

Kouam, Jean C.; Asongu, Simplice

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A G D I Working Paper

WP/22/078

Female Unemployment and Economic Growth in Cameroon: An Estimation of a Nonlinear Okun's Law Specification by the ARDL Cointegration Model

Jean C. Kouam

Nkafu Policy Institute,
Opposite College Jesus-Marie,
Simbock, Yaoundé – Cameroon
E-mails: jkouam@foretiafoundation.org,
jcedrickouam@yahoo.fr

Simplice A. Asongu

Nkafu Policy Institute,
Opposite College Jesus-Marie,
Simbock, Yaoundé – Cameroon
E-mails: asongusimplice@yahoo.com,
asongus@afridev.org

Research Department

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Jean C. Kouam & Simplicie A. Asongu

Abstract

The main objective of this paper is to assess the impact of female unemployment on economic growth in Cameroon. Using the Auto Regressive Distributed Lag (ARDL) model, applied to data covering the period 1987-2020, our results show that the relationship between female unemployment and economic growth in Cameroon is negative and significant in both the short and long runs, which is consistent with Okun's law. This finding reflects the need for the government to support the creation of women's led business and improve the business environment in order to stimulate private investment (private sector support and entrepreneurship promotion). Similarly, labor market institutions should evolve to reduce the rigidity that hinders the willingness and ability of firms to hire women. These measures should actually address the weak capacity of the public sector to create enough jobs to mitigate the severity of women's unemployment.

Key words: Female Unemployment, Economic growth, NARDL Model

1. Introduction

The positioning of this study is premised on four main fundamentals in the extant policy and scholarly literature, notably: (i) the growing relevance of exclusive development in Sub-Saharan Africa (SSA) in general and Cameroon in particular; (ii) the importance of gender inclusion in achieving inclusive development, especially as it pertains to reaching sustainable development goals (SDGs) in the post-2015 sustainable development agenda of the United Nations; (iii) the relevance of economic growth in achievement development outcomes, especially within the remits of reducing income inequality and mitigating extreme poverty in Cameroon in particular and SSA in general and (iv) gaps in the extant scholarly literature on the problem statement. The four points are expanded in the same chronology as highlighted.

First, in the light of the premise that most countries in the SSA failed to achieve the millennium development goal (MDG) extreme poverty target just around the year 2015, a growing body of literature has attributed the failure of countries in the sub-region to achieve the attendant MDG objective to the perspective that the fruits of economic growth are not evenly distributed across the population (Tchamyou, 2019, 2020). Moreover, in the corresponding post-2015 inclusive development literature, Bicaba *et al.* (2017) have concluded that unless the concern of income inequality is addressed in SSA, most countries in the region (i.e. including Cameroon) are unlikely to achieve most inequality-related and poverty-oriented SDGs targets. It follows that concerns surrounding income inequality, especially forms like gender economic exclusion are important in fighting the underlying concern of poverty that is standing on the way to the achievement of the SDGs. In order to put this concern into more perspective, it has recently been established that SSA outpaced South Asia in 2019 to become the region in the world hosting the highest number of people living in extreme poverty (Nwani & Osuji, 2020).

Second, there is some consensus in the extant literature that SSA is also host to the highest number of marginalized women, who are for the most part, limited to operating in the informal sector of the economy, through, *inter alia*, subsistence farming and petty trading (Achuo *et al.*, 2022; Ngono, 2021). This concern of gender economic exclusion substantially compounds the problem of income inequality discussed in the previous paragraph. To put this point in greater perspective, a recent report from the World Bank which is substantiated with complementary

scholarly research has it that, the economic exclusion of women has engendered a loss of approximately 160 trillion USD in relation to gross domestic product (GDP) (World Bank, 2018; Asongu *et al.*, 2021a). The policy concern of gender socio-economic and political exclusions is articulated in the fifth SDG (or SDG5) of the United Nations SDGs, which aims to substantially reduce gender economic exclusion by the year 2030. As previously discussed, economic growth is a means by which income inequality can be mitigated, poverty reduced and gender economic inclusion promoted (Tchamyou *et al.*, 2019a; Tchamyou, 2021).

Third, economic prosperity has been established to be immiserizing as well as important in the alleviation of poverty and promotion of inclusive development dynamics such as female socio-economic promotion (Vu, 2011; Peprah *et al.*, 2019; Tchamyou *et al.*, 2019b; Asongu & Odhiambo, 2020). Accordingly, economic growth has been established to be relevant in the realization of a plethora of economic development outcomes such as, *inter alia*, social mobility, investment and consumption avenues, employment opportunities and living standards (Hassan, 2005; Ngouhouo & Nchofoung, 2021). This study contributes to the extant literature by assessing the nexus between female unemployment and economic growth in Cameroon, not least, because of an apparent gap in the extant literature.

Fourth, the extant scholarly literature on gender inclusion and economic growth can be discussed in two main strands. On the one hand, the attendant socio-economic inclusion literature has largely been concerned with *inter alia*, the importance of mobile money innovations in reducing concerns surrounding income inequality (Awel & Yitbarek, 2022); the relationship between gender economic inclusion and tax performance (Asongu *et al.*, 2021a); the relevance of microfinance and bank mechanisms in addressing concerns pertaining to gender economic exclusion by means of mobile money innovations (Ngono, 2021); the political participation of the female gender (Bezinna *et al.*, 2021); the relationship between inclusive finance and mobile money innovations (Lashitew *et al.*, 2019; Kim, 2022); nexuses between information and communication technology (ICT) and access to financial services (Asongu & Odhiambo, 2018; Osabuohien & Karakara, 2018; Coffie *et al.*, 2021) as well as gender gaps that are traceable to financial exclusion (Mndolwa & Alhassan, 2020).

On the other, Cameroon-centric inequality and gender inclusive literature has not focused on the problem statement being considered in this study not least, because the attendant literature has

substantially be concerned with *inter alia*, income inequality within the framework of colonial rule (Alvaredo *et al.*, 2021); understanding income inequality in rural areas in the context of economic welfare and income from forest exploitation (Etoh-Anzah & Njong, 2021); income disparities in an urban area in Cameroon (Nanche, 2021); assessing the redistribution impact from healthcare (Ntembe *et al.*, 2021); vulnerability to climate change, ethnicity and gender inclusion (Azong & Kelso, 2021); determinants of gender differences in inclusive finance (Ndoya & Tsala, 2021) and gaps in earnings between women and men in the labor market that is informal (Wirba *et al.*, 2021).

It is worthwhile to motivate the above positioning of the study with insights from stylized facts in order to better articulate the focus on Cameroon. Consistent with the Nkafu Policy Institute (NPI, 2022), in Cameroon cross-city differences in labor force market participation are more apparent for women compared to men. According to the attendant policy literature, the situation is traceable to a plethora of challenges women are confronted with, which include access to finance and education. The corresponding literature maintains that in 2018, only about 32.5% of women in the country had attained secondary education, relative to 39.2% of men. Moreover, girls are also being confronted with additional constraints beyond the concerns surrounding educational enrolment, especially in terms of cultural barriers to female economic emancipation and household chores burdens. These are some of the factors that have led to women's low labor force participation and by extension, the persistent gender wage gap, in spite of reforms that have been put in place by the government of Cameroon recently. Moreover, while in Cameroon about 39% of the country's population is living below the poverty line, women represent 51.50% of these owing to the fact about 79.2% of them are underemployed.

The theoretical underpinnings of this study are consistent with Okun's law (Okun, 1962). In the corresponding literature, the relationship between the unemployment rate and real product growth was formalized by Okun (1962). The validity of Okun's relationship is to determine whether there is a negative relationship between the unemployment rate and real GDP. Originally, the author sought to establish a measure of output that could be obtained under conditions of full employment. According to the author, a 1% point increase in unemployment above 4 percent in the United States would result in a 3 percent decrease in the output gap. Empirical work on the Okun relationship is within the same remit of research as theoretical studies that focus on the relationship between growth and labor market indicators. Pissarides

(1990) is one of the precursors of the theoretical work linking growth and labor market indicators. Pissarides actually extends Solow's model by introducing a matching function and arrives at the result that an acceleration of growth leads to an increase in job vacancies. This result is more or less accepted by Aghion and Howitt (1992), who show that innovation, while creating new jobs, destroys others.

The validity of this Okun relationship which is the theoretical basis for this study has also been demonstrated by numerous empirical studies, including Noor *et al.* (2007) for Malaysia; Saungweme *et al.* (2014) for the case of Zimbabwe; Kargi (2014) with respect to the organization for economic cooperation and development (OECD) countries, Henin and Jobert (1993) for France and El Andar and Bouaziz (2015) for Tunisia. However, several other authors have challenged the validity of this law. This is notably the case for the work of Abu (2016) who shows that the relationship between the unemployment rate and real gross domestic product (GDP) does not exist in the short run in Nigeria. The underlying theoretical underpinnings are also relevant to the study of Sadiku *et al.* (2015) for Macedonia, Moroke *et al.* (2014) for South Africa and Babalola *et al.* (2013) for Nigeria, *inter alia*.

The rest of the study is structured as follows. The data and methodology are covered in Section 2. Section 3 presents the empirical results and corresponding discussion. Section 5 provide policy recommendations while Section 6 concludes with implications and future research directions.

2. Methodology and data

2.1. Methodology

To study the effects of women's economic empowerment on economic growth in Cameroon, the study employs an ARDL (Auto Regressive Distributed Lag) model to overcome the limitations of conventional cointegration methods (Engle & Granger, 1987; Johansen, 1991). This model, developed by Pesaran *et al.* (2001), is a new approach that is more flexible and less restrictive than previous techniques. It is preferred to the Engle and Granger or Johansen methods because of the presence of integrated series at different orders, on a small sample and in the presence of endogenous explanatory variables (Narayan, 2005). Thus, the ARDL approach allows for the simultaneous treatment of long-run dynamics and short-run adjustments.

Moreover, unlike the models of Engle and Granger (1987) and Johansen (1991), the ARDL model can be applied irrespective of degree of integration of the variables that are used: exclusively I (0), exclusively I (1) or mixed. The estimation approach has also been documented to have superior statistical properties for small samples (Cheung & Lai, 1993). Accordingly, the ARDL test does not require that variables in the model should be purely I (0) or I (1). Moreover, it reflects an estimation approach offering the possibility of jointly dealing with both short-run adjustment and long-run dynamics. Hence, the approach has been selected for the analysis of the dynamic relationship between female unemployment and economic growth in Cameroon.

In the light of the above, this present study performs unit root tests for the variables using the Augmented Dickey–Fuller (ADF) test, in order to assess the stationarity of the variables in terms of their degrees of integration. The model is then analyzed by employing the ARDL procedure, given the need to take stock of both the long-run and short-run dynamics of the analysis. Accordingly, ARDL modeling using the appropriate lags addresses two concerns pertaining to endogeneity and correlation of the series. Another motivation for employing the ARDL method is that it is comparatively more robust especially for small sample sizes. The number of lags of the dependent variable and the explanatory variables is selected using the Schwartz Information Criterion (SIC). This model, which belongs to the class of dynamic models enables the study to capture the temporal effects and is presented as follows. We consider an endogenous variable (GDP_t), its own past values (GDP_{t-i}), which is an autoregressive model (AR) to be written as:

$$GDP_t = a_0 + a_1 GDP_{t-1} + \dots + a_p GDP_{t-p} + \varepsilon_t$$

Or

$$GDP_t = a_0 + \sum_{q_i=0} a_i GDP_{t-i} + \varepsilon_t \dots \dots \dots (1)$$

With

$\varepsilon_t \sim \text{idd} (0, \sigma)$: error term.

As well as by the exogenous variables (X_t) and their past values (Y_t), we speak here of staggered lag models (DL) which take the following form:

$$GDP_t = \beta + b_0 X_t + \dots + b_q X_{t-q} + z_t$$

Or

$$GDP_t = \beta + \sum_{q_i=0} b_i X_{t-i} + z_t \dots \dots \dots (2)$$

Indeed, the combination of the two models gives produces the ARDL model (autoregressive models with staggered or distributed delays), so its form is written:

$$Y_t = \varphi + a_1 GDP_{t-1} + \dots + a_p GDP_{t-p} + b_0 X_t + \dots + b_q X_{t-q} + e_t$$

Or

$$Y_t = \varphi + \sum_{q_i=0} a_i GDP_{t-i} + \sum_{q_i=0} b_i X_{t-i} + e_t \dots \dots \dots (3)$$

We note that (b_0) explains the short-run effect of (X_t) on (Y_t), and to explain the long-run effect of (X_t) on (Y_t), we need to calculate (λ) from the long-run relationship:

$$Y_t = k + \lambda X_t + u$$

With

$$\lambda = \sum b_i / (1 - \sum a_i)$$

In this study, which seeks to investigate the effects of women's economic empowerment on economic growth in Cameroon, the representation of our econometric ARDL model is as follows:

$$\begin{aligned} \Delta \ln GDP_t = & a_0 + \sum_{p_i=0} a_1 \Delta \ln GDP_{t-i} + \\ & \sum_{q_i=0} a_2 \Delta fem_unempl_{t-i} + \sum_{r_i=0} a_3 \Delta HDI_{t-i} + \sum_{s_i=0} a_4 \Delta GFCE_{t-i} + b_1 \Delta \ln GDP_{t-i} + \\ & b_2 \Delta fem_unempl_{t-i} + b_3 \Delta HDI_{t-i} + b_4 \Delta GFCE_{t-i} + e_t \dots \dots \dots (4) \end{aligned}$$

With :

- Δ : First difference operator; \ln is the natural logarithm; a_0 : Constant; $a_1 - a_5$. The representation of the error correction model; $b_1 - b_5$ Coefficients Long term dynamics of the model; p, q, r, s and t are the delay numbers of the variables; $e_t \sim \text{idd}(0, \sigma)$: error term (White Noise).
- The variables are defined as follows:
 - The Gross domestic product (GDP) denotes the sum of value added from all producers in the economy. Value added represents the value of the gross output of producers minus the value of intermediate services and goods that are consumed in production, before taking into account consumption of fixed capital in production.
 - The human development index (HDI) measures the average level of human development achieved by each country in three key areas: longevity and health; income level and education level. Its mapping allows us to understand the distribution of inequalities in the world.
 - Female unemployment (fem_unempl), refers to the share of the labor force that is without work but available for and seeking employment.

- Gross fixed capital formation as % of GDP (*GFCF*): Gross fixed capital formation (formerly known as gross fixed domestic investment) encompasses land enhancements (ditches, fences, drains, *inter alia*), factories, construction of roads, machinery and equipment purchases, railroads, *inter alia*, including schools, hospitals, offices, private residential units as well as commercial and industrial buildings. With respect to the 1993 System of National Accounts, capital formation is also constituted by net acquisitions.

2.2. Sources of variables and descriptive statistics

The data used come from two main sources. First, we use annual data from the World Bank's World Development Indicators (2020). The series considered are annual and are in the form of time series. They cover the period from 1987 to 2020. The choice of this period is mainly justified by the availability of data as well as the liberal gender promotion policies implemented in Cameroon since the 1980s. The descriptive statistics suggest little variation for some of the descriptive variables. From the summary statistics, it is apparent from the research that the variables being considered are comparable within the remit of mean values. Furthermore, the corresponding variations from the standard deviations provide insights into the stance that reasonable estimated linkages can be obtained from the regressions.

Table 1: Summary statistics

	<i>LN</i> GDP	<i>GFCF</i>	<i>fem_{unemploy}</i>	<i>IDH</i>
Mean	23.68857	18.22360	5.244517	0.483345
Median	23.69419	18.56513	4.904000	0.470000
Maximum	24.41149	19.89581	6.697000	0.563000
Minimum	22.90959	14.30539	3.499000	0.431000
Std. Dev.	0.504156	1.297938	1.129209	0.046672
Skewness	-0.014508	-1.516709	0.088103	0.449374
Kurtosis	1.418045	5.300279	1.287292	1.728665
Jarque-Bera	3.024969	17.51226	3.582004	2.929048
Probability	0.220362	0.000157	0.166793	0.231188
Sum	686.9685	528.4843	152.0910	14.01700
Sum Sq. Dev.	7.116841	47.16999	35.70319	0.060993
Observations	29	29	29	29

Notes: Female Unemployment (*fem_{unemploy}*); Gross domestic product in logarithm (*Ln*GDP); human development index (*HDI*), Gross fixed capital formation as % of GDP (*GFCF*). Sum Sq. Dev.: Sum squared Deviation. Source: Authors

3. Empirical analysis

3.1 Stationarity tests

To investigate the stationarity of the series, the study applies the Augmented Dickey-Fuller (1979) (ADF) and Phillips-Perron (1988) (PP) tests. In the corresponding tests, the null hypothesis is the position of non-stationarity. We performed the ADF test to analyze the level of stationarity between the variables. This is a statistical test usually used to verify whether a time series is stationary or not. The unit root test is then carried out under the null hypothesis ($\pi_i = 0$) against the alternative hypothesis ($\pi_i < 0$). The statistics from the ADF test can be significant at 1%, 5% and 10% levels. The value of the test statistic is compared with the p-value for time series. When the value of test statistic is greater than 0.01, 0.05, and 0.1, then the decision criteria will fail to reject the alternative hypothesis and the time series is stationary.

This method has been used by Wolters *et al.* (2005) where they reveal that the occurrence of unit roots in time series has substantial consequences for both univariate and multivariate modelling. Hence, unit root tests are in the contemporary era, the starting point of most empirical studies using time series. The oldest and most widely used test, to the best of knowledge is the Dickey and Fuller (1979) test. For Perron and Ng (2001), when there are errors characterized by a moving-average root which is close to -1 , a high order augmented auto regression is relevant for the unit root tests to have good size; however the information criteria such as the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) tend to generate a truncation lag (k) that is very small.

The application of ADF unit root tests on the series studied leads to the rejection of the stationarity hypothesis for all series, except for gross fixed capital formation (GFCF), which is stationary in level. The results also imply that the other series are integrated of order I (1). It is therefore apparent that no series is integrated of order two I (2) or a higher order, which is necessary for the application of the ARDL. The same is true for the PP unit root test, which leads to the rejection of the stationarity hypothesis for all series except for gross fixed capital formation (GFCF). No series is therefore integrated of order I (2) or more from this test, which justifies the use of the ARDL methodology.

Table 2: Unit root tests: Augmented Dickey Fuller (ADF) & Philips-Perron (PP) tests results

	<i>ADF in level</i>	<i>ADF in first difference</i>	<i>Order of integration</i>
--	---------------------	--------------------------------	-----------------------------

<i>GFCF</i>	−4.69** (0.0006)	-	I (0)
<i>HDI</i>	2.18 (0.99)	−2.84** (0.064)	I(1)
<i>LnGDP</i>	−1.33 (0.95)	−7.23** (0.000)	I(1)
<i>fem_unempl</i>	−1.72 (0.40)	−2.42** (0.0174)	I(1)

Philips-Perron (PP) test results

	<i>ADF in level</i>	<i>ADF in first difference</i>	<i>Order of integration</i>
<i>GFCF</i>	−4.44** (0.0013)	−	I(0)
<i>HDI</i>	1.16 (0.99)	−2.68** (0.08)	I(0)
<i>LnGDP</i>	−1.76 (0.97)	−7.09** (0.000)	I(1)
<i>fem_unempl</i>	−1.06 (0.25)	−2.42** (0.0174)	I(1)

Notes: Female Unemployment ($fem_{unemploy}$); Gross domestic product in logarithm ($LnGDP$); human development index (HDI), Gross fixed capital formation as % of GDP ($GFCF$). Source: Authors

3.2 ARDL optimal and Bounds test

We now proceed to the study of cointegration by employing the method of Pesaran *et al.* (2001) and Narayanan (2005) for a small sample, granting that the adoption of the Johansen test is considered in the case in which the series are integrated within the same order, while the "bounds test to cointegration" is adopted in scenarios where the series are integrated of two different orders, notably: I (0) and I (1). It is also worthwhile to note that the underlying does not exclude the adoption of the "bounds test" in the scenarios where the series are integrated in the same order. Within this framework, the present study adopts the ARDL models and to overcome the requirement of the Johansen test for the same order of integration. Indeed, it should be noted that this model, which serves as the basis for the staggered lag cointegration test (Pesaran *et al.*, 2001), generally takes the form of a vector error correction model (VECM).

Determination of the optimal ARDL model

- Testing for cointegration at the ARDL model bounds: Bounds tests

Table 3 provides values for the Bounds test which builds on the Fisher test to test the hypotheses of cointegration. Hence, the null hypothesis of the absence of cointegration is tested against the alternative hypothesis on the presence of cointegrating nexuses in the traditional approach of

Pesaran *et al.* (2001) and in the Narayan (2005) small sample approach. The testing procedure is tailored such that the values of the bounds test have to be compared with the Fisher test. Should the Fisher value be higher than the upper bound, the null hypothesis is rejected, while in the opposite case in which the Fisher value is lower than the lower bound, the corresponding null hypothesis is not rejected.

Table 3: Results of the bounds test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	10.62	10%	2.37	3.2
<i>k</i>	3	5%	2.79	3.67
		2.50%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	25	Finite Sample: n=30		
		10%	2.67	3.58
		5%	3.27	4.31
		1%	4.61	5.96

Source: Authors' calculations

At the critical threshold of 5%, it appears from the Bounds test table that the Fisher statistic which takes the value of (F=10.62) is higher than the first upper bound which is 4.66, as well as the second upper bound (i.e. 5.96), which leads to the rejection of the null hypothesis or the absence of a cointegrating nexus and consequently non-rejection of the alternative hypothesis of the existence of a cointegrating nexus between the variables being considered. Evidence of a cointegrating nexus thus motivates the long and short term relationships.

- **Validation of the model**

The AIC is employed to select the optimal ARDL model or the model that provides statistically significant findings with the least number of parameters. Findings from the estimation of the selected optimal ARDL model show the optimal model is selected from 500 other models that are considered to be better when the whole evaluation is considered. The selected model is the ARDL (1, 4, 0, 4) model, corresponding to the smallest value of the AIC. The specification obtained in the ARDL (1, 4, 0, 4) model is therefore globally satisfactory. The model can explain almost 84.84% of the observed variability of the gross domestic product. With respect to the robustness tests, the null hypothesis is not rejected in all the tests and hence, the residuals are consistent with the conditions of model validity, notably, the absence of autocorrelation and presence of homoscedasticity and normality.

Table 4: Diagnostic tests on the ARDL model

<i>Test hypothesis</i>	<i>Test</i>	<i>F – stat</i>	<i>Prob</i>
Autocorrelation	Breusch-Godfrey Serial Correlation LM Test	1.19	0.34
Heteroscedasticity	Breusch-Pagan-Godfrey	0.88	0.58
	Ramsey RESET Test	0.12	0.73
Normality	Jarque-Bera	1.29	0.72

Source: Authors

The empirical tests for model validation are provided in Table 4, namely the Autoregressive conditional heteroscedasticity (ARCH) test for Heteroskedasticity, the Jarque-Bera (JB) test for normality of residuals, the Ramsey functional form test (RESET) to establish the absence of Heteroskedasticity and normality of residuals. Alternatively, the functional form of our specifications is correct.

3.3 Estimation results

The short-run and long-run elasticities obtained by estimating the ARDL model are presented in Table 5 below. The term *CointEq* (–1) corresponds to the lagged residual linked to the long-run equilibrium equation. The corresponding estimated coefficient is negative and significant, thus confirming the presence of an error-correction mechanism and hence a long-run nexus between the variables. The value of this coefficient is 0.76, which indicates a 76% deviation of the economic growth rate from its long-run equilibrium caused by the selected variables of the model.

The below table shows that in the short and long runs, the relationship between female unemployment and the growth rate of the economy is negative and significant. In the short run, a 1% decrease in the economic growth results in a 3.7% increase in female unemployment. However, a 1% increase in female unemployment engenders a 2.7% decrease in growth. The long-run elasticity of output with respect to the female unemployment rate is significant at the 1% level. Our results also show that the relationship between domestic production of goods and services and the female unemployment rate is negative in the long run. Accordingly, a 1% decrease in long-term economic growth leads to a 2.77% increase in female unemployment. In other words, an increase in the female unemployment rate of 1% leads to a decrease in output of 0.36% in Cameroon. Okun's law is thus validated as to the relationship between female unemployment and economic growth in Cameroon.

Our results are consistent with the reality of other works conducted in sub-Saharan Africa, notably that of Elshamy (2013) who, by performing a cointegration analysis (MCE) on Egyptian data over the period 1970-2010, shows that the Okun coefficient is negative and statistically significant in both the short and long run. These results are also consistent with those obtained in other developing countries by Tatoglu (2011), Khan *et al.* (2013), Abdul-Khaliq *et al.* (2014), Makun and Azu (2015), El Andar and Bouaziz (2015), N’guessan (2014, 2019), who study the Okun relationship using the Johansen cointegration model.

Assuming the linearity of the relationship between economic growth and the female unemployment rate, the ARDL model (i.e. in the last specification of Table 5) proves that there is a cointegration relationship between unemployment and economic growth. Indeed, the estimated long-run coefficient (Okun coefficient) is negative and significant. The estimation of the linear model (ARDL Error Correction Regression) leads to the significance of the coefficient of Okun's law, as well as its estimation from the NARDL model.

Table 5: Estimation of short and long term relationships between female unemployment and economic growth in Cameroon

Variable	Linear analysis			Non-linear analysis
	ARDL Model (1, 4, 0, 4)	ARDL Error Correction Regression	ARDL Long Run Form ARDL (1, 4, 0, 4)	Model Estimation NARDL (4, 3, 0, 4)
<i>LNGDP</i> (-1)	0.231106 (0.1448)	-0.76889*** (0.0002)	—	-0.604404** (0.0355)
<i>LNGDP</i> (-2)				-0.549883*** (0.0055)
<i>LNGDP</i> (-3)				-0.451384*** (0.0113)
<i>LNGDP</i> (-4)				-0.286646** (0.0324)
<i>fem_unempl</i>	-0.076816 (0.1638)	-0.278606*** (0.0001)	—	—
<i>fem_unempl</i> (-1)	-0.147881 (0.1342)	—	—	—
<i>fem_unempl</i> (-2)	-0.008662 (0.9255)	—	—	—
<i>fem_unempl</i> (-3)	0.193467** (0.0533)	—	—	—
<i>fem_unempl</i> (-4)	-0.238713*** (0.0017)	—	—	—
<i>fem_unempl_POS</i>	—	—	—	0.6856*** (0.0093)
<i>fem_unempl_POS</i> (-1)	—	—	—	-0.037215

Variable	Linear analysis			Non-linear analysis
				(0.8544)
<i>fem_unempl_POS(-2)</i>	–	–	–	–0.167715 (0.4080)
<i>fem_unempl_POS(-3)</i>	–	–	–	0.113420 (0.3997)
<i>fem_unempl_NEG</i>	–	–	–	–0.537166*** (0.0003)
<i>FBCF</i>	0.056740** (0.0381)	0.056740** (0.0381)	–	–
<i>IDH</i>	–7.878884** (0.04030)		–	–0.169977 (0.9584)
<i>IDH(-1)</i>	5.410567 (0.2560)	1.069609 (0.3306)	–	–9.296219 (0.1274)
<i>IDH(-2)</i>	12.78099** (0.03)	–	–	–1.803522 (0.7153)
<i>IDH(-3)</i>	–3.518521 (0.4288)	–	–	5.054251 (0.3261)
<i>IDH(-4)</i>	–5.724545 (0.1078)	–	–	10.11894** (0.0535)
<i>D(FEMALEUNEMPLOYMENT)</i>	–	–0.076816 (0.1638)	–0.076816* (0.0754)	–
<i>D(FEMALEUNEMPLOYMENT(-1))</i>	–	0.053908 (0.3545)	0.053908 (0.2767)	–
<i>D(FEMALEUNEMPLOYMENT(-2))</i>	–	0.045246 (0.4108)	0.045246 (0.3312)	–
<i>D(FEMALEUNEMPLOYMENT(-3))</i>	–	0.238713*** (0.0017)	0.238713*** (0.0003)	–
<i>D(IDH)</i>	–	–7.878884** (0.0403)	–7.878884*** (0.0082)	
<i>D(IDH(-1))</i>	–	–3.537925 (0.3180)	–3.537925 (0.1824)	
<i>D(IDH(-2))</i>	–	9.243066 (0.0120)	9.243066*** (0.0029)	
<i>D(IDH(-3))</i>	–	5.724545 (0.1078)	5.724545** (0.0342)	
<i>C</i>	18.16129*** (0.0002)	18.16129*** (0.0002)	–0.076816*** (0.0000)	64.9892*** (0.0000)
<i>CointEq(-1)</i>			–0.768894*** (0.0000)	
		<i>Long term elasticities</i>		
<i>FEMALEUNEMPLOYMENT</i>	–	–0.362345*** (0.0000)	–	–
<i>FBCF</i>	–	0.073794* (0.0778)	–	–
<i>IDH</i>	–	1.391100 (0.2687)	–	–
<i>C</i>		23.62*** (0.0000)		–
R-squared			0.8412	0.9958
Adjusted R-squared			0.7619	0.99
Akaike info criterion	–2.90		–3.2274	–2.90
Dubbin-Watson stat			1.95	2.07
F-Statistic	206.36*** (0.0000)			171.93*** (0.0000)

Note: ARDL Error Correction Regression, Dependent Variable: D (LNGDP), Selected Model: ARDL (1, 4, 0, 4) Restricted Constant and No Trend. Notes: Female Unemployment ($fem_{unemploy}$); Gross domestic product en logarithme (LnGDP); human development index (HDI), Gross fixed capital formation as % of GDP (GFCF). Source: Authors

Calculation of the adjustment speed

The 76% adjustment coefficient obtained by estimating the ARDL Error Correction Regression that explains the deviation of the economy's growth rate from its equilibrium level can be used to calculate the speed of its return to equilibrium after an exogenous shock that further increases female unemployment. The speed formula is written as follows:

$$(1-\beta_0) = (1 - |\alpha_1|)^t$$

$$\text{Log} (1-\beta_0) = t * \text{Log} (1 - |\alpha_1|)$$

With: t number of years, α_1 the error-corrected coefficient, and β_0 the percentage of shock to be removed (95%). According to our model, the elimination of 95% of a shock on the growth of the real economy requires:

$$t = \frac{\text{Log}(1 - \beta_0)}{\text{Log}(1 - |\alpha_1|)} = \frac{\text{Log}(1 - 0.95)}{\text{Log}(1 - 0.76)} = \frac{-1.301}{-0.619} = 2.10$$

Eliminating 95% of a shock to the growth of the economy due to a large increase in the level of female unemployment can take up to 2.10 years for the growth rate to return to its pre-shock level. In this context, active employment policies should target women, for whom the unemployment rate has reached alarming levels. Absorbing this category of job seekers would also help to increase labor productivity, which has been consistently well below its potential in the country.

4. Complementary measures for reducing women's unemployment

Our results show that in Cameroon, deviations in real GDP are very sensitive to fluctuations in the female unemployment rate; both in the short and long run (i.e. variations in female unemployment explain deviations in real GDP). This means that the Cameroonian economy

cannot develop without a significant decrease in women's unemployment. Such evidence leads us to make the following policy recommendations in view of promoting the employability of women:

- ***Promoting women's access to finance.*** Many women in Cameroon are unemployed because they lack the necessary financing to sustain their businesses. To reverse this trend, it is appropriate for the authorities to introduce policies and regulations on financial inclusion that are favourable to women. For instance, married women should no longer seek the authorization of their spouse to obtain credit, start or register a business. The government should revise the decree N° 2007/254 of September 4th, 2007 regarding the criteria of obtaining a national identity (ID) card which shows that married women need to present a marriage certificate before obtaining it. This national ID is also required when registering a business and when applying for a loan from a financial institution.
- ***Encouraging girls' and women education in science, technology, engineering and mathematics (STEM):*** Many girls and women in Cameroon remain unemployed because they do not have access to science, technology, engineering and mathematics (STEM) quality education and, consequently, in STEM careers. Compared to boys, girls are held back by prejudices, social norms and expectations that influence their education and the subjects they study. Yet STEM careers are today jobs of the future, bringing innovation, social progress and growth.
- ***The government and private organizations should put in place measures to support childcare.*** Many women remain unemployed due to a number of family constraints, including childcare. The implementation of measures aimed directly or indirectly at providing childcare services will contribute significantly to supporting women's participation in the labor market and their economic empowerment. The availability of public and private childcare services and, in particular, the affordability or free provision of such services is essential to reduce women's unpaid domestic work and unemployment.

5. Concluding implication and future research directions

This study is an attempt to investigate the relationship between female unemployment and GDP growth in Cameroon for the period 1987 to 2020. After reviewing the literature, we developed a theoretically-informed model. Then, an econometric procedure is adopted to estimate the Okun coefficients. Using an ARDL (Auto Regressive Distributed Lag) model, our results show that in the short and long runs, the relationship between female unemployment and the growth rate of the economy is negative and significant. In the short run, every 1% increase in female unemployment leads to a 2.7% decrease in growth. Similarly, the long-run output elasticity of the female unemployment rate is significant at the 1% level. An increase in the female unemployment rate of 1% leads to a decrease in output of 0.36% in Cameroon in the long run. Okun's law is therefore validated with respect to the relationship between female unemployment and economic growth in Cameroon.

Our results highlight the need for more women to be engaged in the formal economic sector in order to boost economic prosperity in the country. Such economic prosperity is essential for the achievement of other societal benefits such as poverty reduction, inequality mitigation and the delivery of socio-economic amenities, *inter alia*. The study has also provided empirical validity to ongoing efforts by the Cameroonian government to engage more women in the formal economic sector in order to boost growth opportunities and corresponding economic development externalities.

Given the weak capacity of the public sector to create sufficient jobs to alleviate the acuteness of unemployment, especially among university graduates, economic policies to be implemented would benefit from prioritizing the support of the private sector and promoting female entrepreneurship. In this sense, it would be effective to subsidize business creation and to clean up the business environment in order to boost private investment. Similarly, labor market institutions should evolve to alleviate the rigidity that undermines the willingness and ability of firms to hire women. It may also be a question of the government opening up national services markets to create new employment opportunities for women. On the demand side, the education system needs to be refocused to better adapt training to the needs of the productive system.

Future studies can focus on assessing the opposite nexus in order to provide poor policy insights into the achievement of the sustainable development agenda of the United Nations. In other words, investigating the gender economic inclusive response to economic growth is worthwhile

in understanding if the recent growth resurgence of the country has benefited women in terms of their involvement in the formal economic sector. Moreover, building on the approach adopted by Dixon *et al.* (2017), an extension of this study would be to estimate Okun's relationship using unemployment rates disaggregated by age, gender, industry, and region.

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