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| RESEARCH ARTICLE

Factor Accumulation, Total Factor Productivity, Random Shocks and Output Growth in Cameroon

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| ABSTRACT
The main focus of this paper is to examine the proper channels through which the Cameroon economy can achieve a high output (GDP) growth rate and sustain it over time in order to accelerate her pace of economic recovery. Specifically, the paper attempts to understand the role of the various determinants of GDP and to investigate the role of random shocks (RNDSH) in GDP growth in the Cameroon economy from 1970 to 2015. A maximum likelihood technique (MLT) is used to estimate a trans log stochastic frontier production function in a one stage estimation procedure. The results reveal that GDP growth in the Cameroon economy is promoted by labour and capital, which jointly contribute 68% (47% for labour and roughly 22% for capital) against -22% for total factor productivity (TFP). The results also show that RNDSH impedes the GDP growth of the country at an annual average rate of 9.1% throughout the study period. These results imply that the Cameroon economy needs to focus on labour intensive techniques of production so as to propel GDP growth. This study recommends that more efforts should be invested in human capital development, reduction of inefficiency in production processes, and design of proper mechanisms to minimise the effects of Random shocks in the economy.

| KEYWORDS

Crisis, determinants, development, efficiency, production, random shocks.

| ARTICLE INFORMATION

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1. Introduction

The Cameroon economy passed through one of her most difficult periods from 1985 to 1994 following the economic crisis of the mid 1980s that caused an unprecedented decline in national output (Amin 1996). Studies such as Njinkeu et al. (1997), Fambon et al. (2004), and Tabi (2005) on the economy revealed that growth is gradually returning to the economy but at a very slow pace. Fambon et al. (2004) explain that in 1996, about 68% of Cameroonians were poor, and the situation had not greatly improved since then. According to Tabi (2005), labour and capital contributed 99.86% to output growth, while TFP's contribution was very close to zero (0.14%).

According to the African Development Bank [AfDB] (2017), the Cameroon economy actually registered a very negative performance during the 2008 global financial and economic crisis period. The growth rate of real per capita GDP dropped from 5.8% in 2014 to 5.6% in 2015. The per capital income growth rate dropped from 3.3% in 2015 to 2.2% in 2016. The trade balance (Percentage of GDP) fell from 2% in 2008 to -2.1% in 2016. The current account picture had a similar negative trend in terms of deficit as a percentage of GDP. It moved from a deficit of 1.2% in 2008 to 4.8% in 2016. Concerning the global investment expenditure by the public sector, the investment rate increased from 4.9% in 2008 to 6.4% in 2015. The unemployment rate registered an upward trend, moving from 5.5% in 2005 to 8.3% in 2012.

Total factor productivity growth (TFPG) consistently registered a negative trend since 1996. Its growth rate decelerated from -0.3% for the period 1996-2006 to -0.4% in 2015. The primary sector, which contributes about 14.6% of total GDP, grew by only 0.1%

between 2014 and 2015. The secondary sector registered a significant annual growth rate of 5.5% during the period 2011 to 2014 in spite of the decline in the value added of the sector from 9% in 2015 to 4% in 2016. Growth in the economy had actually been propelled by the tertiary sector, especially in the transport and telecommunication subsectors, which grew from 3.4% in 2015 to 8.4% in 2016. The banking and finance subsector also grew from 8% in 2015 to 9% in 2016 (AfDB 2017).

The World Bank [WB] (2017) posits that the overall number of poor in Cameroon increased by 12% to 8.1 million between 2007 and 2014, with 56% of the poor concentrated in the Northern regions of the country. The same source explained that for the country to move from a lower middle income country to an upper middle income country by 2035, it has to increase productivity and unleash the potential of the private sector. As a result, the real GDP of the country has to grow by roughly 8% or 6% per capita from 2015 to 2035. This requires the investment share of GDP to increase from about 20% in 2015 to 30% in 2035 and the productivity growth rate to reach 2% over the same period from its average zero growth over the period 2007-2016. These actually present a very daunting task for the economy with respect to the efforts needed to accelerate the pace of economic recovery. The diagnosis presents two principal worries that need to be addressed in this investigation. One, will the Cameroon economy be able to secure and sustain a higher growth rate of output over time by continuously increasing labour and capital in the face of decreasing returns to these factor inputs? Two, should the Cameroon economy embark on productivity improvements in the face of declining technological progress (TP) and increasing inefficiency in the production process?

Considering the pervasive and devastating effects of RNDSH on GDP growth in world economies, Bhattacharya and Sabyasachi (2017) disclosed that in the Indian economy, for instance, RNDSH caused the GDP growth rate to fall by 57%, inflation to increase by 74% and foreign exchange rate to fall by 70% in the short run. In the long run, these shocks caused output to fall by 29%, inflation to increase by 47% and foreign exchange to drop by 13.4%. Given that the effects of RNDSH are very common in less industrialised countries (LICs), it is necessary to investigate their effects on GDP growth in the Cameroon economy at a period when another crisis is looming on the horizon. Therefore, the main objective of this paper is to examine the proper channels through which the Cameroon economy could achieve a sustained level of GDP growth over time in order to accelerate its pace of economic recovery. Other specific objectives of the paper include:

- To estimate stochastic frontier and efficiency models for the Cameroon economy.
- To understand the relative role of GDP growth determinants in the Cameroon economy.
- To investigate the role of RNDSH on GDP growth in the Cameroon economy.
- To suggest ways for accelerating GDP growth and economy recovery in the Cameroon economy.

Amin (1996, 2002) has discussed GDP growth in the Cameroon economy but placed little or no emphasis on the effects of RNDSH on GDP growth. By considering the effects of RNDSH on GDP growth, this paper offers a ground for better insights and a good basis for policy prescriptions to decision makers concerning the dynamics of GDP growth in the economy.

After the introduction in Section 1, the rest of the paper is organised as follows. The review of theoretical literature is done in Section 2. Section 3 explains the methodology employed to attain the objectives of the study. Section 4 concentrates on data analysis and discussion of the results, while Section 5 covers the conclusion, recommendations of the paper, and areas of future research.

2. Literature Review

The theoretical literature is based on the exogenous and endogenous growth models. Some recent developments on economic growth issues as perceived by the World Bank (WB) are also reviewed.

The exogenous growth models (EXGMs) argue that TP is the key determinant to long term economic growth as well as international productivity differences. Under this framework, the neoclassical growth models of Solow (1959) and Swan (1959) posit that, in the absence of TP, the output per unit of labour can only be increased if there is an increase in the capital-labour ratio. This requires a high rate of savings and investments. Hence, if a country is able to accumulate more physical factors of production through more savings and investments, the level of per capita output must grow, especially in the short run. But in the long run, growth can only be sustained through exogenous TP. EXGMs did not clearly distinguish between TP and TFPG but rather used them synonymously. These make them not very useful on the policy front because it is difficult to explicitly explain the determinants of TFPG in the economy for policy intervention. Another important limitation is the assumption of diminishing marginal productivity (MP) of the factor inputs, which ignores the important role of increased investments in Research and Development (R & D) and human capital development in the growth process. The main challenges in using this route to achieve higher levels of GDP growth rest on the high level of financial resources needed, which are not easy to mobilise, especially in LICs. Besides, it is difficult to improve productivity because production factors are not explicitly explained by models using the growth accounting technique (GAT).

The endogenous growth models (ENGMs) explained that by endogenising the steady state growth rate and introducing the role of human capital (Knowledge acquisition, skills and training of the workforce), MP of inputs remains constant (Y = AK model) or even increases over time rather than decrease. ENGMs hold that factor accumulation is necessary for short run growth, but in the long term, growth in output can only be supported by improvement in human capital, higher investment in R & D, efficiency improvements in the production process, more international trade and cooperation for knowledge diffusion and a greater role on entrepreneurship (Griliches 1980). Lucas (1988) shared the same point of view but argued that productivity growth is not directly observable and cannot be easily measured because the effects of GDP growth can also be observed through other variables.

Although ENGMs seem to be a sure path to propel and preserve GDP growth, there are major inherent challenges that cannot be easily overcome in LICs. One, the type of education and training offered in some LICs is inadequate to endow the labour force with the necessary skills to introduce innovations and increase the capacity of the labour force to absorb new knowledge from technological spillover (Nelson and Phelps 1966). Two, human capital depreciates just like physical capital and would need constant repairs in the form of a good health care delivery system and more investment in R & D in order to reduce inefficiency and boost the productivity of workers (Romer 1990). Yet these are largely under produced in LICs. Three, ENGMs mostly apply GAT and the econometric technique (ECT) in the estimation process. The main limitation of these techniques is that they do not explain the sources of inefficiency in production. As a result, they are not also very relevant on the policy front.

WB (2010) states that the search for answers to rapid economic growth should not merely focus on economic factors but should also take into consideration the historical and institutional settings of each country. More emphasis should rather be placed on the binding constraints on growth, such as reducing the limitations on mobilising sufficient domestic and foreign finance, improving the level of human capital and technological capacities, removing weaknesses in governance structure and poor functioning of institutions that regulate markets, and providing public goods and social services to people. Based on observations, it can be deduced that LICs always lag behind most industrialised countries (MICs) in terms of growth in per capita income due to these binding constraints. To overcome these binding obstacles, LICs need to adopt and adapt modern technologies; apply import substitution policies and engage in a win-win international trade with trading partners; develop proper resilient mechanisms to future adverse internal and external shocks; and enhance growth productivity through efficient allocation of production resources and rapid accumulation of qualitative physical and human capital. These prescriptions emphasise both factor driven growth and productivity driven growth. Yet the main problem with these prescriptions is the difficulty of achieving the two objectives simultaneously because huge financial and material resources are required, which are not easy to raise in LICs. This makes the puzzle of GDP growth in LICs largely unsolved and a subject of recurrent debates on the appropriate growth channels to apply in order to increase GDP in these economies.

This paper falls within the context of ENGMs because it attempts to achieve a high and sustained GDP growth rate over time in order to accelerate the pace of economic recovery in the Cameroon economy. It considers productivity improvement as the suitable path to accelerate and preserve GDP growth in the economy of the country. In this regard, it departs from previous models by considering that productivity improvement can also be achieved through the reduction of inefficiency in the production process rather than through increasing only the use of physical factors of production and the rate of savings in an economy. Hence, it utilises the stochastic frontier analysis instead of the GAT used in most previous studies. Some studies that have investigated the role of efficiency in explaining productivity improvement and GDP growth using the stochastic frontier analysis include Baier et al. (2002), Kumbhakar and Lovell (2000), Coelli et al. (1998), Farell et al. (1994), Battese and Coelli (1992), Cornwell et al. (1990), Nishimizu and Page (1982), Aigner et al. (1977), Battese and Corra (1977), and Meeusen and Van den Broeck (1977).

3. Methodology

The methodology focuses on the estimation procedure of the translog stochastic production function. It also discusses the sources of data used, the description and measurement of variables along with their theoretical expected signs, and the tools used in the analysis and interpretation of data. This study spans the period 1970 to 2015. This time frame coincides with periods in which the Cameroon economy experienced crises such as the oil crisis of 1973, the economic crisis of the mid 1980s and recently, the global financial and economic crisis of 2008, whose understanding of the effects may enable to appreciate the overall economic performance of the Cameroon economy during the period of review. In analysing long term economic growth in Cameroon, this study focuses on the aggregate economy rather than individual sectors or subsectors of the economy. Furthermore, it emphasises the supply side factors such as capital accumulation, increase in labour inputs under TP and inefficiency variables.

3.1 Model Specification

The main equation for the empirical analysis of this study is a translog specification of the stochastic frontier production function as presented by Aigner et al. (1977) and Meeusen and Van den Broeck (1977) as specified in (1).

$$\ln Y_{it} = \alpha_0 + \alpha_L \ln L_i + \alpha_K \ln K_i + \alpha_t t + 0.5\beta_{KK}(\ln K_i)^2 + 0.5\beta_{LL}(\ln L_i)^2 + 0.5\beta_{tt}t^2 + \beta_{LK}(\ln L_i)(\ln K_i) + \beta_{tL}(\ln L_i)t + \beta_{tK}(\ln K_i)t + (V_{it} - U_{it})$$

.... (1)

$\text{In}Y_{it}$ is the observed output. $\text{In}L_i, \text{In}K_i$ are the natural log of labour and capital, respectively. t is a time trend that indexes technology. $V_{it}\, and\, U_{it}$ are error terms. α_L and α_K are the coefficients of the first order derivatives of labour and capital, respectively, while α_o is the constant and α_t, the coefficient of the time trend. Since the technical efficiency term (U_{it}) follows a halve normal distribution truncated at zero, its distribution is modelled as in (2).

$$U_{it} = \beta_0 + \beta_1(ROINVST) + \beta_2(ATPDW) + \beta_3(RUELEC) + \beta_4(TECHDIF) + \beta_5(HUMCAP) + \beta_6(ROINF) + \beta_7(SOGFIN) + \beta_8(TROPEN) + \beta_9(FINDEV) + \beta_{10}(EXCHR) + \varepsilon_t \quad \text{....... (2)}$$

The effects of TP in (1), which represent the accumulation of the physical factors of production labour and capital, are captured by the stochastic frontier function. Meanwhile, the effects of the inefficiency variables in (2) are accounted for by the technical efficiency model in the stochastic frontier production function. The estimation is done using a one stage MLT procedure.

3.2 Data Sources, Description of Variables, Measurement and Signs of Variables

This section discusses the data sources and characteristics of variables used in this study. Also, it elucidates the expected signs of the variables used in the regression analysis. The data for this study are sourced from the database of the World Development Indicators 2017 for the Cameroon economy, where the data for the inefficiency variables were sourced. The data for labour and output (GDP) were obtained from the Total Economy Data Base-Regional Aggregates (Output, labour and labour productivity: 1950-2017). The data for capital stock (CAPSTOC), exchange rate (EXCHR) and the rate of replacement investment (ROINVST) were sourced from the works of Timmer et al. (2015). The data are found in the Penn World Table, version 9.1. Computations were done based on Liao et al. (2002) authors to obtain values of variables such as TP, output elasticity of labour and capital, return to scale (RTS) and the share of labour and capital in income.

The variables used to address the objectives of the study are selected from five categories of inefficiency factors, namely international trade and financial development, infrastructure, innovation, institution, and TP. The variables retained from each group include labour, accumulation of CAPSTOC, and stock of human capital (HUMCAP) for TP block; EXCHR, rate of inflation (ROINF), and size of the government finance (SOGFIN**)** within the institutional scope; and rate of technological diffusion (TECHDIF) in the domain of innovation. Other retained variables are the extent of rural and urban electrification (RUELEC), and the rate of replacement investment investment (ROREINVST) is measured as the rate of depreciation in the economy. Access to portable drinking water (ATPDW) in the infrastructure arena, while trade openness (TROPEN) and financial development (FINDEV) are considered in the international trade and financial development sphere. These are presented in Table 1.

Table 1: Description of Variables and Anticipated Signs

Variable	Description	Measurement	Expected Sign
HUMCAP	Labour endowed with skills to absorb and make efficient use of new technology embodied in capital assets acquired	Years of schooling and returns to education	Positive
ROREINVST	Rate of depreciation in the economy	Percentage	Positive
TECHDIF	Level of foreign direct investments in the economy	Percentage	Positive
ATPDW	Proportion of the population with access to portable drinking water in the economy	Percentage	Positive
RUELEC	Percentage of the population with access to electricity in the economy	Percentage	Positive
ROINF	Annual gross domestic product deflator in the economy	Percentage	Negative
SOGFIN	General final government consumption expenditure in the economy	Million US Dollars	Negative
TROPEN	Ratio of imports to exports in the economy	Million US Dollars	Positive
FINDEV	Flow of funds from savers to borrowers destined for investment activities in the economy	Million US Dollars	Positive
EXCHR	Average of market exchange rates and official in national units per USD rates	National currency unit per unit of US Dollars	Negative
GDP	Sum of all productive forces value added in the economy	Million US Dollars	-

Source: Authors' Conception

The rate of technological diffusion (TECHDIF) represents the rate of transfer of technological know-how through trade between economies. TECHDIF is measured as the level of foreign direct investment in the economy. Innovation comes from investment in knowledge that translates into new technologies as well as a more efficient way of using existing resources in the economy. Technological diffusion produces positive effects on output growth in the economy. EXCHR is measured as the period averages of market exchange rates and official rates, and it is expressed in national currency units per US Dollar unit.

3.3 Estimation Procedure and Analytical Tools

The model is estimated using MLT in a one stage simultaneous estimation procedure to obtain the estimates of the stochastic frontier model and the technical inefficiency function. This is done using the Frontier 4.1 version in the R econometric software package based on Battese and Coelli (1993). The entire period of study is divided into five sub periods: 1970-1979, 1980-1989, 1990-1999, 2000-2009 and 2010-2015. The annual average growth rate for each sub period is obtained by dividing the sum of the annual growth rates for each sub period by the number of years. The share contributions made by labour and capital, respectively, for each sub period is obtained by multiplying the share of labour in income by the growth of labour, and the same is done for capital. The sum of the share contributions made by labour and capital to GDP growth for each sub period constitutes the share contribution by the physical factors for the corresponding sub period.

A similar exercise is conducted for TFP for each sub period. This estimation enables us to know the relative importance of physical factors as well as TFP to GDP growth in order to attain the set objectives of the inquiry. Concerning the role of RNDSH in GDP growth, the sum of the contributions made by physical factors and that of TFP is subtracted from the total GDP growth rate for each sub period. This permits us to know the share contributions of RNDSH to GDP growth. The results for share contributions by factor inputs to GDP growth are presented in tables or graphs. However, for a better appreciation of the magnitude of these contributions, the share contributions are converted into percentage contributions.

3.4 Hypotheses Tests Results

The generalised likelihood ratio tests are conducted to check the validity of the functional form adopted in the estimation process and test the presence of inefficiency in the model. These are presented in Table 2. The tests of hypotheses show that all the null hypotheses are rejected at a 5% level of significance in favour of their corresponding alternative hypotheses. This indicates that the functional specification that best fits the data for the production technology is the translog specification with no TP as against the more restrictive Cobb-Douglas specification. The results obtained are in line with Battese and Broca (1997), who explain that the translog and Cobb-Douglas production functions are the two most commonly used functional forms in empirical works, but the Cobb-Douglas production function is more prone to model errors due to its highly restrictive nature. Furthermore, the production technology assumes non neutral TP and the presence of technical inefficiency. These results validate the essence of this study, for if TP is neutral, it will be difficult to explain how it grows over time, and consequently, policy interventions within the economy will not really have a target to follow. Likewise, if technical inefficiency does not change over time, then policy interventions will be irrelevant because they will not produce any change in inefficiency. Since the null hypothesis of no technical inefficiency effects in the model is also rejected at a 5% level of significance, it implies that the model can capture the effects of inefficiency in production. These results justify the use of the translog functional form of the model and the presence of technical inefficiency as confirmed by the one stage MLT procedure adopted in the estimation of parameters.

Table 2: Generalised Likelihood Ratio Test Results

Null hypothesis	Log likelihood value	Test statistic (λ)	Degrees of freedom	Critical value at 5% level	Decision
Cobb-Douglas specification $H_O:\beta_{11}= \beta_{22} = \beta_{33}\, \beta_{12} = \beta_{13} = \beta_{23} = 0$	86.1463	54.085	6	12.592	Reject
No technical change $H_O:\beta_3 = \beta_{13} = \beta_{23} =\beta_{33} = 0$	107.71	10.9578	4	9.488	Reject
Neutral technical progress $H_O:\beta_{13} = \beta_{23} = 0$	108.9297	8.5182	2	5.991	Reject
No technical inefficiency $H_0: \delta_1 = \delta_2 =\ldots= \delta_{10} = 0 : \gamma = 0$	96.9265	32.5246	10	18.308	Reject
Inefficiency does not change over time (No intercept) $H_o : \delta_o = 0$	101.4828	23.412	1	3.841	Reject

Source: Authors, E-views Econometric Package

4. Results and Discussion

This section addresses the specific objectives of the study. After the analysis of data and results with respect to the specific objectives, a comparative analysis of the results obtained with similar studies done on the Cameroon economy is carried out for inference purposes.

4.1 Summary Statistics of Variables in the Stochastic Frontier and Inefficiency Models

The results of the summary statistics show that the sample mean of the dependent variable (GDP) falls within the minimum and maximum range. This gives an indication of the scope for expansion of output in the production process if inefficiency is reduced. For instance, if inefficiency is reduced, there is a high potential for GDP to increase, as reflected by the values of the standard deviation. Concerning the independent variables of the study, it is observed that their sample mean falls within the maximum and minimum range, showing that there is not much variability of the estimates over time. Since the variables could be increased, according to the results, it indicates the possibility that GDP can also be increased.

Table 3: Summary Statistics of Variables in the Stochastic Frontier Model and the Inefficiency Model

Variable	Sample mean	Standard deviation	Minimum value	Maximum value
HUMCAP	1.529589	0.042384	0.421250	1.881361
ROREINVST	0.044962	0.000467	0.039683	0.049728
TECHDIF	1.210422	0.223685	-1.539910	5.392024
ATPDW	53.10826	1.974913	28.90000	75.60000
RUELEC	34.99196	2.174783	17.35000	57.20000
ROINF	5.619598	1.055005	-2.392300	39.80020
SOGFIN	1.62E+10	1.32E+08	50905426	3.79E+09
TROPEN	0.88138	0.036375	0.429016	1.331259
FINDEV	18.01731	1.056704	5.914426	37.54655
EXCHR	410.32301	22.153194	211.2796	733.0385
LABOUR	6352913	0.1509520	0.055220	0.660450
CAPSTOC	77196.78	30333.480	32363.82	146378.3
GDP	1.71E+10	1.02E+09	6.06E+09	3.36E+10

Source: Obtained using the R Econometric Package

4.2 Estimation of Stochastic Frontier and Inefficiency Models

MLT estimation produced the results in Table 4, Table 5 and Table 6. Concerning the stochastic variables in panel 1, the results show that most of the coefficients are statistically significant except for capital stock and the interaction term, labour squared. This indicates that most of the variables have a positive impact on output growth, except for the variables capital stock and labour squared, which produce a negative impact on output growth. The explanation that can be given to these contrary results of the capital stock variable is that the capital stock purchased are ill adapted for the production context of the economy. Another reason is that the capital stock is subject to high depreciation, but very little attention is placed on their maintenance or to replace them. The labour force do not have the necessary skills to adapt to technological innovations, and as a result, their increased employment in the production process (Labour squared) reduces efficiency and labour productivity.

Table 4: Maximum Likelihood Estimates for Parameters of the Stochastic Frontier (Translog) Function

Variables	Parameter	Coefficient	Standard error	z-value	p-value
Stochastic model	-	-	-	-	-
Constant	B_0	34.308	0.98657	34.7746	0.00000***
CAPSTOC	B_1	-6.7603	0.17359	-38.943	0.00000***
LABOUR	B_2	4.3655	0.81686	5.3443	0.862361
TIME	B_3	0.01401	0.080844	0.1734	0.00000***
½*TIME^2	B_{33}	0.0003960	0.00009757	3.9697	0.00000***
½*log(CAPSTOC)^2)	B_{11}	0.1011	0.022205	4.5567	0.00000***
½*log(LABOUR)^2)	B_{22}	-0.76835	0.15048	-5.1060	0.00000***
log(CAPSTOC)* log(LABOUR)	B_{12}	0.31811	0.064270	4.9497	0.00000***
Log(LABOUR)*TIME	B_{23}	0.016512	0.0085003	1.9425	0.052078
Log(CAPSTOC)*TIME	B_{13}	-0.014349	0.0012331	-11.636	0.00000****

******Significance above1%, ***Significance at 1%, **Significance at 5%, *Significance at 10%**

Concerning the variance parameters, the value of gamma (γ = 0.99942) indicates that the frontier model is the most appropriate model to employ because about 100% deviation in the data (Total variance of the compose error) is explained by the variance of the technical inefficiency term (U_{it}). This result is in line with the work of Limam (2004), who conducted a similar study for some 80 LICs and MICs.

Table 5: Maximum Likelihood Estimates for Variance Parameters of the Stochastic Frontier (Translog) Function

Variables	Parameter	Coefficient	Standard error	z-value	p-value
Gamma	γ	0.99942	0.0058876	169.7498	0.00000****
Sigmma(σ^2)	(σ^2)	0.00027635	0.00003	9.7429	0.00000****
Sigmma.sq.U	σ^2(U)	0.0008	0.0003	3.278064	0.00000****
Sigmma.sq.V	σ^2(V)	0.000012913	0.0001359	0.09019	0.9243
Sigmma	σ	0.0042151	0.0017129	2.4607	0.013865*
Sigmma.U	σ (U)	0.0285182	0.00043152	6.556178	0.00000****
Sigmma.V	σ (V)	0.0035935	0.01890923	0.190084	0.08493*
Lamda.sq	λ^2	61.98195	670.8947	0.09239	0.9263906
Lamda	λ	7.872862	42.60806	0.0.1848	0.853406
Var(U)	-	0.0002908	-	-	-
Sd(U)	-	0.0170541	-	-	-
GammaVar	-	0.99942	-	-	-
Log likelihood	-	113.1888	-	-	-
LR test	-	95.6	-	-	-
Mean efficiency	-	0.98637	-	-	-
Chi-square value	-	14.3279	-	-	0.01875*

****Significance above1%, ***Significance at 1%, **Significance at 5%, *Significance at 10%

The results of his study revealed that there is technical inefficiency in all the five groups of countries that were considered in the study. That is, in Africa, the average value of gamma is 0.9895, in Latin America (0.9063), West (0.9313), East Asia (0.9760) and South Asia (0.9898), with all the results significant at 1% level. These results indicate that there is a higher level of inefficiency in production in these groups of countries, and the level of inefficiency in production in Cameroon (0.9994) is comparable to that in the different regions considered in Limam (2004) study, even though it is slightly above the African average value of 0.9895. The positive sign of the mean efficiency term (U_{it} = 0.9864) for the Cameroon economy indicates that efficiency decreases over time and, therefore, has an impact on the rate of change of productivity. This indicates that if producing units within the Cameroon economy adopt "best practices" on the efficiency variables retained for this study, output can be increased by about 97%. Similar results are reported by the work of Limam (2004), where the mean efficiency for Latin America is 0.777 or 78% with a variability of 14.9, West (0.855 or 86%) with a variability of 8.5, East Asia (0.799 or 80%) with a variability of 11.4 and Africa (0.3318 or 34%). The results for the Cameroon economy re-enforces the importance of efficiency improvements in our production process and justifies the use of a stochastic frontier model in the drive to improve productivity growth in the economy.

Table 6: Maximum Likelihood Estimates for Parameters of the Inefficiency Function

Variables	Parameter	Coefficient	Standard error	z-value	p-value
Inefficiency model	-	-	-	-	-
Constant	δ_0	103.333	-	-	0.0000**
HUMCAP	δ_1	-0.0000634	0.0090914	-0.0070	0.994436
EXCHR	δ_2	0.0013622	0.024066	0.0566	0.954861
ATPDW	δ_3	1.2442	0.026296	4.9497	0.00000***
RUELEC	δ_4	-0.27724	0.10185	-2.7221	0.006488**
ROINF	δ_5	-0.0051727	0.0030428	-1.7000	0.089136
SOGFIN	δ_6	-0.2841	0.07892	-3.6001	0.00032***
TROPEN	δ_7	-0.0074199	0.021784	-0.3406	0.733391
FINDEV	δ_8	-0.0046477	0.013741	-0.3382	0.735188
TECHDIFF	δ_9	0.0042151	0.0017129	2.4607	0.013865*
RINVEST	δ_{10}	0.74316	0.040640	18.2864	0.0000****

****** Significance above1%, ***Significance at 1%, **Significance at 5%, *Significance at 10%**

4.3 Role of Determinants of GDP Growth

The share contribution of TFP physical factors to output growth in the Cameroon economy for the period 1970-2015 is presented in Table 7. In order to better appreciate the magnitude of the contributions by the various factors, their share contributions (Table 7) are converted to percentage contributions (Table 8). It is observed in Table 7 that labour contributes 47% to GDP growth, more than capital, which makes a contribution of 22%, implying that a labour intensive method of production is appropriate to promote the growth of output in the economy. The results of this work are similar to that of Van der Eng (2007) on the Indonesian economy, which revealed that GDP growth in Indonesia was mostly promoted by factor accumulation (Labour and capital) relative to TFP, which instead made negative contributions. The results of this study are also in line with that of Amin (2002), even though he used the growth accounting technique for the Cameroon economy. Krugman (1994) explained that East Asia could not sustain their GDP growth in the face of diminishing returns to scale because their growth mainly depended on the mobilisation of inputs rather than on productivity improvements. These comments were based on the works of Kim and Lau (1994) and Young (1992, 1994).

The results indicate that labour and capital (68%) contributed more than TFP (-23%) to the growth of output from 1970 to 2015. Thus, factor accumulation represents the solid foundation to propel the growth of output in the economy. These imply that the economy has to mobilise huge financial resources in order to raise the growth rate of its output. This is, however, not an easy task to surmount due to enormous financial constraints. The negative and less significant contribution of TFP indicates that, even if the economy struggles to achieve a high growth rate of output through factor accumulation, it cannot sustain it in the long run. This directly implies that it is not easy for the economy to quickly reverse her poor performance and prevent mass suffering. The random factors have actively been contributing to reducing the growth of output in the economy, implying that the economy offers very little resilience to random shocks, and this can easily destabilise the entire growth process in the economy.

Table 7: Share Contributions of Labour, Capital, and TFP to GDP Growth in the Cameroon Economy, 1970-2015

Period	GDP growth	Share of labour	Share of capital	Share of labour and capital	Share of TFP	Share of RNDSH
1970-1979	6.7806	0.9889	3.1713	4.16020 (61.35%)	-1.779(26.24%	0.84 (12.41%)
1980-1989	3.5880	1.6841	0.4636	2.14767 (54.28%)	-1.6121(44.9%	-0.572 (-4.79%)
1990-1999	3.2632	1.7863	-0.0109	1.7972 (55.07%)	0.655(20.03%	-0.19 (24.86%)
2000-2009	3.9444	2.9062	0.96179	3.8679 (98.06%)	-0.071(1.93%	0.15 (0.01 %)
2010-2015	4.9706	2.1022	1.09145	3.19370 (64.25%)	-1.135(22.83%	-0.55 (-12.92%)
1970-2015	4.1094	2.0935	1.1354	3.2516 (67.718%)	-1.193(-23.2%)	-0.0644 (-9.08%)

Source: Authors, using information from Tables 3, 4, 5

4.4 Role of Random Shocks on GDP Growth

The share percentage of TFP physical factors to GDP growth in the Cameroon economy for the period 1970-2015 is presented in Table 8. The results in Table 8 (Column 7) show that the random factors have potential effects on output growth in the economy. During the period 1970-1979, they caused the growth of output to increase by 13%, similar to the role played by labour (15%). These results can be explained by a favourable external economic climate since the economy was not very open to the rest of the world, and the principal agricultural exports had very high external demand and high prices. During the following decade, from 1980-1989, the growth of output reduced by 5%. This could be due largely to the economic crises of 1986-1987. Another reason was that the exports were not very competitive due to low quality and productivity. Still, it is observed that in the post crisis period of 2010-2015, these shocks reduced GDP growth by 13%, and for the entire period of study, it reduced GDP growth at an annual rate of 9%. This indicates that the economy does not have the appropriate mechanism to produce resilience in order to insulate the economy from adverse internal and external shocks. Since these shocks are inevitable in any economic setting, the direct implication is that the growth process will constantly be destabilised.

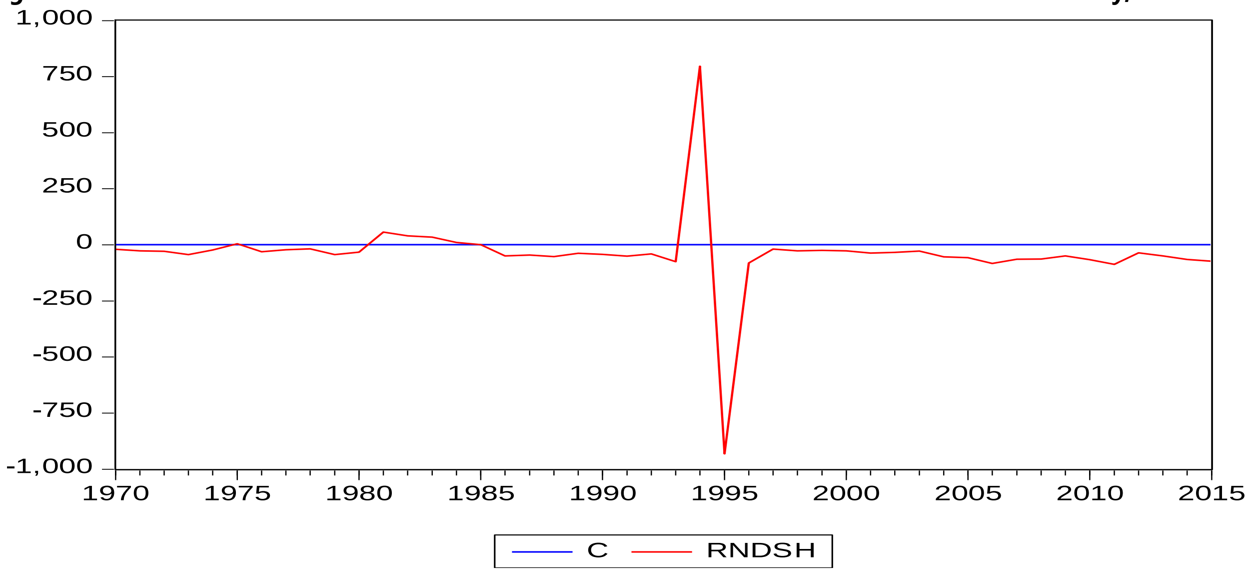
Table 8: Share Percentage of Labour, Capital, and TFP to GDP Growth in the Cameroon Economy, 1970-2015

Period	Output growth	Share percentage of labour (%)	Share percentage of capital (%)	Share percentage of labour and capital (%)	Share percentage of TFP (%)	Share percentage of RNDSH (%)
1970-1979	6.7806	14.58	46.93	61.35	-26.24	12.41
1980-1989	3.5880	46.94	12.92	59.86	-44.93	-4.79
1990-1999	1.2632	54.74	3.33	55.07	20.07	24.86
2000-2009	3.9444	73.68	24.38	98.06	-1.93	0.01
2010-2015	4.9706	42.29	21.96	64.25	-22.83	-12.92
1970-2015	4.1094	46.446	21.904	67.718	-23.2	-9.082

Source: Authors, using information from Table 7

Figure 1 describes the pattern of RNDSH in the Cameroon economy for the period 1970-2015. Its value is negative in most of the study period from 1970 to 1980. It is observed that throughout the study period, there is variability in the trend of random shocks. Its value is negative in most of the study period from 1970 to 1980. However, there was some positive improvement from 1980 to 1985, after which the negative trend continued up to 1993. There was a marked improvement in the positive contributions of the random factors up to 1995. This could be due to the economic reform programmes such as the Structural Adjustment Programme (SAP) put in place following the economic crisis of 1986 and the devaluation by 50% of the CFA franc currency in 1994. The measures helped to boost productivity and internal demand for home products. However, these measures were not sustainable because the positive effects lasted for a very brief period before the 2008 crisis, but in the post crisis period, the negative contribution of the random factors still resumed. One possible explanation for these negative performances is the absence of good policies to insulate the economy from these adverse shocks.

Figure 1: Evolution of the Contribution of Random Shocks to GDP Growth in the Cameroon Economy, 1970-2015



Source: Authors, using E-views Econometric Package

4.5 Empirical Justification of Results

Comparing the results of this study with those of previous studies on the Cameroon economy helps to reveal the importance and significance of this study. It also gives an empirical justification of the results of this study. The methodology and results of this study are compared with that of Amin (2002) in the same economy. The studies are similar in that output growth is mostly propelled by the accumulation of factor input than TFPG, which consistently contributed negatively to GDP growth in all the sub periods except in 1990-1999, where it made a positive contribution of 20% to GDP growth. Amin (2002) reported a contribution of 21% for the period 1987-1993. The positive contribution reported by these studies could be explained by the economic reform programmes, such as the Structural Adjustment Programme (SAP) that took place following the economic crisis of the mid-1980s.

In this study, labour contributed more than capital in all the sub periods except in the period 1970-1979, where capital contributed more than labour, whereas, in Amin (2002), capital contributed more than labour except in the sub periods 1970-1979 and 1980-1991, where labour contributed more than capital. The significant contribution made by capital relative to labour during the period 1970-1979 can be explained by the fact that the economy accumulated much capital stock for investments, and at that time, the quantity and quality of the labour force were still very low, hence the limited contribution of labour in GDP growth in the economy. The differences in the results of the two studies could be due partly to the differences in the sub periods considered as well as the methodology used. In Amin (2002), the growth accounting technique is used to determine the contributions of the various factors to output growth in the economy of Cameroon; meanwhile, in this study, the stochastic frontier analysis is used, making it possible for inefficiency issues to be considered as well as the effects of random factors.

5. Conclusion, Recommendations and Areas of Future Research

This study reveals that the presence of technical inefficiency in production greatly hinders GDP growth, especially under conditions of decreasing RTS. It also reveals that productivity growth and RNDSH produce less significant and negative impacts on GDP growth in the economy. Therefore, in order to achieve and sustain a high level of GDP growth in the Cameroon economy, the following recommendations can be advanced. One, deliberate efforts have to be made at the policy front to reduce the level of inefficiency in the production process, improve the management of productive resources, and ensure adequate training and development of the labour force. Two, significant efforts have to be put in place to increase the resilience of the economy to adverse internal and external shocks. Three, focus should be placed on labour intensive techniques of production so as to propel GDP growth.

This study covers the aggregate economy. It would be very important for this type of study to be conducted at the level of individual sectors of economic activities (Agriculture, industry and services) or different subsectors (Crop production in the agricultural sector, banking or education in the services sector). This will provide a very extensive line of research. It would also be interesting to investigate the relative role of demand and supply shocks to GDP growth in Cameroon. Abundant literature exists on investigating the various determinants of economic growth as well as the channels that an economy could take in order to increase its GDP growth. However, it may be interesting to predict the future rate of GDP growth given the actual or observed GDP growth rate to provide economic signals that can position the economy on fair and loyal competition with its trading partners. Other potential areas of exploitation on the subject matter addressed in this paper include the following. The relative role of the demand factors will constitute an interesting future line of research. Another important consideration concerns the RNDSH, such as climate change, ill health for the worker, the outbreak of diseases and pests, changing technological innovations that cause variation in the domestic demand structure, and sociopolitical unrest. This study captured all of these factors in a single variable and examined their joint effect on output growth in the Cameroon economy. A disaggregation can be obtained in order to carry out other studies on the individual factors.

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Declaration: The authors declare that this article entitled **Factor Accumulation, Total Factor Productivity and Random Shocks on Output Growth in Cameroon,** carried out at The University of Bamenda in Cameroon, is our original work and has never been considered for publication elsewhere.

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