Short-Run and Long-Run Relationships between Economic Growth, Inflation, Exchange Rate and Remittance in Ethiopia: Application of Vector Error Correction Model Approach

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Abstract

Background: Economic growth is the central aim of countries worldwide. Sustaining economic growth is among the main challenges in Ethiopia. This could be attributable to the fluctuations in domestic inflation and exchange rate.

Objective: The objective of this study was to analyze the short-run and long-run relationships between economic growth, inflation, exchange rate and remittance in Ethiopia.

Materials and Methods: The yearly time series data from 1990 to 2020 (30 years) was used. The Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests of unit root were employed to examine whether the series became stationary or not at level. The Johanson co-integration test was performed to determine the co-integration of the variables in the long-term. After stationarity and integration tests were performed, the Vector Error Correction Model (VECM) was employed to estimate the model.

Results: The trace statistic and the maximum eigen-value test of co-integration showed that at least one co-integrating vector ($r>1$) exists in the system at 0.05 level of significance. The results provided that for economic growth, the system corrects its previous period disequilibrium at the speed of 27.34% yearly in the long-run. For inflation rate, exchange rate and remittance, the system corrects its previous period disequilibrium at a speed of 3.58%, 5.38% and 9.84% yearly in the long-run, respectively. Economic growth was negatively affected by inflation rate and positively affected by remittance in the shot-run. Inflation rate was negatively affected by remittance in the short-run. The exchange rate was negatively affected by economic growth and inflation and remittance was negatively affected by economic growth in the short-run.

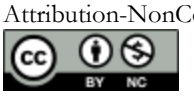
Conclusion: The short-run changes in inflation and remittance had a strong and significant effect on the changing economic growth in the long-run. The study recommended that a monetary policy be formulated with the objective of achieving and maintaining price stability, as opening the market for receiving remittance through increasing investment and human capital and to ensure inflation rate stability as well as enhance local production and export trade.

Keywords: Co-integration; long run; short run; stationarity; vector error correction

1. Introduction

Economic growth is the main target for countries all over the world. Among other things, gross domestic product (GDP) increment is a good indicator of economic growth; higher GDP implies higher income and better standard of living. One of the important ingredients of GDP is saving. Therefore, most efforts to increase GDP and economic growth rely on savings (Karen and Louise, 2018).

For various developing countries including Ethiopia, the inflow of remittance shows increment and imperative rising of GDP, which has a building effect on the economy. According to the data of World Bank, from the entire remittance the country received in the previous three decades, more than 87% of the inflow was gained in the last two decades (Ratha, 2016). While the emerging economies increased, the general inflow of Foreign Direct Investment (FDI) declined the inflow of remittance remained increasing and sustaining the people's livelihood via reducing poverty and meeting their demands (Tassew and Nandeeswar, 2016). Remittance has increased in Ethiopia which constitute 300 billion dollars in 2007, 538 million dollars in 2011, 833 million dollars in 2013 and its increased to 1,796 million dollars in 2014 and 1,087 million dollars in 2015 while its decline to 393 million dollars in 2017 and raised to 531 million dollars in 2019 (WB, 2015). There are different contradictory perspectives regarding the impact of remittance on economic growth. These are optimists (with a view that



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remittances have a positive effect on economic growth for the countries receiving remit through increasing investment and human capital) and pessimists (remittances negatively affect economic growth through inflation and moral hazards resulting from reduced labor supply) (Haas, 2007; Tassew and Nandeeswar, 2016). The study done by Jemma *et al*, (2019) found that remittance affects economic growth positively (increment in remittance would increase foreign investment thus, GDP should increase) and on the other hand, the remittance affects the economic growth negatively in long-run (increase in remittance increase domestic inflation so that GDP would decline) (Tassew and Nandeeswar, 2016).

A stable long-term economic growth requires stable trade and foreign exchange markets to ensure a stable exchange rate system and favorable terms of trade. Different papers present the relationship of exchange rate and economic growth in different ways; Razzaque et al. (2017) found that the exchange rate affects economic growth negatively in the long-run and in the short-run in Bangladesh. Correspondingly, Kogid et al. (2012) found that both exchange rates, nominal and real, are considered to have positive effects on economic growth. The study adopted Autoregressive distributed lag by using the data from 1971-2009. As reported in the study undertaken in Ethiopia, real effective exchange rates, broad money supply and trade openness have a positive impact on economic growth in the long-run (Nigussie, 2016). Similarly, the real effective exchange rate has a positive effect on economic growth in short-run through depreciation in the value of the domestic currency and it has negative effect on economic growth in the long-run (Fentahun, 2011).

In developing countries like Ethiopia, double digit inflation has become problematic for policy makers as well as the society. Emrta (2013) found the optimal level of inflation in Ethiopia around which inflation affect economic growth optimally. The study has applied threshold approach. By doing so on the data from 1971-2010, inflation level of about 10% is optimal for Ethiopia. The most important approach that claims the existence of a positive relationship between inflation and growth is the Phillips Curve approach. This approach assumed that a high inflation causes low rates of unemployment thereby affect economic growth positively (Emrta, 2013). According to the Annual Report of National Bank of Ethiopia, the annual average headline inflation at the end of the fiscal year 2019/20 was rose to 19.9 percent from 12.6 percent a year ago. This was largely owing to 10.2 percent rise in food & non-alcoholic beverages inflation from 13.1 percent to 23.3 percent and 3.9 percent increase in non-food inflation from 11.9 to 15.8 percent (NBE, 2019/20). In general, the overall inflation has increased by 13.6 percent in November 2017 as compared to the one observed in November 2016. The food inflation has increased by 18.1 percent in November 2017 as compared to the one observed in November 2016. The non-food inflation also increased i.e. by 8.6 percent in November 2017 as compared to the one observed in November 2016 (Rajesh, 2018).

Inflation undermines the confidence of domestic and foreign investors about the future route of monetary policy (International Monetary Fund, 2019). Some researchers have studied the linkage between inflation and economic growth using different approaches. There exists a positive relationship between inflation and economic growth in Ethiopia (Demile, 2015). Another study confirmed that the linkages between inflation and economic growth are negative (Yabu and Kessy, 2015; Mamo, 2012). Tadele (2014) found that the relationship between inflation and economic growth was positive in Ethiopia in the long-run and short-run; but for Uganda there is negative relationships between inflation and growth. Wambui (2013) found a positive relationship between inflation and economic growth in Kenya.

This study was intended to examine the relationships between inflation, exchange rate, remittance and economic growth in the short- and long-run. It also assessed the extent to which inflation, exchange rate and remittance affect economic growth in Ethiopia. Accordingly, the main objective of this study is to see the short- and long-run relationship between economic growth, inflation, exchange rate and remittance in Ethiopia by employing 30-year time series data and using econometric analysis.

2. Material and Methods

2.1. Data Source

The study employed the yearly data from 1990 to 2020 to determine the short-run dynamics and long-run relationship between economic growth, inflation, exchange rate, and remittance in Ethiopia. The data on GDP in US dollar was obtained from the International Monetary Fund (IMF) and the World Economic Outlook databases. Data on remittance in US dollar, inflation and exchange rate were extracted from World Bank database.

2.2. Econometric Model Specification

The stationarity test of the time series data can be determined by applying the unit root test such as Augmented Dickey-Fuller (ADF) test, Philips Peron (PP) test, Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests, ADF-GLS test and soon. Among these unit root tests, in this study Augmented Dickey-Fuller (ADF) test and Philips Peron (PP) test were applied. A time series data is said to be stationary when its mean and variance are similar over the given time and the covariance that exists between the two variables was invariant in the observed time.

2.2.1. The augmented Dickey–Fuller (ADF) test

The ADF test builds a parametric adjustment for higher order correction by assuming that the series Y_t follows autoregressive, AR(p) process with order of lag p (Dickey and Fuller, 1979). Thus, the test has been done adding p lagged difference terms of the dependent variable as an independent variable on the right-hand side of the test regression. The ADF test estimating the following regression:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad (1)$$

Where, β_1, β_2, δ and α are coefficients, t is the stochastic time-trend, ε_t is a white noise error term and $\Delta Y_{t-1} = Y_{t-1} - Y_{t-2}, \Delta Y_{t-2} = Y_{t-2} - Y_{t-3}$, etc.

2.2.2. Philips Peron (PP) tests

The Phillips-Perron test is an alternative technique for unit root tests which ignores any serial correlation in the error-term without adding lagged difference terms and they use the standard DF or ADF test but adjust the t-ratio so that the serial correlation does not affect the asymptotic distribution of the test statistic.

2.2.3. Co-integration test

In the entirely particular regression model $Y_t = \beta X_t + \varepsilon_t$, there is a presumption that the disturbances ε_t are stationary, white noise series. But this presumption is unlikely to be true if Y_t and X_t are integrated series. Generally, if two series are integrated to different orders, then linear combinations of them will be integrated to the higher of the two orders. If Y_t and X_t are each drifting upward with their own trend, then unless there is some relationship between those trends, the difference between them should also be growing, with yet another trend. There must be some kind of inconsistency in the model. Intuitively, if the two series are both $I_{(1)}$, then the difference between them might be stable around a fixed mean. The implication would be that the series are drifting together at roughly the same rate. Two series that satisfy this requirement are said to be co-integrated vector. In such a case, it can be differentiated between a long-run relationship between Y_t and X_t that is, the manner in which the two variables drift upward together, and the short-run dynamics, that is, the relationship between deviations of Y_t from its long-run trend and deviations of X_t from its long-run trend. If this is the case, then differencing the data would be counterproductive, since it would obscure the long-run relationship between Y_t and X_t. Studies of co-integration and a related technique, error correction, are concerned with methods of estimation that preserve the information about both forms of co-variation.

2.2.4. Vector error correction model (VECM)

The vector autoregressive (VAR) model is a common framework used to express the dynamic interrelationship among stationary variables. So, the first step in time series analysis should be to decide whether the levels of the data are stationary. If not stationary, take the first differences of the series and try again. If the time series are not stationary at level, then the VAR framework needs to be modified to allow consistent estimation of the relationships among the series. The Vector Error Correction model (VECM) is just a special case of the VAR for variables that are stationary in their differences (i.e., $I_{(1)}$). If the series are co-integrated, the series move together in the long-run. A VAR of the first differences does not capture the long-run relationship. Therefore, it is appropriate to use VECM rather than VAR in order to reveal the short- and long-term tendencies between the series. The VECM can also take into account any co-integrating relationships among the variables.

Consider a VAR with p lags

$$Y_t = B + A_1 Y_{t-1} + A_2 Y_{t-2} + ... + A_p Y_{t-p} + \varepsilon_t \quad (2)$$

Where, Y_t a Kx1 vector of variables, B is Kx1 vector of parameters, $A_1 .... A_p$ are KxK matrix of parameters and ε_t is Kx1 vector of disturbances. The VEC model is specified as follows:

$$\Delta Y_t = B + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t$$

here, $\Pi = -I_n + \sum_{i=1}^{p} A_i$, (3)

and I_n is an identity matrix, A's are KxK matrix of parameters.

Specifically, when we use our variables the VECM can be specified as follows: -

$$\Delta GDP_t = \alpha_1 + \sum_{i=1}^{p-1} \alpha_{2i} \Delta GDP_{t-1} + \sum_{j=1}^{p-1} \alpha_{3j} \Delta INR_{t-1} + \sum_{k=1}^{p-1} \alpha_{4k} \Delta EXR_{t-1} + \sum_{l=1}^{p-1} \alpha_{5l} \Delta REM_{t-1} + \eta_1 EC_{t-1} + \varepsilon_{1t} \cdots (4)$$

$$\Delta INR_t = \beta_1 + \sum_{i=1}^{p-1} \beta_{2i} \Delta GDP_{t-1} + \sum_{j=1}^{p-1} \beta_{3j} \Delta INR_{t-1} + \sum_{k=1}^{p-1} \beta_{4k} \Delta EXR_{t-1} + \sum_{l=1}^{p-1} \beta_{5l} \Delta REM_{t-1} + \eta_2 EC_{t-1} + \varepsilon_{2t} \cdots (5)$$

$$\Delta EXR_t = \theta_1 + \sum_{i=1}^{p-1} \theta_{2i} \Delta GDP_{t-1} + \sum_{j=1}^{p-1} \theta_{3j} \Delta INR_{t-1} + \sum_{k=1}^{p-1} \theta_{4k} \Delta EXR_{t-1} + \sum_{l=1}^{p-1} \theta_{5l} \Delta REM_{t-1} + \eta_3 EC_{t-1} + \varepsilon_{3t} \cdots (6)$$

$$\Delta REM_t = \gamma_1 + \sum_{i=1}^{p-1} \gamma_{2i} \Delta GDP_{t-1} + \sum_{j=1}^{p-1} \gamma_{3j} \Delta INR_{t-1} + \sum_{k=1}^{p-1} \gamma_{4k} \Delta EXR_{t-1} + \sum_{l=1}^{p-1} \gamma_{5l} \Delta REM_{t-1} + \eta_4 EC_{t-1} + \varepsilon_{4t} \cdots (7)$$

Where, ΔGDP_t is the difference of economic growth at time t, ΔINR_t is the difference of inflation rate at time t, ΔEXR_t is the difference of exchange rate at time t, ΔREM_t is the difference of remittance at time t, EC is the error correction term which is the estimated residual from the co-integration regression and ε_t is the random disturbance term at time t. Here, gross domestic product is the major indicator of Ethiopian economic growth. Therefore, the study tried to find the short-run dynamics and long-run relationship between economic growth and other macroeconomic variables considered.

3. Results and Discussion

3.1. Descriptive Statistics

To accomplish the research objectives, the yearly data span from 1990 to 2020 in Ethiopia was investigated. In this study, different econometric models were employed to analyze the relationship between gross domestic product (proxy for economic growth) and inflation, exchange rate and remittance. Some descriptive statistics including mean, standard deviation, minimum and maximum values of the series under study were computed (Table 1). The result presented that the average gross domestic product covering the year from 1990 to 2020 in Ethiopia was 30.54 billion dollars whereas the minimum and maximum values were 6.92 billion dollars and 95.91 billion dollars over 31 years, respectively. The reason for the minimum GDP was that, Ethiopia experienced political instability, poverty and drought. Furthermore, the average inflation rate was 10.98% and exchange rate was 12.62 dollars over the year from 1990 to 2020. On average, the remittance over 31 years was 0.315 million dollars whereas the minimum and maximum remit money from abroad were 0.005 million dollars and 1.796 million dollars, respectively.

Table 1. Descriptive statistics.

Variables	Obs	Mean	Std. Dev.	Min	Max
GDP in billion dollars	31	30.544	29.353	6.928	95.91
Inflation rate	31	10.979	11.378	-8.484	44.391
Exchange rate	31	12.619	8.843	2.07	33.25
Remittance in million dollars	31	0.315	0.400	0.005	1.796

Note*: GDP = Gross Domestic Product, Obs = Observations, Std.Dev. = Standard Deviation, Min = Minimum value, and Max = Maximum value.*

The trends of the selected macroeconomic variables were displayed as shown in Figure 1 and suggested that the series of all the variables were non-stationary at their level and shows increasing trend except inflation rate and remittance.

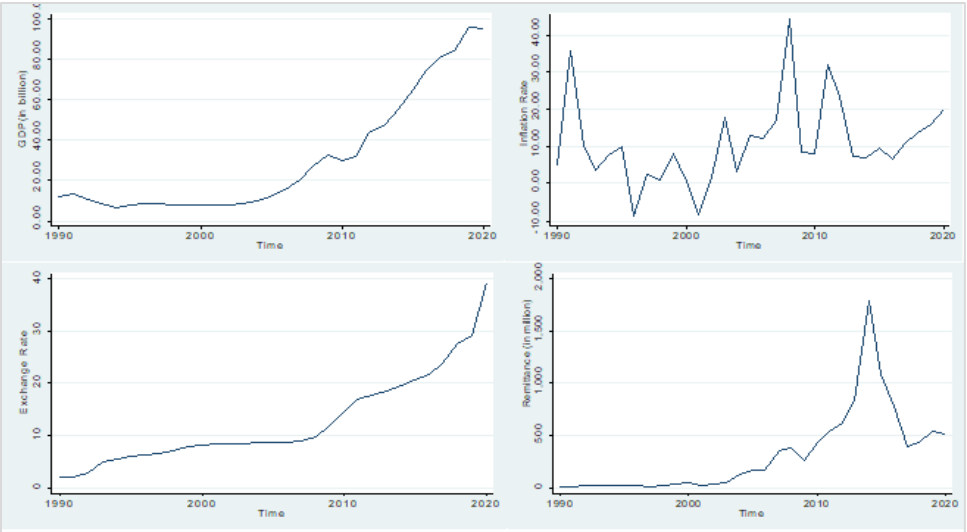

Figure 1. Plots of economic growth, inflate rate, exchange rate and remittance.

3.2. Unit Root Test

The time series under contemplation should be checked for stationary before one can endeavor to fit an appropriate model. That is, the variables have to be tested for the presence of unit root(s) thereby the order of integration of each series was determined. The stationarity of the series was tested by using an Augmented Dickey-Fuller test and a Phillips and Perron test. The results of ADF and PP tests, with constant and trend both at level and first difference for each series were presented in Table 2. The results indicated that the null hypothesis that the series in levels contain unit root could be accepted for all series. That is, the respective p-values were greater than conventional significance levels $\alpha = 0.05$ and 0.01. Since the null hypothesis cannot be rejected, in order to determine the order of integration of the non-stationary time series, the same tests were applied to their first differences. The order of integration is the number of unit roots that should be contained in the series so as to be stationary. This implies that all variables were stationary at first difference I(1), hence proving argument sustained for further estimating the long-run relationship.

Table 2. Unit root test results.

Variable	ADF Test		PP Test	
	At Level	At first difference	At Level	At first difference
	P- value	P- value	P- value	P- value
GDP	1.76	0.000	-0.16	0.000
Inflation rate	1.93	0.000	-0.76	0.000
Exchange rate	0.68	0.000	-1.39	0.000
Remittance	-1.54	0.000	-2.03	0.000

Note*: ADF is Augmented Dickey-Fuller test and PP is Phillips and Perron test.*

3.3. Co-integration Analysis

It was possible to proceed for co-integration test since the variables were integrated of order one. The existence of potential short-run dynamics and long-run equilibriums among the variables in the model was determined using the co-integration test. Test of Johansen (1992) co-integration was applied to the variables under study to test for co-integration based on the trace statistic test and maximum egien-value test. The trace tests and maximum eigen-value test were made consecutively based on the first hypothesis of no co-integration to a rising number of co-integrating vectors. The results of co-integration tests for economic growth, inflation, exchange rate and remittance were described in Table 3. Results of co-integration test revealed that the trace statistic and the maximum eigen-value test indicated that at least one co-integrating vectors ($r>1$) exists in the system at the 95% confidence level. The result was consistent with that of Dufera and Desa (2020).

Table 3. Co-integration test results.

Hypothesis		Trace Statistic			Maximum Eigenvalue		
H_0	H_1	Trace Statistic	5% Critical Value	P-value	Max-Eigen value	5% Critical Value	P-value
$r \leq 0$	$r > 0$	59.4569	48.8743	0.0033	31.3564	28.5843	0.0054
$r \leq 1$	$r > 1$	30.2546*	29.7854	0.0512	20.5532*	21.1316	0.0636
$r \leq 2$	$r > 2$	8.6963	15.5479	0.3654	8.5769	14.2654	0.4258
$r \leq 3$	$r > 3$	0.0864	3.8698	0.9810	0.0985	3.8415	0.9562

Note*: * Denotes rejection of null hypothesis at 5% level of significance. H_o: there is no co-integration among variables H_1: there is co-integration.*

Decision: Reject the null hypothesis (H_o) which was no co-integration among variables and therefore, it can be concluded that there is co-integration among variables. From the Johansen co-integration test, it was determined that the rank of co-integration matrix to be equal to one. Consequently (Table 5), the co-integrating vector is given by β= (1, -1.62584, 1.52529, -1.26247). The values correspond to the co-integrating coefficients of GDP (normalized to one), inflation, exchange rate and remittance, respectively. Thus, the vector above can be expressed as follows:

$$ECT_{-1} = GDP - 1.62584INR_t + 1.52529EXR_t - 1.26247REM_t$$

Where, ECT is error correction term, INR is inflation rate, EXR is exchange rate, and REM is remittance.

3.4. Lag Length Selection Results

Preferring an appropriate lag length had strong inferences for successive modeling. Choosing too few lags could result in systematic variation in the residuals whereas if too many lags were selected, it came with the penalty of fewer degrees of freedom. The likelihood ratio (LR), Akaike information criterion (AIC), Bayes information criterion (BIC), and Hannan-Quin information criteria (HQIC) were used to determining a suitable lag length (Table 4). Lag two was selected to be the appropriate lag length, as these were selected by the majority of the criterion.

Table 4. Lag selection criteria for co integration.

Lag	LL	LR	df	P	FPE	AIC	HQIC	BIC
0	-65.73	-	-	-	.000804	4.23	4.28688	4.40724
1	92.03	315.52	16	0.000	1.5e-07	-4.37	-4.06	-3.46*
2	138.24	51.19*	16	0.000	7.6e-08*	-5.23*	-4.43*	-2.87
3	112.64	41.22	16	0.001	1.2e-07	-4.64	-4.09	-3.01
4	149.57	22.66	16	0.123	1.3e-07	-4.94	-3.91	-1.86

Note*: LL is lag length, LR is likelihood ratio, Df is degrees of freedom, P is probability, FPE is Final Prediction Error, AIC is Akaike Information Criterion, HQIC is Hannan-Quinn Information Criterion, BIC is Bayes Information Criterion, and *indicates lag order selected by the criterion.*

3.5. Vector Error Correction Model (VECM) Estimation

Co-integration and non-spurious regression were the basic requirements of VECM. There was adequate substantiation on the long-run relationship between the variables under consideration according to the results of co-integration test (Table 3) as there was a co-integration relationship. Result of ADF and PP tests provides adequate verification of stationarity of the variables (Table 2) at first difference. Since the series were co-integrated and non-spurious, it was possible to estimate VEC Model. The estimation results of VECM given in (Table 5).

Table 5. Vector error correction model estimation results.

Variable	Coef.	Std. Err.	z-stat	P-value
ΔGDP_t				
EC_{t-1}	-0.27345	0.11911	2.295	0.000*
ΔGDP_{t-1}	0.32728	0.19459	1.681	0.193
ΔINR_{t-1}	-0.10834	0.03344	-3.239	0.003*
ΔEXR_{t-1}	-1.53016	0.25902	-5.907	0.536
ΔREM_{t-1}	0.43237	0.36947	1.170	0.001*
_cons	0.51481	0.39018	1.319	0.187
ΔINR_t				
EC_{t-1}	-0.03582	0.01645	-2.177	0.000*
ΔGDP_{t-1}	3.03171	0.85604	3.541	0.089
ΔINR_{t-1}	-0.12970	0.21557	-0.602	0.885
ΔEXR_{t-1}	5.64983	0.61595	9.172	0.100
ΔREM_{t-1}	-5.13618	0.82301	-6.240	0.002*
_cons	0.24039	0.39818	0.603	0.920
ΔEXR_t				
EC_{t-1}	-0.05382	0.20653	-0.261	0.003*
ΔGDP_{t-1}	-0.18448	0.05638	-3.240	0.005*
ΔINR_{t-1}	-0.13703	0.11003	-1.245	0.000*
ΔEXR_{t-1}	0.51876	0.16768	3.093	0.132
ΔREM_{t-1}	0.27442	0.20081	1.366	0.172
_cons	0.16066	0.11703	1.372	0.170
ΔREM_t				
EC_{t-1}	-0.09845	0.04658	-2.113	0.000*
ΔGDP_{t-1}	-0.10587	0.04617	-2.293	0.001*
ΔINR_{t-1}	-0.63225	0.49693	-1.272	0.432
ΔEXR_{t-1}	0.05531	0.13264	0.416	0.677
ΔREM_{t-1}	-0.36933	0.15885	-2.325	0.000*
_cons	0.069226	0.09258	0.747	0.455

Note*: EC = error correction, GDP = gross domestic product, INR = inflation rate, EXR = exchange rate, REM = remittance, _cons = constant value, Coef = coefficients, Std.Err. = standard error, z-stat = Z-statistic, and * indicates that significance level at 5% level of significant.*

Normalization form of co-integrating coefficients (p-values in parentheses)

GDP	INR	EXR	REM
1.00	-1.625842	1.52529	-1.26247
	(0.000)	(0.016)	(0.008)

The VECM estimates indicated that in the economic growth (ΔGDP) equation, the lagged error correction (EC) term was negative and significant at 5% level meaning that the system corrects its previous period disequilibrium at a speed of 27.34% yearly. It implied that the model identified the substantial speed of adjustment by 27.34% of disequilibrium correction yearly for reaching long-run equilibrium steady state position. The coefficient of the lagged EC term for inflation rate (η_2 = -0.03582, P= 0.000) was negative and significant meaning that the system corrects its previous period disequilibrium at a speed of 3.58% yearly. The coefficient of the lagged EC term for exchange rate (η_3 = -0.05382, P=0.003) was negatively significant at 5% level indicating that system corrects its previous period disequilibrium at a speed of 5.38% yearly and the coefficient of lagged EC term for remittance (η_4 = -0.09845, P=0.000) were negative and significant at 5% level implying that the system corrects its previous period disequilibrium at a speed of 9.84% yearly. This result was inconsistent with the finding of Abis (2014).

As indicated in Table 5, the short-run dynamics were hold throughout the individual coefficients of the difference terms. The examination of the short-run relationship between the variables confirmed that economic growth was negatively affected by the first lag of inflation rate and positively affected by the first lag of remittance in shot-run. In this equation, the short-run coefficients of first lag of exchange rate and past values of GDP were insignificantly different from zero. This implies that the values of exchange rate and previous values of economic growth had no short-run effects on the economic growth. This result is consistent with some other studies (Jemma *et al*, 2019; Mamo, 2012; Yabu and Kessy, 2015). In the inflation rate regression, the effects of the first lag of remittance were negatively significant, but the other short-run coefficients in this equation were insignificantly different from zero. This implied that inflation was negatively affected by remittance in Ethiopia, but GDP and exchange rate had no short-run effects on inflation. This result was in contrast with the finding by Gizaw (2016), but similar with the finding of Lim and Sek (2015).

For the exchange rate equation, the short-run coefficient of the first lag of GDP and first lag of inflation rate were negatively significant, but the short-run coefficients of remittance were insignificantly different from zero. This implied that remittance had no short-run impact on exchange rate. This result is inconsistent with the finding of Fentahun (2011) who found that the real effective exchange rate had a positive effect on economic growth in the short-run. In the remittance regression, the effects of the first lag of GDP and its own past values were negatively significant and the other coefficients were insignificantly different from zero. This implied that economic growth of previous year negatively affected the remittance in the short-run. Furthermore, values of remittance in previous years inversely affected the current values of remittance. Thus, as economic growth of previous year was raised, the demand of people for remitting money from abroad in the current year was decreased. But, inflation and exchange rate had no relationships with remittance in the short-run.

4. Conclusion and Recommendations

The main objective of this study was to analysis the short-run and long-run relationships between inflation, remittance, exchange rate and economic growth in Ethiopia. The study used the World Bank's and international monetary fund databases spanning from 1990 to 2020 periods as sources of data or information. The study employed vector error correction model data analysis methods. Economic growth, inflation, exchange rate and remittance were stationary at first difference and there is at least one co-integration between them. The results of the study showed that the system corrects its past period disequilibrium at a specified speed of adjustment in long-run for economic growth, inflation, exchange rate and remittance. The inflation rate and remittance had strong impacts on economic growth in the short run. Furthermore, remittance affects inflation negatively in the short-run while GDP and inflation rate have strong impact on exchange rate in the short-run. Economic growth strongly and negatively affected remittance in the short-run. However, exchange rate had no short-run effect on GDP while GDP and exchange rate had no impacts on inflation in the short-run. The results also indicated that in a case of shock and disequilibrium, the model converges to its equilibrium position in the long-run. The estimated results revealed that 27.34% of the disequilibrium in economic growth adjusted each year.

Based on the finding of this study, it is recommended that a monetary policy be formulated with the objective of achieving and maintaining price stability, as opening the market for receiving remittance through increasing investment and human capital and to ensure inflation rate stability as well as enhance local production and export trade. In addition, the implication of a holistic program of economic reform is essential to complement the inflation rate and remittance policy to encourage economic growth.

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