UNEMPLOYMENT AND NIGERIA'S HUMAN-CAPITAL FLIGHT (1990 – 2020): AN EMPIRICAL INVESTIGATION OF A MODELLED CASE STUDY OF RECRUITMENT OF NIGERIAN DOCTORS BY SAUDI ARABIA

ABSTRACT

Unceasing substantial loss of intellectuals and technical personnel from any nation causes dire depletion of the economy of that nation and should give anyone who means well for the nation serious cause for concern. Offor P. U. et al (2022) used matching function model to analyse reasons for brain drain with a case study of a recruitment exercise organized in August 2021, in Abuja, by the Saudi Arabia health ministry for Nigerian medical doctors. This paper is all about investigating empirical relevance of Offor P. U. et al (2022)'s matching function model. With the model, we target to carry out empirical investigation of the relationship between unemployment and Nigeria's brain drain (1990 – 2020) using secondary data. *The ARDL model is our parameter estimator. The matching function model is found to be stable and the empirical investigation reveals that Nigeria's brain drain is not necessarily caused by unemployment rate in Nigeria; some other variables like poor real GDP (PPP based) are significantly responsible. The study concludes with a recommendation that Nigerian authorities should take giant strides to fix the insecurity problems of the country in order to create safe environment that can attract both local investments and foreign direct investments which will, among other benefits, favour Nigeria in exchange rate, improve her GDP and discourage brain drain.*

KEYWORDS: Matching Function, Human-Capital Flight/Brain Drain, Purchasing Power Parity, Unemployment Rate.

1. INTRODUCTION

Some time in August 2021, the news made the rounds that over 500 Nigerian medical doctors teemed out at Sheraton Hotel Abuja for an organized recruitment exercise by the Saudi-Arabian health ministry. This came at a time when resident doctors under the aegis of the Nigerian Association of Resident Doctors were on strike. The strike was over the inability of the Federal Government to implement the agreements it entered with the union 113 days after it suspended the previous strike.

The televised news showed a large crowd of Nigerian doctors with different specialties such as anesthesia, ICU, pediatric surgery, emergency medicine, orthopedic surgery, family medicine, obstetrics, hematology, radiology, gynecology, etc, with some of them granting the media interview. Some of the doctors stressed that they had been thrown to the liberty to do whatever they wanted since the government had failed to fulfill her promises.

It was reported that the recruitment exercise was conducted by an agency/a firm on behalf of the Saudi Ministry of Health with the applicants paying N10,000 as the application fee and that another recruitment exercise would be conducted in one or two other cities of the country. It was further reported that it was not the first time the agency/firm would be recruiting for Saudi authorities, that the agency/firm conducted a similar interview in 2018 for medical consultants, one in Abuja and another in Lagos.

Offor P. U. et al (2022) used matching function model to analyse reasons for brain drain with a case study of this recruitment exercise This paper targets to investigate the empirical relevance of the model. With the model, we target to carry out empirical investigation of the relationship between unemployment and Nigeria's brain drain (1990 – 2020) using secondary data.

According to Wikipedia (visited on October 19, 2021), Human-Capital Flight refers to the emigration (or immigration) of labour force who have received advanced training at home. This is known as Brain Drain. It is loss of intellectual and technological labor force through the migration of human capital to more favorable geographic, economic, or professional environments. This movement usually occurs from developing countries to developed countries or areas.

Purchasing Power Parity is the measurement of prices in different countries that uses the prices of specific goods to compare the absolute purchasing power of the countries' currencies.

Unemployment Rate refers to the proportion of the labour force of a nation who are qualified and are ready to work but not currently employed.

Many a time, Nigeria's brain drain is associated with desire to secure a foreign job just like the case captured in our background to this study. Could this be as a result of high unemployment rate in Nigeria? Are there other facts or variables behind this brain drain? It is against this backdrop we have set out to

empirically investigate the relationship between Nigeria's unemployment and brain drain. Based on this statement of the problem, our broad objective of this study is to investigate the relationship between unemployment and Nigeria's brain drain (1990 – 2020) using secondary data. The specific objectives are:

i. to determine the extent to which unemployment rate in Nigeria causes Nigeria's brain drain.
ii. to ascertain the extent to which poor real GDP in Nigeria causes Nigeria's brain drain.
iii. to assess the extent to which low value added by the manufacturing sector to Nigeria's economy causes Nigeria's brain drain.

The following research questions have been mapped out:

i. To what extent does unemployment rate in Nigeria have effect on Nigeria's brain drain?
ii. To what extent does poor Real GDP in Nigeria have effect on Nigeria's brain drain?

iii. To what extent does low value added by the manufacturing sector to Nigeria's economy has effect on Nigeria's brain drain?

The following hypotheses, therefore, are to be tested in this study:

i. $\boldsymbol{H_0^1}$**:** Unemployment rate in Nigeria has no significant effect on Nigeria's brain drain.
ii. $\boldsymbol{H_0^2}$**:** Poor Real GDP in Nigeria has no significant effect on Nigeria's brain drain.
iii. $\boldsymbol{H_0^3}$**:** Low value added by the manufacturing sector to Nigeria's economy has no significant effect on Nigeria's brain drain

For the significance of the study, it is expected that the findings of this study will disclose or unravel some of the variables responsible for Nigeria's brain drain and proffer solutions that will help scale down the brain drain. And for the scope of the study, the empirical investigation involves the following variables – Human-Capital Flight, Unemployment, Real GDP and Value added by the manufacturing sector to Nigeria's economy from 1990 to 2020.

2. PRELIMINARIES FROM THE LITERATURE

2.1 Matching Function, Vacancy-Unemployment Ratio and their Elasticities

According to Julio Garia et al (2018), when a job seeker and a job meet, if the wage is not fixed, negotiation takes place to determine the wage. There is search process which stochastically brings together the unemployed job-seeking persons and vacant jobs in a pairwise fashion called *matching function.*

Matching function refers to a search model which stochastically brings together the number of unemployed job-seeking persons and number of vacant jobs in a pairwise fashion. This model seeks to determine the number of job vacancies that are filled each instant as a function of the number of unemployed job-seeking persons and the number of vacancies that exist (plus some exogenous variables). The model assumes that only vacant positions are in offer. The idea is that the firm is not searching for workers to replace existing but unsatisfactory workers. It is either the person has a job or he is unemployed, and only the unemployed engage in search. Precisely, firms have jobs that are either filled or vacant.

Ben J. Heijdra (2009) introduced this model of search in the labour market with the following assumptions:

i. There are many firms and many workers.
ii. There is perfect competition
iii. Each employed worker supplies only one unit of labour with a constant effort

We denote unemployment rate by U, the vacancy rate is by V.

Let N denote the number of labour force. Then, at any point in time, there are UN unemployed workers and VN vacant jobs trying to find each other.

The number of successful matches is a dependent variable of UN and VN. Denoting the matching rate by X, Heijdra defined the matching function by $XN = M_U UN + M_V VN = M(UN, VN)$. We adopt the assumptions given by Offor P. U. et al (2022).

Where: XN is the total number of matches. We used M because it is the first letter of $matching\text{-}function$. the function $q(\theta)$ is interpreted as probability of a vacancy being filled. The output $[q(\theta)]$ elasticity of vacancy-unemployment ratio (θ), in absolute term, is given by $E_{q(\theta)} = -\frac{dq}{q} \div \frac{d\theta}{\theta} = \frac{-\theta}{q} \times \frac{dq}{d\theta}$ $= \frac{-\theta}{q}\left(\frac{-M_U}{\theta^2}\right) = \frac{M_U}{\theta q}$ where $q = \frac{XN}{VN}$ and $\theta = \frac{V}{U}$. Offor P. U. et al (2022). stated that $0 < E_{q(\theta)} < 1$ which $\text{means that } E_{q(\theta)}$ is inelastic. This implies that job vacancy filling does not respond as much and fast as change in vacancy-unemployment ratio.

For workers, the probability of finding a firm with a vacancy is given by $\frac{XN}{UN}$ ($XN =$ number of vacancies, $UN =$ number of unemployed workers)

$$\frac{XN}{UN} = \frac{M(UN,VN)}{UN} = \frac{VN \,.\, M(^{UN}/_{VN},\ 1).}{UN} = \frac{V}{U} M\left(\frac{U}{V},\ 1\right) = \theta q(\theta) = f(\theta)$$

$f(\theta)$ represents the probability of an unemployed worker finding a job. The output $[f(\theta)]$ elasticity of vacancy-unemployment ratio (θ), in absolute term, is given by $E_{f(\theta)}$ and $0 < E_{f(\theta)} < 1 \Rightarrow$ inelastic. Again, this implies that the chance of an unemployed worker finding a job does not come as fast as change in vacancy-unemployment ratio.

Thus, both the job vacancy filling elasticity of vacancy-unemployment ratio and job-finding elasticity of vacancy-unemployment ratio are inelastic.

2.2 Willingness to Search for a Job

A worker with a job earns a wage W while an unemployed worker gets some sort of unemployment benefit z, exogenously. z is a transferred payment, or could even be pecuniary value of leisure.

With the assumption of Heijdra (2009) that there is an exogenously given job destruction process that ensures that a proportion s of all filled jobs disappears at each instant. Denoting the present value of the expected stream of income of an employed worker by Y_E and that of an unemployed worker by Y_U and interest rate by r, Heijdra (2009) stated the steady-state equation for an unemployed worker as $rY_U = z + \theta q(\theta)(Y_E - Y_U)$ and for an employed worker as $rY_E = W - s(Y_E - Y_U)$ and this leads to $rY_U = \frac{z(r+s) + W\theta q(\theta)}{r+s+\theta q(\theta)}$ and $rY_E = \frac{sz+W[r+\theta q(\theta)]}{r+s+\theta q(\theta)} = \frac{rW-rz+rz+sz+W\theta q(\theta)}{r+s+\theta q(\theta)} = \frac{r(W-z)}{r+s+\theta q(\theta)} + rY_U$. Thus, for anyone to desire to search for a job, rY_E must be greater than or equal to rY_U, ceteris paribus

3. RESEARCH METHODOLOGY

3.1 Research Design: Empirical Investigation

This paper is all about investigating empirical relevance of Offor P. U. et al (2022)'s matching function model. With the model, we target to carry out empirical investigation of the relationship between unemployment and Nigeria's brain drain (1990 – 2020) using secondary data.

3.2 Model Specification

As we stated earlier, brain drain is migration of intellectuals and technical personnel from a nation. Offor P. U. et al (2022)'s model focuses on job as the force of attraction. Thus, brain drain here has to do we the number of job vacancies abroad that are filled at each instant.

To carry out an empirical analysis of the matching function, our first effort is to linearize the matching function.

Here is the matching function: $M(UN, VN) = [\alpha(\Psi UN)^{\frac{\xi}{\xi-1}} + (1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}]^{\frac{\xi-1}{\xi}}$, $0 < \alpha < 1$

By the way of binomial expansion, the series is infinite since $\frac{\xi-1}{\xi} < 1$ and we have

$$[\alpha(\Psi UN)^{\frac{\xi}{\xi-1}} + (1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}]^{\frac{\xi-1}{\xi}} = \left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}} + \binom{\frac{\xi-1}{\xi}}{1}\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-1}\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right) + \binom{\frac{\xi-1}{\xi}}{2}\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-2}\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right)^2 + \dots$$

Where $\binom{\frac{\xi-1}{\xi}}{1} = \frac{\xi-1}{\xi}\,C_1$, $\binom{\frac{\xi-1}{\xi}}{2} = \frac{\xi-1}{\xi}\,C_2$, and so on. We truncate at the first term and with brain drain proxied by human-capital flight (HF), we have $HF = \left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}} = \alpha^{\frac{\xi-1}{\xi}}\Psi UN$.

Truncation Error

There is always an error when a series is truncated. If our own case here is not managed well, we may have a very explosive truncation error which will lead to spurious empirical analysis. Our effort now is to bring the error to a value very close to zero.

Our truncation error is the value of the series that we have just cut off. That is,

$$\text{Truncation error} = \binom{\frac{\xi-1}{\xi}}{1}\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-1}\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right) + \binom{\frac{\xi-1}{\xi}}{2}\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-2}\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right)^2 + \binom{\frac{\xi-1}{\xi}}{3}\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-3}\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right)^3 + \dots$$

OR $$\text{Truncation error} = \sum_{r=1}^{\infty}\binom{\frac{\xi-1}{\xi}}{r}\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-r}\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right)^r$$

Now consider the limiting values of $\frac{\xi-1}{\xi}$ and $\frac{\xi}{\xi-1}$. $\lim_{\xi\to\infty}\frac{\xi-1}{\xi} = \lim_{\xi\to\infty}\frac{\xi}{\xi-1} = 1$

If we subject ξ to a very large value, the values of $\frac{\xi-1}{\xi}$ and $\frac{\xi}{\xi-1}$ will be very close to 1. And if we make the proper fraction α come so close to 1 that the difference $(1-\alpha)$ becomes infinitesimal (nearest to zero), then the following shall be our results:

i. $\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}$ will be very close to being equal to ΨUN and $\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-r}$ $(r = 1, 2, 3, \dots)$ will tend to zero as r increases. This is obvious because $\frac{\xi-1}{\xi} - r$ $(r = 1, 2, 3, \dots)$ is increasingly negative.

ii. $(1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}$ will be very close to being equal to zero and $\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right)^r$ $(r = 1, 2, 3, \dots)$ will be very much closer to being equal to zero as r increases.

iii. $\binom{\frac{\xi-1}{\xi}}{r}$ $(r = 1, 2, 3, \dots)$ will alternate in sign since $\frac{\xi-1}{\xi}$ is less than 1. And we shall have

$$\binom{\frac{\xi-1}{\xi}}{r}\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-r}\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right)^r = \begin{cases}\text{negative when } r = \text{even number}\\ \text{positive when } r = \text{odd number}\end{cases} \quad (r = 1, 2, 3, \dots).$$

With this alternation in sign, the terms of the truncation error will keep cancelling out instead of accumulating. So that,

$\text{Truncation error} = \sum_{r=1}^{\infty}\binom{\frac{\xi-1}{\xi}}{r}\left(\alpha(\Psi UN)^{\frac{\xi}{\xi-1}}\right)^{\frac{\xi-1}{\xi}-r}\left((1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}\right)^r$ will be approximately equal to zero.

Thus, our choice of ξ so large enough that the limiting values of $\frac{\xi-1}{\xi}$ and $\frac{\xi}{\xi-1}$ tend to 1, together with our choice of the proper fraction α so close to 1 that the difference $(1-\alpha)$ becomes infinitesimal brings our truncation error very close to zero. We can now confidently take our matching function as

$\mathrm{HF} = \alpha^{\frac{\xi-1}{\xi}} \Psi UN$, HF = Human-Capital Flight.

Recall that UN is the number of unemployed workers and ΨUN is the product of the number of unemployed workers and the variables responsible. Variables in this product ΨUN include, but not limited to:

- Mass unemployment proxied by unemployment rate and denoted by UNEMP
- Poor salaries and poor economic performance proxied by GDP per capita by purchasing power parity (real GDP, PPP based) and denoted by RGDP
- Poor workers' welfare and poor working conditions proxied by life expectancy of workers, and denoted by LE
- Insecurity $\Rightarrow \left.\begin{matrix}\text{Religious crises}\\ \text{Communal crises}\\ \text{Political crises}\\ \text{Crimes}\end{matrix}\right\}$ proxied by Security Threat Index and denoted by INS
- $\left.\begin{matrix}\text{Outdated and inappropriate school curricula}\\ \text{Lack of quality education}\end{matrix}\right\}$ proxied by Human development index and denoted by HDI
- Paucity of manufacturing factories proxied by value added by the manufacturing sector as percent of GDP and denoted by VAMS
- Recession/Depression proxied by Economic Decline Index denoted by ED

We are cutting down to variables with fairly reasonable quantity of available data. We are going with HF, RGDP, UNEMP, VAMS, ED and HDI. Our model can now be specified as follows:

$HF = \alpha^{\frac{\xi-1}{\xi}} (RGDP)^{\vartheta}(UNEMP)^{\jmath}(VAMS)^{\tau}(LE)^{\omega}$. Taking logarithms of both sides, we have

$$\mathrm{LOG(HF)} = \frac{\xi-1}{\xi}\mathrm{LOG}\alpha + \vartheta\mathrm{LOG(RGDP)} + \jmath\mathrm{LOG(UNEMP)} + \tau\mathrm{LOG(VAMS)} + \omega\mathrm{LOG(LE)} + \mu_t$$

We may choose to shorten LOG to L and have a little touch on the parameters and then have:

$$\mathrm{LHF} = \beta_0 + \beta_1\mathrm{LRGDP} + \beta_2\mathrm{LUNEMP} + \beta_3\mathrm{LVAMS} + \beta_4\mathrm{LLE} + \mu_t$$

Where:

LHF = Natural logarithm of human-capital flight, LRGDP = Natural logarithm of real GDP (PPP based)

LUNEMP = Natural logarithm of unemployment rate

LVAMS = Natural logarithm of value added by the manufacturing sector as percent of GDP

LLE = Natural logarithm of life expectancy of workers, μ_t = The Error term

The ARDL model is our parameter estimator and we go with the structure $ARDL(p,q,m,n)$. The error correction model is specified as follows: $\Delta\mathrm{LHF}_t = \zeta_0 + \zeta_1\mathrm{LHF}_{t-1} + \zeta_2\mathrm{LRGDP}_{t-1} + \zeta_3\mathrm{LUNEMP}_{t-1} + \zeta_4\mathrm{LVAMS}_{t-1} + \sum_{i=1}^{p}\lambda_{1i}\Delta\mathrm{LHF}_{t-i} + \sum_{i=0}^{q}\lambda_{2i}\Delta\mathrm{LRGDP}_{t-i} + \sum_{i=0}^{m}\lambda_{3i}\Delta\mathrm{LUNEMP}_{t-i} + \sum_{i=0}^{n}\lambda_{4i}\Delta\mathrm{LVAMS}_{t-i}.$

Where Δ = the difference operator, ζ and λ are the parameters.

3.3 Source of Data: Annual time series data from 1990 to 2020 are used in this study and the following websites are the sources of the data https://www.worlddata.info, www.globalhungerindex.org, and https://www.theglobaleconomy.com/download-data.php

3.4 Model Estimation/Method of Data Analysis

The empirical investigation will take the following steps:

- Finding the appropriate lag
- Examination of the stationarity of the variables using the Unit Root Test
- ARDL Cointegration Tests: The Bounds Test, Long-run relationship and Short-run relationship tests.
- Examination of the causal relationships among the variables using the Granger Causality Test and
- Diagnostic Tests.

4. RESULTS AND DISCUSSIONS

4.1 FINDING THE APPROPRIATE LAG

Akaike Info Criterion (AIC) and Schwarz Info Criterion (SIC)

Table 1.1: Excerpt from ARDL Lag 2 Structure

R-squared	0.991788	Mean dependent var	0.825183
Adjusted R-squared	0.989050	S.D. dependent var	0.068046
S.E. of regression	0.007120	**Akaike info criterion**	**-6.822763**
Sum squared resid	0.001065	**Schwarz criterion**	**-6.445578**
Log likelihood	106.9301	Hannan-Quinn criter.	-6.704633
F-statistic	362.3069	Durbin-Watson stat	1.931800
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection

Table 1.2: Excerpt from ARDL lag 4 criterion

R-squared	0.993826	Mean dependent var	0.833271
Adjusted R-squared	0.991082	S.D. dependent var	0.063258
S.E. of regression	0.005974	**Akaike info criterion**	**-7.141656**
Sum squared resid	0.000642	**Schwarz criterion**	**-6.709711**
Log likelihood	105.4124	Hannan-Quinn criter.	-7.013216
F-statistic	362.1722	Durbin-Watson stat	2.404127
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection

Table 1.3: Excerpt from ARDL lag 6 criterion

Singular Matrix

*Note: p-values and any subsequent tests do not account for model selection.

From the excerpts of tables 1.1. 1.2 and 1.3 above, our best bet is to go with lag 4 because it is the lag with least AIC and SIC.

Table 1.4: Excerpt from Vector Autoregression Estimates for choice of Lag

Determinant resid covariance (dof adj.)	3.28E-15
Determinant resid covariance	6.17E-17
Log likelihood	350.6241
Akaike information criterion	**-20.93512**
Schwarz criterion	**-17.67153**

From Table 1.4, Akaike Information Criterion (-20.93512) is less than Schwarz Information Criterion (-17.67153), we shall therefore go with Akaike Information Criterion. Thus, our chosen lag for our analyses is Lag 4 under Akaike Information Criterion.

4.2 SUMMARY OF THE RESULTS OF THE UNIT ROOT TEST

Series	5%Critical value @ Level	ADF t-Statistics @ Level	5%Critical value @ 1st Difference	ADF t-Statistics @1st Difference	Order of Integration
LHF	-1.952473	5.033749	-	-	$I(0)$
LRGDP	-1.952910	0.768886	-1.952910	-2.131107	$I(1)$
LUNEMP	-1.952473	1.737871	-1.952910	-4.562023	$I(1)$
LVAMS	-1.952473	-1.205098	-1.952910	-3.775617	$I(1)$
LLE	-1.953381	0.416376	-1.953381 @ **5%** -1.609798@**10%**	-1.618517	$I(1)$ @ **10%**

Table 2.1: Unit Root Test from Eviews 9.

The result of the unit root test above shows that human-capital flight (LHF) is stationary at level while Real GDP (LRGDP), Unemployment rate (LUNEMP), Value added by the manufacturing sector (LVAMS) are all stationary at first difference. We have mixed order of integration. ARDL Bounds test is therefore needed to investigate the cointegration or long-run relationship of the variables. The life expectancy is stationary at first difference only at 10% level of significance. We want to maintain 5% level of significance in our ARDL estimations. We shall, therefore, not use life expectancy (LLE).

4.3 MULTICOLLINEARITY TEST

Variance Inflation Factors
Date: 03/05/22 Time: 18:38
Sample: 1990 2020
Included observations: 31

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.146808	10475.61	NA
LRGDP	0.009110	8413.640	7.132574
LUNEMP	0.001665	49.91007	1.874503
LVAMS	0.003277	276.0842	5.569446

Since the Centered VIF coefficients are less than 10 for all the explanatory variables, we conclude that no severe multicollinearity exists in the model.

4.4 ARDL COINTEGRATION TESTS

4.4.1 Bounds Test

ARDL Bounds Test
Date: 10/18/21 Time: 11:03
Sample: 5 31
Included observations: 27
Null Hypothesis: No long-run relationships exist

Test Statistic	Value	k
F-statistic	10.43367	3

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	3.47	4.45
5%	4.01	5.07
2.5%	4.52	5.62
1%	5.17	6.36

Table 3.1: Bounds Test from Eviews 9

From the table, F-statistic value (10.43367) is greater than the upper bound 5% critical value. We therefore reject the null hypothesis which states that “No long-run relationships exist”. Thus, we uphold that long-run relationships exist amongst the variables.

4.4.2 ARDL Short-run Cointegration and Long Run Coefficients Test

ARDL Cointegrating And Long Run Form
Dependent Variable: LHF
Selected Model: ARDL (4, 0, 3, 0)
Date: 10/18/21 Time: 11:11

Sample: 1 31
Included observations: 27

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LHF(-1))	0.952268	0.308968	3.082092	0.0076
D(LHF(-2))	0.741432	0.240886	3.077938	0.0077
D(LHF(-3))	0.460406	0.186373	2.470349	0.0260
D(LRGDP)	-0.121977	0.048696	-2.504846	0.0243
D(LUNEMP)	-0.044767	0.026802	-1.670295	0.1156
D(LUNEMP(-1))	0.010588	0.030553	0.346559	0.7337
D(LUNEMP(-2))	0.098592	0.028496	3.459820	0.0035
D(LVAMS)	-0.006396	0.018569	-0.344442	0.7353
D(@TREND())	0.015972	0.003060	5.219425	0.0001
CointEq(-1)	-1.710869	0.345503	-4.951825	0.0002

Cointeq = LHF - (-0.0713*LRGDP -0.0584*LUNEMP -0.0037*LVAMS +
0.9582 + 0.0093*@TREND)

Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRGDP	-0.071295	0.027421	-2.599988	0.0201
LUNEMP	-0.058395	0.021393	-2.729686	0.0155
LVAMS	-0.003738	0.010547	-0.354469	0.7279
C	0.958218	0.097745	9.803236	0.0000
@TREND	0.009336	0.000556	16.793950	0.0000

Table 3.2, Source: Eviews9 output.

Table 3.2 gives us the long-run cointegrating equation as

$$\text{LHF} = 0.9582 - 0.0713(\text{LRGDP}) - 0.0584(\text{LUNEMP}) - 0.0037(\text{LVAMS})$$

Both RGDP and UNEMP are statistically significant but are in inverse relationship with HF. 1% increase in RGDP will bring about 0.0713% decrease in Human-Capital Flight. Similarly, 1% increase in unemployment rate will cause 0.0584% decrease in Human-Capital Flight. The inverse relationship of unemployment rate with Human-Capital Flight appears to be contrary to expectation (a priori). This reversed expectation could be coming from the fact that a good number of those who flee do not do so because they are unemployed in the home-country, but because they have found other reasons to flee, such as insecurity.

On the other hand, value added by the manufacturing sector VAMS is not statistically significant even though the sign of the coefficient was our a priori expectation. It is in inverse relationship with HF. 1% increase in the value added by the manufacturing sector will bring about 0.0037% decrease in human-capital flight.

The result further shows that the error correction term ECT (-1) is significant, properly signed and the speed of adjustment towards long-run equilibrium is -1.710869. This means that approximately 171% of

the error is corrected in each period. This high speed of adjustment implies that all deviations/errors will be corrected within one year to bring the system to long-run equilibrium.

4.5 GRANGER CAUSALITY TEST

Pairwise Granger Causality Tests
Date: 10/18/21 Time: 11:45
Sample: 1 31
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
LRGDP does not Granger Cause LHF	30	3.65127	0.0667
LHF does not Granger Cause LRGDP		2.59682	0.1187
LUNEMP does not Granger Cause LHF	30	1.61092	0.2152
LHF does not Granger Cause LUNEMP		3.61836	0.0679
LVAMS does not Granger Cause LHF	30	1.48099	0.2342
LHF does not Granger Cause LVAMS		1.07426	0.3092
LUNEMP does not Granger Cause LRGDP	30	5.66061	0.0247
LRGDP does not Granger Cause LUNEMP		3.91941	0.0580
LVAMS does not Granger Cause LRGDP	30	38.3477	1.E-06
LRGDP does not Granger Cause LVAMS		3.37016	0.0774
LVAMS does not Granger Cause LUNEMP	30	0.68138	0.4163
LUNEMP does not Granger Cause LVAMS		4.37486	0.0460

Table 4, Source: Eviews9 output

The Granger Causality test results above is here to investigate causal relationship amongst the variables. As usual, only two variables are considered at a time and the two variables are both dependent and in turn independent. The test gives us the direction of causality among these variables, and three types of causal relationship exist. Viz: Bidirectional causality, Unidirectional causality and No causal relationship.

In our test results above, we observed that at 5% level of significance, there are no bidirectional relationships, we only have unidirectional relationships: UNEMP does Granger Cause RGDP, VAMS does Granger Cause RGDP and UNEMP does Granger Cause VAMS.

At 10% level of significance however, there are bidirectional causalities. Viz: bidirectional causality exists between UNEMP and RGDP, bidirectional causality exists between RGDP and VAMS.

4.6 DIAGNOSTIC TESTS

4.6.1 Breusch-Godfrey Serial Correlation LM Test: Here, we test for autocorrelation. This is to find out if our model is free from serial correlation.

H_O: There is no autocorrelation.

F-statistic	1.367775	Prob. F(4,14)	0.2948
Obs*R-squared	7.586611	Prob. Chi-Square(4)	0.1080

Table 5, Source: Eviews9 output

The result in the table shows that Prob. Chi-Square of 0.1080, which is not significant at 5% level of significance. We can not therefore reject the null hypothesis. Thus, our model has no significant trace of autocorrelation.

4.6.2: Breusch-Pagan-Godfrey Heteroskedasticity Test:
H_O: There is no Heteroskedasticity

F-statistic	1.694297	Prob. F(11,15)	0.1692
Obs*R-squared	14.95978	Prob. Chi-Square(11)	0.1843
Scaled explained SS	6.943003	Prob. Chi-Square(11)	0.8037

Table 6, Source: Eviews9 output

The result shows that Prob. Chi-Square corresponding to Obs*R-squared is 0.1843, which is not significant at 5% level of significance. Thus, we can not reject the null hypothesis. We therefore conclude that our model has no significant trace of heteroskedasticity.

4.6.3: ARCH Heteroskedasticity Test: To examine if our model is free from ARCH effect
H_O: There is no ARCH effect

F-statistic	0.848073	Prob. F(4,18)	0.5131
Obs*R-squared	3.647234	Prob. Chi-Square(4)	0.4558

Table 7, Heteroskedasticity Test: ARCH

The result in the table shows that Prob. Chi-Square corresponding to Obs*R-squared is 0.4558, which is not significant at 5% level of significance. Therefore, we can not reject the null hypothesis. Thus, we conclude that our model is free from ARCH effect.

4.6.4: Jarque – Bera Test: To find out if the residuals of our model are normally distributed

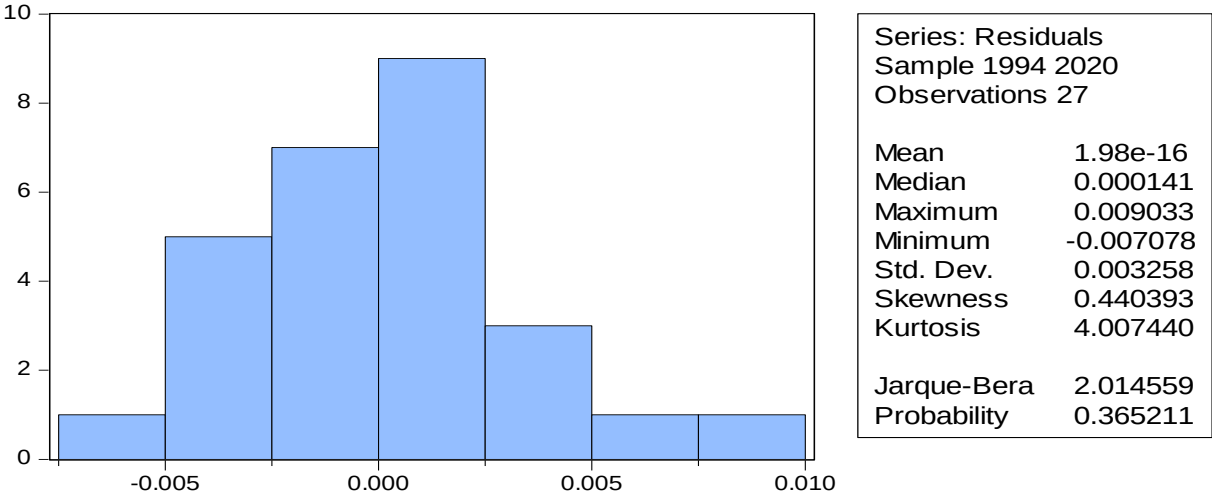

Fig 1, Source: Eviews9 output.

With the prob value greater than 5%, our conclusion is that the residuals of our model are normally distributed.

4.6.5: CUSUM stability Test

Our model is further subjected to a CUSUM stability test and the figure below is the result. CUSUM means cumulative sum. It is used to investigate whether or not the coefficients (parameters) of our model are changing systematically (stable)

Null Hypothesis: parameters are stable.

Acceptance of the null hypothesis is desirable.

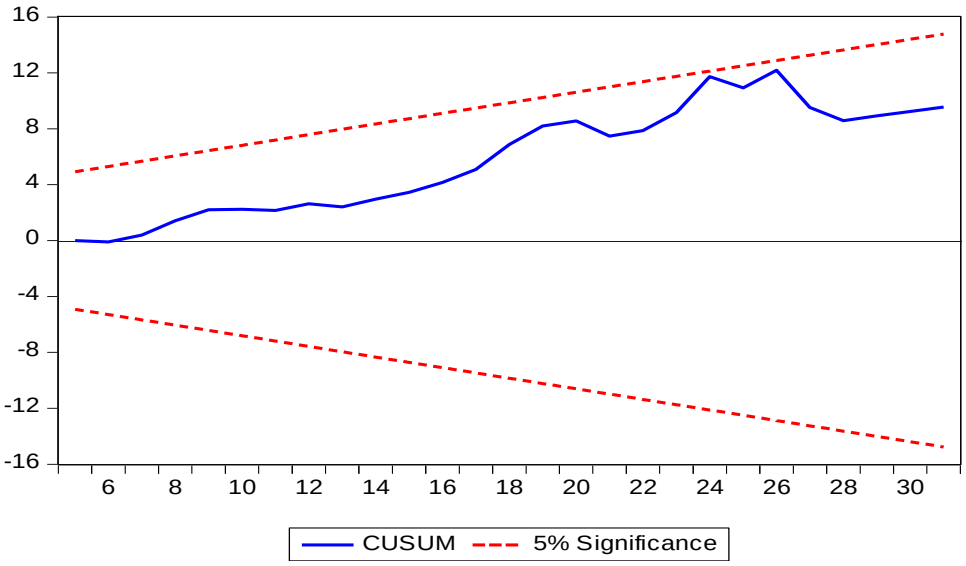

Fig 2, Source: Eviews9 output.

The CUSUM test result above shows that our model is fairly stable given that the CUSUM line is within the 5% significance boundary.

4.7 DISCUSSIONS ON OUR RESEARCH HYPOTHESES

Having carried the necessary tests, it is now time to give responses to our research hypotheses based on our findings.

4.7.1 H_0^1**:** Unemployment rate in Nigeria has no significant effect on Nigeria's brain drain.

Our findings in Table 4.2 show that Unemployment rate in Nigeria has a significant effect on Nigeria's brain drain. Decision: We reject H_0^1**.**

4.7.2 H_0^2**:** Poor Real GDP in Nigeria have no significant effect on Nigeria's brain drain Our findings in Table 4.2 show that Nigeria's real GDP has a significant effect on Nigeria's brain drain.
Decision: We reject H_0^2**.**

4.7.3 H_0^3: Low value added by the manufacturing sector to Nigeria's economy has no significant effect on Nigeria's brain drain

Our findings in Table 4.2 show that value added by the manufacturing sector to Nigeria's economy has no significant effect on Nigeria's brain drain.
Decision: We accept $\boldsymbol{H_0^3}$.

5. SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Findings

This research work is all about data-based testing of Offor P. U. et al (2022)'s matching function model. With the model, we carried out empirical investigation of the relationship between unemployment and Nigeria's brain drain (1990 – 2020) using secondary data.

The matching function model is $M(UN,VN) = [\alpha(\Psi UN)^{\frac{\xi}{\xi-1}} + (1-\alpha)(\Phi VN)^{\frac{\xi}{\xi-1}}]^{\frac{\xi-1}{\xi}}$,

Where:

$UN =$ number of unemployed workers and $VN =$ number of vacant jobs

ξ is so large a value that the values of $\frac{\xi-1}{\xi}$ and $\frac{\xi}{\xi-1}$ are both so close to 1.

$0 < \alpha < 1$ but α so close to 1 that the difference $(1-\alpha)$ becomes infinitesimal (nearest to zero),

The model was linearized as follows

$$\mathrm{LHF} = \beta_0 + \beta_1 \mathrm{LRGDP} + \beta_2 \mathrm{LUNEMP} + \beta_3 \mathrm{LVAMS} + \beta_4 \mathrm{LLE} + \mu_t$$

Where:

$\mathrm{LHF} =$ Natural logarithm of human-capital flight

$\mathrm{LRGDP} =$ Natural logarithm of real GDP

$\mathrm{LUNEMP} =$ Natural logarithm of unemployment rate

$\mathrm{LVAMS} =$ Natural logarithm of value added by the manufacturing sector as percent of GDP

$\mathrm{LLE} =$ Natural logarithm of life expectancy of workers

$\mu_t =$ The Error term

Through relevant tests, it was established that the model is fairly stable and that long-run relationships exist amongst the variables. The empirical findings are:

- Unemployment rate in Nigeria has a significant effect on Nigeria's brain drain in an inverse relationship
- Nigeria's real GDP (PPP based) has a significant effect on Nigeria's brain drain in an inverse relationship
- Value added by the manufacturing sector to Nigeria's economy has an inverse relationship with Nigeria's brain drain but quite insignificantly.

5.2 Conclusion

A priori assertion or judgement not backed by empirical investigations may be quite misleading. This empirical study has revealed that in some economies like Nigeria, unemployment in home nation may not necessarily be a factor responsible for brain drain. For instance, in the case of Nigerian medical doctors who teemed out at Sheraton Hotel Abuja for a recruitment exercise organized by the Saudi Arabia health ministry, most of the doctors were gainfully employed in Nigeria as at the time of the recruitment exercise. This is a clear indication that other stronger variables must be responsible for the Nigeria's brain drain.

In conclusion therefore, this study has disclosed that unemployment rate in Nigeria is not necessarily in direct relationship with Nigeria's brain drain. Within the period of time (1990 – 2020) this study looked into, the relationship empirically reported inverse.

5.3 Recommendations

Once again, this study has disclosed that increase in Nigeria's real GDP (PPP based) significantly discourages Nigeria's brain drain. It also disclosed that increase in value added by the manufacturing sector to Nigeria's economy discourages Nigeria's brain drain, though insignificantly. We therefore recommend that Nigerian authorities should take giant strides to expand and flourish manufacturing sector and this will, by extension, improve Nigeria's real GDP (PPP based). To do this, the authorities need to, among other drawbacks, fix the insecurity problem of the country to create safe environment to attract both local investments and foreign direct investments. This will bring improvement on employment, revenue to the government through tax, transfer of technology, human-capital development, exchange rate, etc.

When the exchange rate is improved, or, when the home currency can compete favorably with the foreign currencies, with insecurity reduced to minimum, the propensity to flee in search of greener pasture will invariably scale down.

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