a_{14}\ and\ a_{15}$ are the long run coefficients. p (= 1) is the optimum lag of dependent variable, q (= 2) is the optimum lag of independent variables, Y, M, N, X and Z are gross domestic product, gross fixed capital formation, secondary school enrollment, remittance and trade openness respectively. The optimum lag length is selected based on the Akaike information criteria. The null hypothesis is $a_{11} = a_{12} = a_{13} = a_{14} = a_{15} = 0$ against the alternative hypothesis $a_{11} \neq a_{12} \neq a_{13} \neq a_{14} \neq a_{15} \neq 0$

Bound test of cointegration based on ARDL consists of two mutually exclusive cases (cointegration or no cointegration) in the way of finding relationship between the variable by using model (3). .

1) If there is no cointegration the ARDL (p, q) model is specified as

$$\Delta Y_t = a_0 + \sum_{i=1}^{p} a_{1i}\,\Delta Y_{t-i} + \sum_{i=1}^{q} a_{2i}\,\Delta M_{t-i} + \sum_{i=1}^{q} a_{3i}\,\Delta N_{t-i} + \sum_{i=1}^{q} a_{4i}\,\Delta X_{t-i} + \sum_{i=1}^{q} a_{5i}\,\Delta Z_{t-i} + e_{1t} \quad \ldots\ldots\ldots(4)$$

Equation (4) is a short run model which is to be estimated only when there is no cointegration.

2) If there exists cointegration, the error correction model (ECM) is specified as

$$\Delta Y_t = a_0 + \sum_{i=1}^{p} a_{1i}\,\Delta Y_{t-i} + \sum_{i=1}^{q} a_{2i}\,\Delta M_{t-i} + \sum_{i=1}^{q} a_{3i}\,\Delta N_{t-i} + \sum_{i=1}^{q} a_{4i}\,\Delta X_{t-i} + \sum_{i=1}^{q} a_{5i}\,\Delta Z_{t-i} + \varphi ECT_{t-1} + e_{1t} \quad \ldots\ldots\ldots(5)$$

Where, ψ is the speed of adjustment parameter with a negative sign and ECT is the error correction term. $a_{1i}$, $a_{2i}$, $a_{3i}$ $a_{4i}$ and $a_{5i}$ are the short run dynamic coefficients of the model's adjustment to long run equilibrium. Model (5) is applicable only when the underlying variables are cointegrated or they have long run relationship.

# IV. EMPIRICAL FINDINGS

## Unit Root Test

The first step in the ARDL model is to investigate the order of integration, a basis to decide the data series whether they are stationary or non-stationary of underlying variables (Y, M, N, X and Z). As described in methodology, the order of integration should be either I(0) or I(1) or the mixture of both. It is the prerequisite for the propose model to apply. For this purpose, ADF and PP tests are employed by choosing intercept and intercept and trend as the benchmark options. The test results are presented in (Table 3). Both ADF and PP tests have proved that the order of integration of all the variables is I(1). It means underlying variables are stationary at first difference. None of them are I(2). Therefore, it allows us to apply bound test to determine the long run relationship between the variables.

**Table 3: Unit root test**

| Variable | ADF | | | | PP | | | |
|---|---|---|---|---|---|---|---|---|
| | Intercept | | Intercept +trend | | Intercept | | Intercept +trend | |
| | t-stat | Prob | t-stat | Prob | t-stat | Prob | t-stat | Prob |
| M | 0.319971 | 0.9749 | -0.359023 | 0.9841 | -0.386313 | 0.8982 | -1.182126 | 0.8942 |
| N | -0.1172056 | 0.9302 | -1.564167 | 0.7782 | -0.227644 | o.9226 | -1.805595 | 0.6716 |
| X | -0.778591 | 0.8092 | -1.434623 | 0.8268 | -791649 | 0.8055 | -1.550841 | 0.7856 |
| Y | 0.903543 | 0.9940 | -2.234732 | 0.4528 | 0.863428 | 0.9933 | -2.234296 | 0.4530 |
| Z | -2.975375 | 0.0501 | -2.88831 | 0.1814 | -2.94299 | 0.0536 | -2.86613 | 0.1861 |
| ΔM | -3.479899* | 0.0022 | -3.92642* | 0.0011 | -4.4432* | 0.0017 | -4.512062* | 0.0071 |
| ΔN | -4.211509* | 0.0035 | -3.160738 | 0.1248 | -4.20703* | 0.0036 | -4.218194* | 0.0151 |
| ΔX | -4.568255* | 0.0013 | -4.48867* | 0.0074 | -4.56880* | 0.0013 | -4.48870* | 0.0074 |
| ΔY | -4.341156* | 0.0022 | -4.71670* | 0.0045 | -4.33938* | 0.0022 | -4.72927* | 0.0043 |
| ΔZ | -3.31537* | 0.0250 | -3.14545 | o.1180 | -3.7848* | 0.0084 | -3.83025* | 0.0310 |

* Significance at 5 percent level.

## Cointegration

Table 4 represents the results of the cointegration test based on the ARDL (1, 2, 0, 2, 0) bound testing approach. ARDL bound testing framework involves the comparison of the F-statistics against the critical values. Cointegration is tested for the model (3) using Y as dependent variable. The resulting value of F-statistics is found 8.71 as shown in the second column of the table. The resulting value is higher than the upper bound critical value at 5 percent significance level which is presented in the middle of the table. It rejects the null hypothesis of no cointegration. This implies that variables included in model (3) are cointegrated. It means they have long run relationship. This model is robust as proved by the diagnostic tests (LM, white, Ramsey and Jarque-Bera) presented in the lower part of the table.

**Table 4: Results of bound testing, critical values and diagnostic testing**

| Test statistic | Value | Bound Critical Values | | | | |
|---|---|---|---|---|---|---|
| | | Statistically significant level | Based on Pesarant al. (2001) | | Based on Narayan (2005) | |
| | | | I(0) | I(1) | I(0) | I(1) |
| F-statistic | 8.71 | 1 percent | 3.29 | 4.37 | 4.28 | 5.84 |
| | | 5 percent | 2.56 | 3.49 | 3.058 | 4.223 |
| | | 10 percent | 2.2 | 3.09 | 2.525 | 3.56 |
| Diagnostic testing | | | | | | |
| Test stat | | | | | (Chi-square) | |
| | | | | | value | Prob |
| Serial correlation(LM) | | | | | 3.106 | 0.21 |
| Heteroscedasticity(white) | | | | | 2.910 | 0.08 |
| Functional form(Ramsey) | | | | | 4.01E-08 | 0.93 |
| Normality(Jarque-Bera) | | | | | 1.53 | 0.99 |

*Source: Critical values are obtained from Pesaran et al. (2001), Table CI(iii) Case III: Unrestricted intercept and no trend, p. 300. Critical values are obtained from Narayan (2005), Table case III: unrestricted intercept and no trend, p. 10.*

## Long Run Estimation

Having the variables under consideration cointegrated the next task is to estimate the long run model. The long run estimation results through ARDL (1, 2, 0, 2, 0) model is reported in Table 5. The value of R-square is 0.92. It implies that 92

percent variation in Y has been explained by M, N, X and Z. The F-statistics (71.23) with probability (0.0) shows that the model is statistically significant. The Durbin-Watson statistics (2.1) indicates that the model is not suffered from spurious relationship and absence of serial correlation.

**Table 5: Long run coefficients estimated through ARDL approach**

| ARDL (1, 2, 0, 2, 0) selected based on AIC | | | |
|---|---|---|---|
| Dependent variable Y | | | |
| Variable | Coefficient | t-stat | Prob |
| M | 0.82 | 3.52* | 0.0080 |
| N | 0.46 | 4.69* | 0.0001 |
| X | 0.36 | 2.79* | 0.0131 |
| Z | 0.30 | 2.91* | 0.049 |
| R-square | | | 0.92 |
| F stat | Value | | 71.23* |
| | Prob | | 0 |
| DW stat | | | 2.1 |

* significant at 5 percent.

Variable X, the central variable of this study has positive and statistically significant coefficient in the long run at 5 percent level. It means remittances support the economic growth in Nepal. However, the impact of remittance on growth is marginal as evidence from the elasticity coefficient. Holding other thing constant, one percent increase in X leads to 0.36 percent increase in Y in the long run. This result is consistent with theoretical arguments and empirical studies (Khathlan (2012), Lucas and Stark (1985), Adams (1991), Giuilano and Arranz (2005), Jongwanich (2007)). In the same manner capital, labor and trade openness represented by the symbol M, N and Z is positive and statistically significant at 5 percent level. The elasticity coefficient is 0.82, 0.46 and 0.30 of M, N and Z respectively. It implies that one percent increase in M, N and Z increases the Y by 0.82 percent, 0.46 percent and 0.30 percent respectively in the long run.

## Diagnostic Stability Test

The estimated results of the long run model (equation 2) require diagnostic tests to check its validity. This model is free from heteroscedasticity as supported by the White test. This rejects the hypothesis of heteroscedasticity. Jarque-Bera test supports that residuals of this model are normally distributed. The model is well specified as supported by Ramsey functional form test. Similarly, the residuals of this model are free from serial correlation. It means hypothesis of serial correlation ($H_0$: serial correlation) is tested using LM test. Result of LM test (LM version: 0.47 and F version: 0.17) with corresponding probability (0.7907 and 0.8487) rejects the hypothesis (Table 6). It means the long run model is not suffered from the serial correlation.

**Table 6: Diagnostic stability test**

| Test Stat | LM version (Chsq) | | F version | |
|---|---|---|---|---|
| | Coefficient | Prob | Coefficient | Prob |
| Serial correlation (LM) | 0.469552 | 0.7907 | 0.165526 | 0.8487 |
| Heteroscedasticity (White) | 23.99628 | 0.2426 | 2.993958 | 0.1137 |
| Functional form (Ramsey) | 0.648534 | 0.5244 | 0.420596 | 0.5244 |
| Normality (Jarque-Bera) | o.831819 | 0.6597 | Not Applicable | |

## Structural Break Test

The stability of both short and long run estimates has been tested by employing the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) test. Such tests are proposed and recommended by Brown et al. (1975) and Pesaran et al. (2001). The stability of the short and long run estimation is in question. To check this CUSUM and CUSUMSQ test are employed. Results of these tests are reported in Figure 6 and Figure 7. Both figures do not cross the 5 percent critical limits. They are within the lower and upper critical limits. So, from this finding long and short runs estimates are stable. It means there is no any structural break. The findings of the estimated model are reliable and efficient.

**Figure 6: Plot of Cumulative Sum of Recursive Residuals**

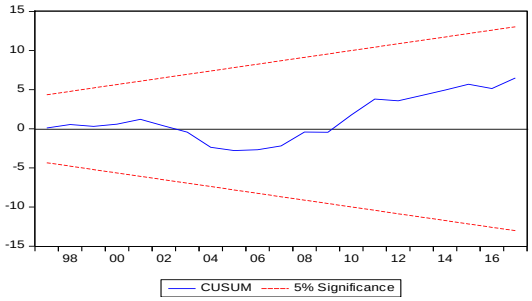
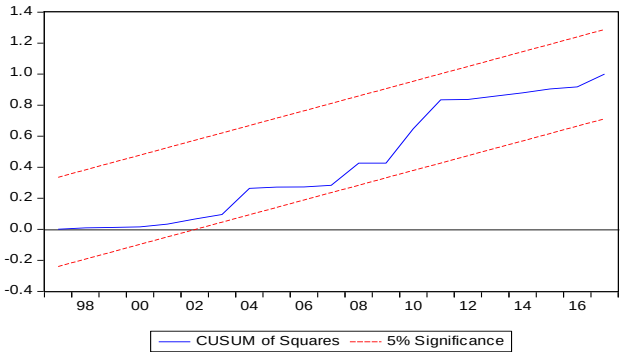



**Figure7: Plot of Cumulative Sum of Squares of Recursive Residuals**



## Short-run Error Correction Estimates

As the bound test based on ARDL (1, 2, 0, 2, 0) equation 3 confirms the existence of long run relationship between the variables. The estimated results of using equation (5) are reported in Table 7.

**Table7: Error correction representation for the ARDL model**

| | Dependent variable Y | | |
|---|---|---|---|
| Independent variable | Coefficient | t-stat | Prob |
| ΔM | -0.06 | -0.26 | 0.79 |
| ΔM(-1) | -0.61 | -2.3 | 0.03 |
| ΔN | 0.12 | 0.64 | 0.53 |
| ΔX | -0.02 | -0.52 | 0.61 |
| ΔX(-1) | -0.09 | -2.24 | 0.03 |
| ΔZ | 0.08 | 0.49 | 0.62 |
| ECT(-1) | -0.27 | -2.8 | 0.01 |

## Short and Long run Equilibrium

Table 8 represents the estimation of short run error correction. Let us deal with the short equilibrium between remittance (X) and per capita GDP (Y). Wald test (5.29) with probability (0.07) suggests that there is a weak short run relationship between remittance and per capita GDP. In other words, remittance causes GDP in the short run. Turning to the M variable (gross fixed capital formation) Wald test shows that there is short run relationship between Y and M. It means M causes Y in the short run. (ECT-1), one period lag residual is the speed of adjustment that shows the rate of speed at which error term restores to equilibrium. This should be negative and significant. As expected it is negative and significant at 1 percent significant level. It confirms the results of the bound test of cointegration. Its value is -0.27. It implies that the speed of adjustment to equilibrium takes place at the rate of 27 percent after shock. The disequilibrium of the previous year's shock converges back to the long run equilibrium in the current year at the speed of 27 percent.

**Table 8: Short and long run equilibrium**

| | Equilibrium | | | | |
|---|---|---|---|---|---|
| | Short run | | Long run | | |
| | Wald test(chi-square) | | | | |
| Variable | Value | prob | Coefficient | t-stat | Prob |
| ΔM | 62.65* | 0 | | | |
| ΔN | 0.98 | 0.32 | | | |
| ΔX | 5.29** | 0.07 | | | |
| ΔZ | 0.27 | 0.6 | | | |
| ECT(-1) | | | -0.27 | -2.8* | 0.01 |

(*), (**) significant at 5 percent and 10 percent respectively.

# V. CONCLUSION

From the couple of decades remittances have been playing important role in the Nepalese economy. Not only for people of rural areas but also for the urban households, remittance is becoming the major source of livelihood. Remittance, a focused variable of this paper has been increasing over the years. The inflow of remittance was US$ 6.6 billion. It jumps to US$ 6.9 billion in 2017 which stands 28.3 percent of GDP. Autoregressive distributed lag model is employed to examine the short and long run relationship between remittance and growth. All variables have become stationary after first difference. ARDL bound testing confirms that variables under consideration are cointegrated showing the long run relationship. Wald test proves that remittance cause per capita GDP in the short run. But in the long run, remittance and per capita GDP has positive relationship. A percent increase in remittance will increase the per capita GDP by 0.36 percent. Similarly, the gross fixed capital formation, secondary school enrolment and the trade openness and per capita GDP have positive relationship. It implies that one percent increase in capital, labor and trade openness increases *the* per capita GDP by 0.82 percent, 0.46 percent and 0.30 percent respectively in the long run.

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