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## Augmented phillips curve with trade openness: Cointegration relationship in democratic republic of Congo

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### Abstract

This study aims at analyzing the relationship between unemployment and trade openness in the Democratic Republic of Congo (DRC) within the framework of augmented Phillips curve. Use is made of cointegrating vector autoregressive (VAR) to this end. Quarterly data are used covering the period 1995 to 2017. The results of the analysis show that there exists a cointegrating or negative equilibrium long-run relationship between unemployment and trade openness in the DRC when controlling for inflation in the context of the traditional Phillips curve. This implies that trade openness may reduce unemployment in the DRC, certainly through technological and skill transfer that are beneficial for human capital and labor productivity. This finding shows the benefit of the economic integration of the DRC and supports the current policy of the DRC's government to participate in the different regional, continental and global free trade agreements.

**Keywords:** Augmented Phillips curve, trade openness, cointegration VAR  
**GEL Classification:** F4.41

### 1. Introduction

Unemployment remains a big problem not only in the Democratic Republic of Congo (DRC) but also in most of developing economies as it contributes to poverty observed in these economies. It is among poverty indicators in developing countries in general. Kiyala <sup>[1]</sup> confirms the higher level of unemployment in the DRC and shows that unemployment level and poverty could decrease in the country if inclusive growth policy advocated by international financial institutions (IFI) is properly followed in DRC.

One of the important theoretical framework within which unemployment is modeled is the Phillips curve. Phillips <sup>[2]</sup> found a negative correlation between inflation and unemployment in United Kingdom. Two years after, Samuelson and Solow confirmed this relationship, and it was named Phillips curve. This relationship became central in economic thought <sup>[3]</sup>. For example, Bonga-Bonga *et al.* <sup>[4]</sup> argued that it is essential for a central bank to establish the correct shape of the Phillips curve for a particular economy in order to assess the dynamics of inflation and unemployment trade-off. Nonetheless, some authors find no evidence of inflation-unemployment within the context of Phillips curve <sup>[5,6]</sup>.

Since IFI recommended to developing countries in general and DRC in particular to widen their economies; it necessary to survey the relation between these three capital variables in each one of these economies. Moreover, this article notes that, trade openness becomes with others; a central variable in the macroeconomic politics in DRC. However, Raifu <sup>[7]</sup> found that trade openness worsens unemployment rate both in the short-run and long run. Yet, DRC like an historic-opened country to international trade, belong to much under-regional and regional contracting free exchange. This means that, trade openness continues to widen and if its effects are not determined with its relationships, all macroeconomic political should distorted and do not lead to success.

This paper contributes to the literature on the relationship between trade openness and unemployment by making use of the augmented Phillips curve framework and using the cointegrating VAR methodology in DRC.

Several studies focused on the relationship between inflation and unemployment since the finding of Phillips in 1958. Recently, Orji *et al.* <sup>[5]</sup> examined the relationship between

inflation and unemployment in Nigeria. They used autoregressive distributed lag model (ARDL) with data covering the period 1970-2011. The result reveals that unemployment is a significant determinant of inflation and that there is a positive relationship between inflation and unemployment rate. This finding invalidates the original proposition on the Phillips curve hypothesis in Nigeria. However, Kojo <sup>[8]</sup> analyzed the nexus between inflation and unemployment in Nigeria from 1972 to 2015. He used Ordinary Least squares (OLS) and estimated NAIRU too. The results established the presence of a negative relation in short and long run between inflation and unemployment. That is to say, the traditional Phillips curve is confirmed in the same country.

Eje <sup>[9]</sup> examined the relationship between inflation and unemployment in Nigeria. His study covered the period from 1986 to 2014. The author used the OLS technique in assessing the relationship between the two variables. The results revealed that inflation rate and interest rate has negative influence on unemployment rate. Similarly, Nurudeen <sup>[10]</sup> examined the Phillips curve hypothesis and its stability in Nigeria from 1980 to 2016 using ARDL bounds testing approach. The result indicated that there is a trade-off relationship between the variables and higher unemployment leads to lower inflation in the long run. That confirms the traditional Phillips curve in Nigeria and implies that each approach has the particularity. However, Rafael *et al.* <sup>[6]</sup> examined econometrically the link between inflation and unemployment in Philippines from 2005 to 2017. Using ordinary least squares estimation and the average of square differences. He found that inflation is positively correlated with unemployment, even when controlling for supply side shocks in the form of oil price inflation, suggesting that the Phillips curve was not present in the Philippines in this period. We can imagine that particularities of each economy influence the relationship between these variables.

Jula *et al.* <sup>[11]</sup> analyzed the relationship between the unemployment rate and inflation, in Romania, during the 1992 – 1997. Using econometrics techniques, (the Hodrick-Prescott, (HP) filter, ARMA Maximum Likelihood (OPG - BHHH) and OLS, the results of the analysis support the hypothesis of a significant relationship between inflation and unemployment.

The results obtained by Jula *et al.* <sup>[11]</sup> are similar to that of Hafnati *et al.* <sup>[12]</sup> who analyzed the relationship between inflation and unemployment in non-accelerating inflation rate of unemployment (NAIRU) estimate in Indonesia through Phillips curve approach, take into account data from 1991 to 2016. They used the Vector Error Correction Model (VECM). The results show that unemployment delivered negative and significant effects on inflation in long run.

Concerning the relationship between trade openness and unemployment, Madanizadeh *et al.* <sup>[13]</sup> investigated the impact of trade openness on labor-force participation rate. They used tariffs rate as the main indicator of trade openness and employed the number of regional trade agreements and the average tariffs rate in the neighbors' countries as instrumental variables to diminish the endogeneity problem of the tariffs rate. Their results show that trade openness increases the participation rate, which is economically and statistically significant. The results show that this correlation is robust under controlling for different variables and using various specifications. They find that 10 percentage point increase in tariffs rate lowers the

participation rate by 4-6 percentage point and this relationship is more severe in the long-run. Yousef *et al.* <sup>[14]</sup> analyzed the net effect of trade openness on the Saudi employment by using annual data of 1980-2015 and by using ARDL cointegration technique. They found that trade openness, government spending on education and economic growth have positive impacts on the employment in long run while mix evidence of these variables are found on employment in the short run with different lag effects.

Nazia *et al.* <sup>[15]</sup> examined the impact of trade openness on unemployment in case of capital-abundant and labor abundant countries. Inflation rate, economic growth, population growth and political rights have been used as control variables in empirical analysis. Their study used the data for the period of 1990- 2012 for 75 labor-abundant countries and 44 capital-abundant countries. IPS panel unit root test was used to check the normality and stationarity of the variables of interest and Mean Group and Pooled Mean Group heterogeneous panel cointegration techniques have been used to check the long run relationships among the variables of their study and to find the long run and short run parameters (*sic*). The results for the case of labor-abundant countries, show that trade openness has a significantly negative impact on unemployment in the long run. The variables of inflation rate and institutional quality also have negative and significant impact on unemployment (*sic*).

Kılıç *et al.* <sup>[16]</sup> researched the long-term relationship between trade openness and unemployment in 17 transition economies between years 1998- 2014. They used dynamic heterogeneous panel data analysis methods. It has been found that there is a significant relationship between trade openness and the rate of unemployment and that trade openness has a reducing effect on unemployment.

Awad-Warrad <sup>[17]</sup> investigates the impact of trade openness and growth unemployment in selected Arab countries. The study provides evidence of large and significant impact of trade openness on employment rate in the selected ARAB countries. His main conclusion comes out of that analysis is that trade openness is playing the expected favorable effect on unemployment in the Arab region. It is the same thing for Asaleye *et al.* <sup>[18]</sup> who examined the relation between trade openness and unemployment in the case of Nigeria. He used Vector Error Correction model and Granger Non-Causality. Their findings show short-run, but no long run causalities among employment, trade openness, (...). Negative long-run relationship between trade openness and output has also been established. This implies that trade has been harmful to employment generation.

Rehman <sup>[19]</sup> analyzed the relation between major macroeconomic variables in Pakistan concerning the period from 1976 to 2016. Trade openness was too, kept among them. After using of ARDL, he discovered that trade and inflation have a negative relation with unemployment. It gives tacitly an augmented shape of Phillips curve in sense we study here.

Ahmed <sup>[20]</sup> found a negative relationship between trade openness and unemployment concerning the period from 1973 to 2010 in Pakistan, after using cointegration analysis. We discovered a lack in literature concerning augmented Phillips curve with trade openness applied in DRC. However, DRC has an open-economy especially concerning trade. That is why this study purposes to fill this gap.

**2. Data analysis and Methodology**

The yearly data used in this paper was collected from the World Bank and Central bank of Congo database and covers the period from 1995 to 2017 in DRC. These yearly data was converted into quarterly data using cubic spline interpolation. DRC is chosen as a case of a developing country. Thus, the findings of this study could be extended to developing countries in general.

The paper employs the cointegration method suggested by Johansen and Juselius. Letting  $Z_t$  a vector that includes different variables, the VAR is represented as:

$$Z_t = \mu + \sum_{i=1}^{n-1} \Pi_i Z_{t-i} + \varepsilon_t \tag{1}$$

where  $\Pi_i$  is a  $n \times n$  matrix of parameters,  $\mu$  is a constant term and  $\varepsilon_t \approx iid(0, \Omega)$ . The VAR system of expression (1) can be rewritten as a vector error correction model (VECM)

$$\Delta Z_t = \mu + \Pi Z_{t-1} + \sum_{i=1}^{n-1} \Gamma_i \Delta Z_{t-i} + \varepsilon_t \tag{2}$$

where  $\Gamma_i$  is the parameter of short-term coefficients and  $\Delta$  is an expression for first difference series. The rank of  $\Pi$ ,  $r$ , determines how many linear combinations of  $Z_t$  are stationary.

If  $r > 1$ , one is able to show the indirect relationship that exists between variables given a proper economic identification. For the sake of this paper the vector  $Z_t$  contains the rate of inflation (Infl<sub>t</sub>), unemployment rate (UR<sub>t</sub>) and trade openness (TOR<sub>t</sub>) in a model called extended Phillips curve. The possible cointegrating relation, when normalised by UR<sub>t</sub>, is expressed as :  
 $UR_t = c + \alpha InflR_t + \beta TOR_t + \varepsilon_t$  (3)  
 with the cointegrating vector given by (1,- $\alpha$ ,- $\beta$ ) in this case.

**3. Results and discussion**

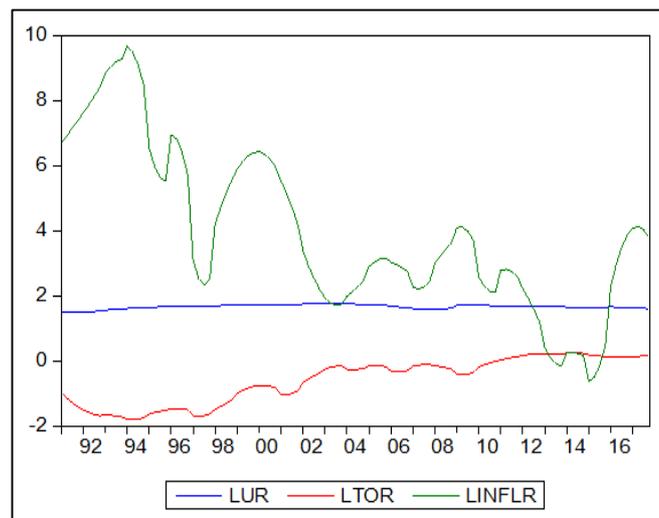
The first step in Johansen cointegration technique, like all cointegration techniques, is to test the level of integration of variables. Johansen cointegration applied when variables are non-stationary, i.e. integrated at level one. Table 1 below shows that the Augmented Dickey Fuller (ADF) test did not reject the null hypothesis of unit root at level but at difference for all the variables. This shows that the 3 variables are integrated at level or I(1).

**Table 1:** Unit root test using the ADF test statistics

Variables	Level	Critical value at 5%	First difference	Critical value 5%	Order of integration
UR <sub>t</sub>	-2.300204	-2.891234	-10.24187*	-2.888932	I(1)
TOR <sub>t</sub>	-2.891234	-1.463254	-10.34169*	-2.888932	I(1)
InflR <sub>t</sub>	-2.252144	-2.890037	-10.21195*	-2.888932	I(1)

\* denotes rejection of the null hypothesis of unit root

Figure 1 confirms that the three variables are not stationary, as each of them does not have unique mean and variance. Both tests indicate that the null hypothesis of no cointegration is rejected



**Fig 1:** Graphs of variables

The second step is to test for cointegration using the trace and Max-Eigen value tests of cointegration. The results reported in Table 2 show the rejection of the null hypothesis of no cointegration and confirm the presence of one relationship among the three variables for both tests.

**Table 2:** result of cointegration test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.192254	36.21991	29.79707	0.0079
At most 1	0.093936	13.80162	15.49471	0.0885
At most 2	0.032266	3.443828	3.841466	0.0635
Trace test indicates 1 cointegrating equation at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.192254	22.41829	21.13162	0.0328
At most 1	0.093936	10.35779	14.26460	0.1895
At most 2	0.032266	3.443828	3.841466	0.0635
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level.				
* denotes rejection of the hypothesis at the 0.05 level				

The estimation of the cointegrating vector normalized by UR<sub>t</sub>, as in Equation 3, is reported in Table 3.

**Table 3:** estimation with VEC

UR (-1)	1.000000
Ltor (-1)	0.175538
	(0.04953)
	[ 3.54397]
Linflr (-1)	0.061011
	(0.01338)
	[ 4.56055]
C	-1.802104

In a unique cointegrating relationship, the estimation reported in Table 3 can be written in a linear combination

form as:  $\varepsilon_t = UR_t + 0.17 TOR_t + 0.06 InflR_t - 1.8$ ; Or again

$$UR_t = 1.8 - 0.17 TOR_t - 0.06 InflR_t + \varepsilon_t.$$

This relationship shows a negative relationship between unemployment and trade openness in that a 1% change in trade openness decreases unemployment by 0.17% in the DRC. Moreover, as expected from the Phillips curve framework, there is a negative relationship between inflation and unemployment in that a 1% increase in inflation reduces unemployment by 0.06%. Although weak, this result shows a possible money illusion in the DRC job market.

The results of this study corroborate several results confirming the negative sense of relationship between unemployment and inflation supported by the Phillips curve framework<sup>[11, 21-26]</sup>. However, these results contrast those of Orji<sup>[5]</sup> whose findings did not support the existence of Phillips curve in Nigeria.

Our results corroborate the results of Ahmed<sup>[20]</sup>; Rehman<sup>[19]</sup> who found a negative relationship between trade openness and unemployment respectively in Pakistan. It corroborates too the result of Madanzadeh *et al.*<sup>[13]</sup> who investigated the impact of trade openness on labor force participation rate. It corroborates equally, the finding of Nazia *et al.*<sup>[15]</sup> who showed that trade openness has a significantly negative impact on unemployment in the long run, in capital-abundant and labor abundant countries. Even if Kılıç *et al.*<sup>[16]</sup> used other method than us and other others above, in 17 transition economies between years 1998-2014; They found that there is a significant relationship between trade openness and the rate of unemployment and that trade openness has a reducing effect on unemployment. Our study corroborates requirement, the result of Awad-Warrad<sup>[17]</sup> who concluded that trade openness is playing the expected favorable effect on unemployment in the Arab region. However, it does not corroborate the evidence of Asaley<sup>[18]</sup> who found that trade has been harmful to employment generation, after using the same model like us in Nigeria. Recently, Rehman<sup>[19]</sup> discovered that trade openness and inflation has a negative relation with unemployment like us; the difference is only in models used.

#### 4. Conclusion and suggestions

The objective of this study was to determine a long-run relationship in a Phillips curve framework augmented with trade openness during period from 1995 to 2017 in DRC. Using ADF, Johansen cointegration tests and cointegrating vector autoregressive model; the result shows that traditional Phillips curve exists in DRC while this period and the trade openness has a negative relationship with unemployment in long run too. These results involve that government of DRC must widen trade openness in controlling inflation with a view to decrease unemployment. It must increase the capacity of appropriation of technological transfer relatively to international trade, which is necessary for a permanent decreasing of unemployment.

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