

Original Article

# Impact of Foreign Direct Investment, Population Growth & Inflation on Unemployment in Rwanda (1985-2018)

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**Abstract** - This paper examines the impact of foreign direct investment, population growth, and inflation on unemployment in Rwanda. Using co-integration analysis of Johansen and Error Correction Model (ECM), annually, periodic data from 1985 to 2018 were analyzed so as to reach this aim. The results indicated that there is a significant long-run relationship between foreign direct investment net inflows (% of GDP), population growth (annual %), inflation, GDP deflator (annual %), and unemployment (% of the total labour force). In the longrun, as well as in the shortrun, the two independent variables (population growth and inflation) have a positive impact on unemployment, but Foreign Direct Investment has a negative impact on unemployment in the period of study. About inflation and unemployment, there is no presence of the Philips curve. The government of Rwanda has been recommended to reinforce policies of attracting foreign investors, to reinforce control of demographic changes, to reinforce made in Rwanda policy in order to discourage imported inflation and controlling money supply using monetary policy tools, especially selective credit control and wage control.

**Keywords** - Johansen co-integration analysis, Error Correction Model, Foreign direct investment, population growth, inflation, unemployment, and Rwanda.

## I. INTRODUCTION

In theories, it has been mentioned that both population growth, foreign direct investment, and inflation play a crucial role in the variation of the unemployment rate. Many empirical studies and theoretical studies focused on the role of foreign direct investment and population growth on economic growth in different nations. Foreign direct investment and population growth have been seen as the engine of economic growth. In Rwanda, from 1985 to 2018, there was an increase in population growth, there is an increase in foreign direct investment, and there is an increase in unemployment, as well as an increase in inflation (World

Bank Report, 2018). Therefore, the purpose of this paper is to econometrically examine the Impact of foreign direct investment, population growth, and inflation on the unemployment rate, using annual data between 1985-2018.

In particular, this study aims to empirically discover whether foreign direct investment decreases unemployment, whether population growth leads to unemployment, or whether inflation decreases unemployment. The paper is structured in the following ways. In Section Two, we present a review of related literature. We dealt with the Methodology, specification of the model and used data used in the third section. In the fourth section, we presented the empirical results and interpretation of the findings. Ultimately, the fifth section shows the policy recommendation and conclusion.

## II. LITERATURE REVIEW

Different academicians and policymakers have conducted many studies and researches on Foreign Direct Investment, Population growth, Inflation, and Unemployment. Regarding the relationship between the variables, they have found almost the same results. The literature review focused on the relationship between each variable and unemployment, but in our study, we focused on a joint relationship between our three independent variables and the dependent variable. The following paragraphs describe different studies conducted in different periods of time, in different countries using different techniques and their results;

Vasile et al. (2015), using the Toda-Yamamoto procedure, Causality analysis, examined the FDI and Unemployment for the latest E.U. members for the period 1991-2012. The findings of the study were that there is no Granger causality between FDI and Unemployment for six countries, and one-directional causality was found for the remaining countries.



Yayli and Deger (2012) investigated the relationship between FDI and Unemployment in Developing countries using dynamic panel causality tests for a period between 1991 to 2008. They have found that there is a causal short-run relationship running from FDI towards employment.

Craigwell (2006), in 20 Caribbean countries in the period 1990-2000, reported that there is a positive effect of the inflow FDI on the employment rate using correlation analysis and Granger causality.

Muhammad et al. (2012) investigated the determinants of unemployment in Pakistan over a period of 1976-2012, using the Autoregressive Distributed Lag (ARDL) approach. They found that FDI is a significant determinant of unemployment in the longrun as well as in Short-run. They also said that in Pakistan, the Philips curve exists in both the long-run and short-run.

Nayyira et al. (2012) evaluated the relationship between FDI and unemployment reduction in Pakistan for the period 1995-2011 using multiple regression analysis. The findings revealed that FDI plays a significant role in unemployment reduction in Pakistan.

Ismail and Latif (2009), using the VAR technique of Variance decomposition and impulse response function under the period of 2001:1 to 2007:4 in Turkey, they have studied the relationship among FDI, exports, unemployment, and GDP, they have found that FDI does not have any impact on unemployment rate in Turkey.

Habiba Edward (2016) carried out a study entitled "Impact of population growth on unemployment in Nigeria for the period 2007 to 2016, using regression analysis. The study revealed that there is population growth plays a very big role in increasing unemployment in Nigeria.

Chaido and Melina (2012) examined the relationship between inflation and unemployment in Nairu in Greece for a period of 1980-2010 using impulse responses. They found

### III. DATA, METHODOLOGY, AND MODEL SPECIFICATION

#### A. Data

In this study, the analysis used the annual time series of 1985 to 2018 in Rwanda. The data set describes observations for foreign direct investment inflows (% of GDP), population growth (annual %), inflation, GDP deflator (annual %), and unemployment (% of the total labour force). All data have been extracted from World Bank Development Indicators 2018.

#### B. Methodology

We conducted the test of stationarity in order to investigate the order of integration for all the series. Given that all series were not stationary in level, the first difference was made,

that there is a long-run and causal relationship between inflation and unemployment within the period of the study.

Islam et al. (2003), using USA time series data of the period 1950-1999, with co-integration analysis and VECM techniques, found that there is a weak long-run relationship between unemployment and inflation in the USA.

Maximova Alisa (2015), in Russia, using the Philips curve, investigated the relationship between Inflation and Unemployment for the period between 1999-2015. The study revealed that there is an inverse relationship between unemployment and inflation in Short-run, but in the longrun, this relationship is absent.

Pa Alien Kasseh (2018), in the Gambia, using the new Keynesian Curve Model with time series of 1991-2015, analyzed the relationship between inflation and unemployment. The results revealed that there is significant existence of an inverse relationship between unemployment and inflation in the Gambia.

Maijama et al. (2019) analyzed the impact of population growth on unemployment in Nigeria using the Dynamic OLS approach for time series data of the period 1991-2017. The results have indicated that population growth positively impacts unemployment.

Ademola and Badiru (2016) examined the effects of unemployment and inflation on economic performance in Nigeria using Julius co-integration test and the OLS for time series data from 1981-2014. The results indicated that unemployment and inflation are positively related to economic growth.

Adekola et al. (2016) examined whether unemployment is caused by demographic changes in Nigeria using a comparative analysis of more populated countries in three continents; China, Nigeria, and the USA. The results show that demographic changes are not a key determinant of unemployment, but in Nigeria, it was inverse because both population and unemployment were growing.

and all series became stationary after the first difference. We estimated, based on the co-integration test and ECM. The co-integration test and ECM have indicated that there is a long-run association between variables. The results indicated that the independent variables (Population growth and inflation) have a positive relationship with the dependent variable (unemployment) in the longrun as well as in the shortrun. Another side, Foreign Direct Investment (FDI), has a negative relationship with unemployment in the longrun and in the shortrun.

#### C. Model specification

$$UNEMPL_t = f(FDI_t, POP_t, INF_t, \dots) \quad (1)$$

After transformation the function has the following form:

$$\text{Log}(UNEMPL)_t = \beta_0 + \beta_1 \log(FDI)_t + \beta_2 \log(POP)_t + \beta_3 \log(INF)_t + \mu_t(2)$$

$INF_t$ : Inflation rate in period t  
 $\beta_0$ = the Intercept.  
 $\beta_1, \beta_2$  and  $\beta_3$  =the coefficient of the model of regression.  
 $\mu_t$ = error term at period t.

In this position;  
 $UNEMPL_t$ : Unemployment rate in period t  
 $FDI_t$ : Foreign Direct Investment in period t  
 $POP_t$ : Population growth rate in period t

**IV. EMPIRICAL ANALYSIS**

**A. Unit root test: Augmented Dickey-Fuller test and Philips-Peron test**

Table 1. Test of Stationarity at Level

Variables	ADF		PP		Conclusion
	Test statistic	Probability	Test statistic	Probability	
UNEMPL	-1.234081	0.8859	-1.114702	0.9112	Not I(0)
FDI	-3.007561	0.1454	-2.901646	0.1749	Not I(0)
POP	-3.597768	0.0961	-2.229649	0.4585	Not I(0)
INF	-3.937763	0.0514	-3.886480	0.0541	Not I(0)

Source: Authors' computation using E-views, 2020.

The results of the unit root test using ADF and P.P. tests have indicated that all variables; Unemployment, Foreign Direct Investment, Population growth, and inflation are non-stationary at the level. This is caused by probabilities higher than 0.05 and critical values that are lower than test statistics for all the variables. After seeing that the series have a unit root at levels, we have to conduct the first difference.

Table 2. Test f Stationarity at First Difference

Variables	ADF		PP		Conclusion
	Test statistic	Probability	Test statistic	Probability	
UNEMPL	-6.799548	0.0000	-6.775980	0.0000	I(1)
FDI	-10.43557	0.0000	-11.21749	0.0000	I(1)
POP	-9.905766	0.0000	-9.235914	0.0000	I(1)
INF	-8.756865	0.0000	-10.23052	0.0000	I(1)

Source: Authors' computation using E-views, 2020

The findings have shown that all series became stationary after the first difference. This is caused by probabilities lower than 0.05 and critical values that are higher than test statistics for all the variables. After seeing that the series have no unit root at the first difference, we have to conduct a co-integration test.

**B. VAR Lag order selection criteria**

Before determining the co-integration among variables, we have to determine the estimated existing number of delays. To do this, we must apply VAR Lag order selection criteria techniques.

Table 3. VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-283.2406	NA	4714.019	19.80970	19.99829	19.86876
1	-40.71857	19.89719*	0.297302*	8.601281*	12.56172*	9.841642*
2	-132.2734	73.65433	1.402439	11.60506	13.30240	12.13665
3	-101.5717	33.87782	0.614932	10.59115	13.04285	11.35899
4	-76.78223	20.51538	0.505988	9.984982	13.19105	10.98908

Source: Authors' computation using E-views, 2020.

The small value of AIC (8.601281\*) indicates that the number of lags is equal to 1. At this level, we can conduct a co-integration analysis. As well as all the variables being integrated in the same order, we are obliged to conduct a co-integration analysis using the Johansen co-integration test.

**C. Johansen co-integration test**

In conducting the co-integration test, the hypotheses were the followings:

- Null hypothesis (H<sub>0</sub>): There is no co-integration among variables,
- The alternative hypothesis (H<sub>1</sub>): There is co-integration among variables

**Table 4. Johansen Co-Integration Test Analysis**

<b>Unrestricted Cointegration Rank Test (Trace)</b>				
Hypothesized No. of C.E. (s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.884350	108.3157	47.85613	0.0000
At most 1	0.478716	39.28565	49.79707	0.0030
At most 2	0.404916	18.43893	25.49471	0.0175
At most 3	0.055561	1.829246	3.841466	0.1762
<b>Unrestricted Cointegration Rank Test (Maximum Eigenvalue)</b>				
Hypothesized No. of C.E. (s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.884350	69.03006	27.58434	0.0000
At most 1	0.478716	20.84672	21.13162	0.0547
At most 2	0.404916	16.60968	14.26460	0.0209
At most 3	0.055561	1.829246	3.841466	0.1762

Source: Authors' computation using E-views, 2020

The findings from table4 indicated that both the trace test and Max-eigenvalue test showed the existence of one cointegrating equation at a 5% significance level. Thus, the variables of the study have a long-run association among them. This implies that there is a long-run relationship between independent variables (Foreign Direct Investment, Population growth, and Inflation) and the dependent variable (Unemployment).

**a) Johansen long-run estimate equation**

**Table 5. Normalized Co-Integrating Coefficients For Long-Run**

LUMPY	LFDI	TOP	LINK
1.000000	+2.412096	-4.443841	-0.913370
	(0.68711)	(0.33806)	(0.16140)

Source: Authors' computation using E-views, 2020

In making the long-run estimate equation, the signs of normalized co-integrating coefficients must be reversed:  

$$\text{LUNEMPL} = -2.412096\text{LFDI} + 4.443841\text{LPOP} + 0.913370\text{LINF} \quad (3)$$

The equation indicated that there is a negative association between Foreign Direct Investment and Unemployment in the longrun. A 1% increase in FDI leads to a 2.41% decrease in unemployment. The findings showed that there is a positive relationship between population growth and unemployment. A 1% increase in population growth leads to a 4.43% increase in unemployment in the longrun. Table 5 and the long-run equation indicate that there is a positive relationship between inflation and unemployment. A 1% increase in inflation leads to a 0.91% increase in unemployment in the longrun.

As well as variables are co-integrated, we are allowed to run the Error Correction Model (ECM), which explains the short-run model.

**D. Error Correction Model (ECM)**

After demonstrating the co-integration among the series, the following step remains to estimate the Error Correction Model or the short-run model. ECM estimates the period in which the explained variable returns to equilibrium after a change in the independent variable.

**Table 6. Estimated Short-Run Equation**

	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.601027	0.001117	-0.918903	0.0203
D(UNEMPL(-1))	0.644349	0.176292	3.655011	0.0169
D(FDI(-1))	-0.415837	0.003850	-1.516029	0.0325
D(POP(-1))	0.066630	0.025343	2.629129	0.0106
D(INF(-1))	0.029525	0.007750	3.809786	0.0032
C	0.022107	0.009339	2.367272	0.0398
R-squared	0.765232	0.592548	0.677928	0.446090
Adj. R-squared	0.643162	0.514192	0.615992	0.339569
Sum sq. resid	0.039858	51.85049	1.009087	12.89370
S.E. equation	0.039154	1.412179	0.197005	0.704210
F-statistic	0.011975	7.562248	10.94548	4.187812
Log likelihood	61.60465	-53.12809	9.901004	-30.86208
Mean dependent	0.032431	0.039221	-0.005559	0.062408
S.D. dependent	0.045006	2.026084	0.317912	0.866540

Source: Authors' computation using E-views, 2020

$$UNEMPL = C (1)*UNEMPL (-1) + C (2)*FDI (-1) + C (3)*POP (-1) + C (4) *INF (-1) + C (5)(4)$$

Table 6 indicated that the value of Error Correction Term (ECT (-1)) is negative (-0.601027), and it is significant provided that is the probability (0.0203) is less than 5% level of significance. This means that 60% of disequilibrium in variables will be corrected in one year, so 100% of errors will be corrected after 1Year 8 months.

The value of R-squared indicated that the independent variables (Foreign Direct Investment, population growth, and inflation) jointly cause variation in the dependent variable (unemployment) 76%. The value of F-statistic, which is less than a 5% level of significance, indicated that the model is significant, and it can be used.

The coefficients of the variables indicated that in the short-run, two variables of the study (population growth and

inflation) have a positive relationship with unemployment and one variable (Foreign Direct Investment) has a negative relationship with unemployment. In all independent variables of the study, a variable that has a great impact on unemployment is Foreign Direct Investment (FDI) in the shortrun.

**V. Diagnostic tests**

Residual tests and stability tests have been conducted in order to make sure that the economic model is not spurious. This helped the model estimators to be BLUE (Best Linear Unbiased Estimator).

**A. Heteroskedasticity test**

In the heteroskedasticity test, the hypotheses were stated in the following ways:

H<sub>0</sub>: the existence of homoscedasticity, H<sub>1</sub>: No existence of homoscedasticity (Heteroskedascity)

**Table 7. Heteroskedasticity Test: Breusch-Pagan-Godfrey**

F-statistic	0.214430	Prob. F(3,30)	0.1069
Obs*R-squared	0.664070	Prob. Chi-Square(3)	0.1039
Scaled explained SS	0.457302	Prob. Chi-Square(3)	0.2161

Source: Authors' Computation Using E-Views, 2020

The results from table 7 have indicated Obs\*R-squared 0.66, which is higher than the 10% level of significance. For this reason, we accepted H<sub>0</sub> thatwe have homogeneity, which means that the variance in the error term is constant.

**B. Serial correlation test**

In the serial correlation test, the hypotheses were stated in the followings:

H<sub>0</sub>: Absence of serial correlation, H<sub>1</sub>: Presence of serial correlation

**Table 8. Breusch-Godfrey Serial Correlation L.M. Test:**

F-statistic	0.057909	Prob. F(2,29)	0.410
Obs*R-squared	0.787751	Prob. Chi-Square(2)	0.390

Source: Authors' Computation Using E-Views, 2020

Table 8 indicated Obs\*R-squared 0.78, which is greater than 10% level of significance, we reject  $H_1$  and accept  $H_0$  then, there is an absence of serial correlation.

**C. Test for autocorrelation (Correlogram-Q-Statistic)**

In the autocorrelation test, the hypotheses were stated in the followings:

$H_0$ : Absence of autocorrelation of errors,  $H_1$ : Presence of autocorrelation of errors

**Table 9. Test For Autocorrelation (Correlogram-Q-Statistic)**

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
.  ***	.  ***	1	0.388	0.388	5.5711	0.151
.  **	.  *	2	0.218	0.080	7.3906	0.152
.  *	.  .	3	0.090	-0.023	7.7083	0.153
.  *	**  .	4	-0.199	-0.286	9.3194	0.154
.  *	.  .	5	-0.113	0.052	9.8539	0.179
.  .	.  *	6	0.054	0.202	9.9801	0.225
.  .	.  .	7	0.052	0.027	10.104	0.283
.  *	.  .	8	0.090	-0.061	10.484	0.333
.  *	.  .	9	0.131	0.051	11.325	0.354
.  *	.  *	10	0.126	0.152	12.136	0.376
.  .	*  .	11	-0.001	-0.096	12.136	0.454
.  .	*  .	12	-0.053	-0.124	12.291	0.523

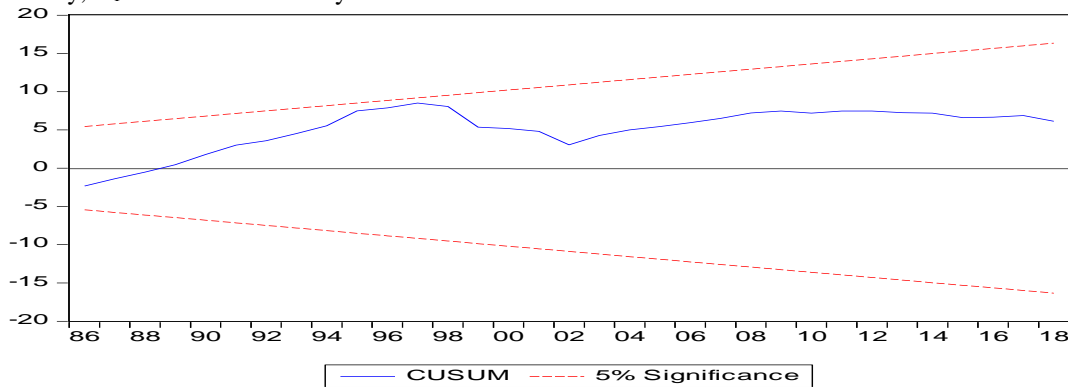
Source: Authors' computation using E-views, 2020.

The findings from Table 9 have shown that all the probabilities are higher than the 10% level of significance up to 12<sup>th</sup> Lag. For this reason, the  $H_0$  is accepted, and  $H_1$  is rejected. Then we concluded that there is an absence of autocorrelation of errors within the time

**D. Stability test**

Instability test, the hypotheses were stated in the followings:

$H_0$ : There is stability,  $H_1$ : There is no stability



**Fig. 1 CUSUM Test**

Source: Authors' compilation using E-views, 2020

From figure 1, the line of CUSUM (blue) does not cross the red lines. We reject  $H_1$ , and we accept  $H_0$  (there is stability). For this reason, at a 5% level of significance, the parameters are stable.

**E. Misspecification test**

In the misspecification test, the hypotheses were stated in the following ways:

H<sub>0</sub>: Absence of misspecification, H<sub>1</sub>: Presence of misspecification

**Table 10. Misspecification Test**

	Value	df	Probability
t-statistic	2.701696	30	0.5112
F-statistic	7.299161	(1, 30)	0.5112
Likelihood ratio	7.404298	1	0.5465

Source: Authors' computation using E-views, 2020

According to table 10, as well as the probability of log-likelihood ratio 0.54 is higher than 10%, there is no misspecification. This implies that no variables are omitted, and no wrong variables are used in the model.

**F. Test for Multicollinearity among the Explanatory Variables**

According to Gujarati (2003:359-362), independent variables experience multicollinearity when the pair-wise correlation between the two regressors is greater than 0.8.

**Table 11. Correlation Matrix**

	FDI	POP	INF
FDI	1	0.151035675	0.268662619
POP	0.151035675	1	0.479204230
INF	0.268662619	0.479204230	1

Source: Authors' computation using E-views, 2020

Table 11 indicates that all correlation coefficients are less than 0.8. This implies the absence of multicollinearity within independent variables

**G. Normality test**

In the normality test, the hypotheses were stated in the following ways:

H<sub>0</sub>: Presence of normal distribution within residuals, H<sub>1</sub>: Absence of normal distribution within residuals

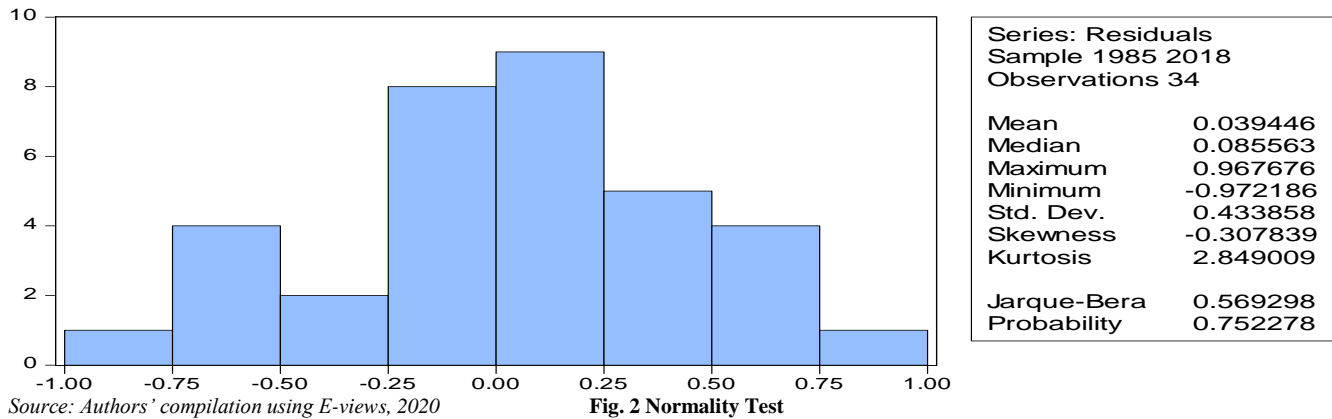


Figure 2 indicated that Jacque-Bera Probability 0.752278, about 76% is higher than the 10% level of significance. For this reason, H<sub>0</sub> is accepted, and H<sub>1</sub> has rejected means that the residuals are normally distributed. The researchers have concluded that the model has sense and can be used.

## V. CONCLUSION AND POLICY RECOMMENDATION

### A. Foreign Direct Investment (FDI) - related policy implications and recommendations

The empirical analysis indicated that Inflow Foreign Direct Investment has a significant negative relationship with unemployment in the longrun as well as in the shortrun. The findings of the study revealed that inflow Foreign Direct Investment (FDI) decrease the rate of unemployment in Rwanda.

For this reason, the government of Rwanda should put more effort into scheming strategies of interesting the foreign investors, provided that the government of Rwanda has this policy of attracting foreign investors. Rwanda recognized the importance of Foreign Direct Investment (FDI) as it contributes to the national economic growth through the production of goods and services, paying taxes, and creating jobs.

The government of Rwanda should put more effort into the process of increasing infrastructures in order to attract more foreign investors. For making the investment climate very flexible, the government of Rwanda should provide more tax breaks as well as more incentives to the foreign investors in order to arouse their interest.

### B. Population growth-related policy implications and recommendations

As was indicated in the study, population growth has a significant positive relationship with unemployment in the longrun as well as in the shortrun in Rwanda. Population increase leads to an excess supply of labour over demand for labour.

The government of Rwanda should encourage demographic control by strengthening family planning in terms of using condoms, contraceptive pills, uterine devices, etc. By implementing these policies, unemployment will be decreased. Family planning in Rwanda should be high implemented if the government tries to provide some incentives to the families that have applied it. The government of Rwanda should encourage female education as this will decrease the fertility rate; it will enhance children's quality and marriage postponing. This policy will decrease the birth rate, then, finally, the number of people who are looking for jobs will be decreased. The government of Rwanda should enhance the development of rural areas in order to discourage rural-urban migration. This will decrease the rate of unemployment in Rwanda.

### C. Inflation-related policy implications and recommendations

The study revealed that inflation has a significant positive relationship with unemployment in the longrun and in the shortrun. In the case of Rwanda, within the period 1985-2018, there is no existence of the Philips curve. In

Rwanda, there is a problem with unemployment and inflation within the period of study. The central Bank of Rwanda should use monetary policies in order to control inflation like selective credit control, decreasing the bank rate, wage control, discouraging imports in order to manage imported inflation in Rwanda. This situation, which looks like stagflation in Rwanda, should be controlled by decreasing the costs of production in industries in Rwanda. This will be done by encouraging made in Rwanda policy, as it will discourage the importation of high inflated goods and services. In this way, in Rwanda, we need to apply an import substitution policy.

Based on the obtained results from data obtained from the World Bank database, also considering the literature review, we concluded that there is a significant positive impact of population growth and inflation on unemployment in the longrun and in the shortrun. On another side, FDI has a significant negative contribution to unemployment both in the long-run and short-run.

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