

Decomposition of Total Factor Productivity Growth in Cameroon: A Policy Perspective

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Abstract

This paper attempts to estimate total factor productivity growth and identify its determinants in the Cameroon economy. The study uses annual data that span the period 1970-2015. The Battese and Coelli (1992) and Nishimizu and Page (1982) functions were used to estimate and decompose total factor productivity growth into its various factors using the stochastic frontier analysis based on the translog production function. The results show that the 1986-1994 period of the 1980s economic crisis remains the worst economic crisis period ever experienced by the Cameroon economy since 1970 as total factor productivity growth registered the lowest negative score compared to the 1973 oil crisis and the 2008 global financial and economic crisis. The study further reveals that allocative efficiency and technical efficiency are the major promoters of total factor productivity growth, while random shocks represent potential reducers of total factor productivity growth in the economy of the country. As a result, it is recommended that more efforts should be placed on human capital development and the expansion of modern technology endowed capital equipment in order to effectively manage productive resources and reduce inefficiency in the production process. Above all, there is the need to introduce structural reforms in the various sectors of the economy to ensure their growth and limit the severe variability of labour productivity between sectors so as to ensure the sustainability of any achieved level of total factor productivity growth in the long run.

Keywords: Determinants, Development, Efficiency, Production, Shock, Technology

1. Introduction

The Cameroon economy experienced a recession following the global financial and economic crisis of 2008. This resulted in disastrous internal and external disequilibrium that aggravated balance of payments deficit, internal and external debts, budget deficit, unemployment rates, decline in per capita income, and the widespread of poverty (African Development Bank [AfDB], 2015). Measures taken by the Government of Cameroon [GoC] to redress the economic condition of the economy yielded unsatisfactory results. For instance, the improvement of trade relations with foreign trading partners such as China, and western countries, has not only reduced the revenue sources of the country through taxation, but also provoked stiff competitive of foreign products against domestic goods and services. These narrowed the scale of operation of domestic industries, dropped industrial production, reduced income earned by workers and fuelled unemployment.

Ndjobo (2012) explains that between 2001 and 2010 the share of workers in the agricultural sector in Cameroon declined from 68% to 57%, while employment in the formal sector dropped from 21% to 19% with a significant increase in the number of unskilled workers' employment in the informal sector from 82% to 84% during the same period for workers in the 15 to 59 years age bracket in the country. Also, it is observed that despite the relatively short weekly working time of 39 hours per week in Cameroon compared to the threshold of 40 hours, a high rate of visible unemployment among employees can be observed, for workers commit at most 35 hours at workplace per week without reasonable excuses.

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This caused underemployment to jump from 76% in 2005 to 82% in 2010, and since then the rising pattern of this disguised unemployment has not been reversed. As regards the scale of operations of Cameroon industries, the efforts put in place produced stagnating results. In 2009, micro enterprises with less than 5 employees and a turnover of less than 15 million of the *Communauté Financière de l'Afrique* [CFA] Franc account for at least 75% of the total number of enterprises in the country, and only 25 industries have at least 1000 workers (World Bank, 2015:23). A similar pattern is observed in 2016 (*Institut National de la Statistique* [INS], 2018:15). These statistics portray a situation of a very difficult economic climate for productivity improvement. During the period 1973-1993, the contribution of total factor productivity [TFP] to real output growth to the economy decreased from 14% to 5% and between 2001 and 2011, the number of poor in the country augmented by 12% to 8 million people with a greater concentration in the northern regions.

To boost productivity in the economy, GoC increased the salary of public officials and the minimum guarantee interprofessional wage [MGIW] in the country. Within the same perspective, professionalism was emphasised in educational programmes to enhance the skills of the workforce and its capacity to absorb the flow of technology from major trading partners such as China, Canada, Italy and other African countries. These efforts seem to target the concern of how productivity growth occurs rather than that of why it occurs in the economy. Under this economic condition and with another crisis looming in the horizon, this paper envisages addressing a series of questions transformed into objectives to attain in order to give a better policy orientation on issues of productivity improvement in the Cameroon economy. Therefore, the main objective of this paper is to analyse the determinants of total factor productivity growth [GTFP] in the Cameroon economy. The specific objectives of the paper include:

- To estimate the rate of GTFP for the Cameroon economy.
- To understand the pattern of GTFP over time for the Cameroon economy.
- To decompose GTFP for the Cameroon economy.
- To investigate the role of random shocks [RNDSH] in GTFP in the Cameroon economy.
- To offer recommendations towards TFP enhancement for the Cameroon economy.

This study differs from previous studies in a number of ways. One, it investigates the role of RNDSH in GTFP in the Cameroon economy in order to enable policy makers understand the extent of vulnerability of the economy in the presence of adverse shocks. Two, while previous studies used the highly restrictive Cobb-Douglas production function with constant elasticity of substitution, this study employs a flexible translog frontier production function with variable elasticity of substitution. Three, in the process of TFP decomposition, this study segments the entire study period into sub periods to enable a better understanding of the dynamics of GTFP and its main determinants for the whole economy. Four, GTFP index is calculated as a division index to enable the analysis of the continuous effects of TFP change over time. Five, this study investigates the joint effects of RNDSH on productivity growth at the aggregate level given their residual nature.

Following the introduction in Section 1, the rest of the paper is organised as follows. The review of literature is done in Section 2. Section 3 focuses on the methodology used to address the objectives of the paper. Section 4 concentrates on data analysis and discussion of results, while Section 5 offers the conclusion, recommendations, and further areas of research on the subject matter addressed by the paper.

2. Literature Review

Several studies have been conducted on the relationship between GTFP and its various components across the globe. Focusing on the agricultural sector in Sri Lanka, Basnayake and Gunaratna (2002) identified the age of farmers, their occupation, and the level of education type of crop cultivated as potential drivers of technical efficiency [TE] in that economy. Shiu and Heshimati (2006) investigated the relationship between technical progress and GTFP for 30 Chinese provinces from 1993-2003 in a panel data study. The random effects model with heteroscedastic variance was applied in the study to estimate a translog production function. The results show that GTFP was positive for all the provinces during the entire study period mainly due to technological progress or technological change [TP].

It was also revealed that information and communication technology [ICT] and foreign direct investment [FDI] are mainly responsible for TFP differences in the regions in the country. Hence in the Chinese economy, there is a positive relationship between TP and GTFP, and growth in output is mainly promoted by factor accumulation instead of productivity growth. These results agree with prior expectations and the studies of Chow (1993) and Hu and Khan (1997) on that economy.

Amin (2017) examined the relationship between TE and GTFP for some 55 Indonesian food manufacturing industries for the period 2000-2006. The data envelopment analysis [DEA] developed by Farrell (1957) and popularised by Charnes *et al.* (1978) and the Malmquist productivity index [MPI] of Malmquist (1953) were used in the estimation process. The results show that TP caused productivity to increase by an annual average rate of 7%, while

TE reduces growth by 2% per annum. These indicate that TP has a positive relationship with GTFP, while TE is negatively related with GTFP in Indonesia. Therefore, TP is the main driver of GTFP in food manufacturing industries in the country.

Idris (2007) analysed GTFP and its determinants in Malaysia for the period 1971-2004. Changes in the production frontier was estimated using DEA (Farrell, 1957; Charnes *et al.*, 1978) approach, while MPI (Malmquist, 1953) was used to decompose GTFP into TP, technical efficiency change [TECH], scale efficiency change [SECH] and allocative efficiency [ALOECH]. The results of the study show that the economy is able to cause a shift in its frontier due to innovation. The presence of foreign companies, openness to trade, and the restructuring of the economy through a shift of resources between the sectors are the major promoters of GTFP in the economy. However, TP stood as the main source of productivity growth caused by increase in the number of skilled workers and the adoption of new technology.

Pires and Garcia (2012) used the stochastic frontier analysis to measure GTFP for a sample of 75 countries in the developed and the developing worlds over the period 1950-2000. The Bauer (1990) and Kumbhakar (2000) decomposition techniques were applied on the sample of interest to assess the effects of TP, SECH and TECH in those economies. The results show that differences in growth performance noticed among the countries were mainly due to productivity differences among them. This explains that TP, TE and ALOECH contribute significantly to GTFP in the countries with an annual average score ranging from 0.30% to 0.56%. The study also revealed that RNDSH caused an annual average increase of 1% in Australia, 2.3% in Ireland, 1.01% in Israel, 1% in South Korea and 1% in Chili on TFP, on one hand. On the other hand, RNDSH caused GTFP to shrink by 1.3% in Jamaica, 1% in Spain and 1.4% in Mexico. These statistics imply that RNDSH are potential promoters or reducers of growth in an economy.

Roy *et al.* (2017) used the stochastic frontier production approach to decompose GTFP in thirteen 2-digit manufacturing industries in West Bengal, India from 1981-2011. The results indicate that TP is the main source of GTFP in almost all the industries. In a similar vein, Singbo and Larue (2014) estimated the returns to scale [RTS] of dairy farms in Canada from 2001-2010 using the stochastic frontier analysis based on an input distance function. The results explain that ALOECH is the main source of GTFP in the dairy farms.

In Nigeria, Amaechi *et al.* (2014) identified for the palm oil produce mills industry that the level of education of farmers, processing experience, availability of credits, capital and water are factors that impact positively on TE. On the other hand, it was observed that the age of workers, interest on loans, and household size were negatively related to TECH. Still in the agricultural sector, Sebasia and Shumway (2014) identified that in the United States [US], increased innovation and improvement in human capital are potential sources of TP in the sector. Yet TE was promoted by farm size, and the ratio of family to total labour, while scale and mix efficiency was driven by agro climatic conditions, weather and farm size. These works drive to the fact that the potential determinants of each component depend on the sector and also on the economy under consideration, hence the significance of the scrutiny of the literature on the phenomenon under investigation.

3. Methodology

This section describes the scope and study area of the paper. It also explains the methods adopted and tools used to capture the specific objectives of the paper.

3.1. Scope and Study Area

This study spans the period 1970-2015. Three major global events that spread their multiplier effects on the economy of Cameroon influenced the choice of the period of review.

These are the 1973 oil crisis, mid 1980s economic crisis and 2008 global financial and economic crisis. This period enables to assess the severity of those crisis on GTFP, which is important for future policy interventions concerning productivity improvements.

This study is carried out in Cameroon. Cameroon is a sub Saharan central African country situated between latitude 2° and 12° North above the Equator and longitude 6° and 13° East of the Greenwich Meridian of the globe [Figure 1].

Cameroon shares boundaries with the Federal Republic of Nigeria on the West, Central African Republic on the East, Tchad on the North, and Congo, Gabon and Equatorial Guinea on the South. The country is governed by 10 administrative regions [Adamaoua, Centre, East, Far North, Littoral, North, Northwest, South, Southwest, and

West] spread over a total land mass of 475650Km² with a population estimated at 23799022 inhabitants in 2018 and a population growth rate of 2.37% per year. In 2018, the country’s gross domestic product [GDP] was estimated at US\$38.502 billion. Based on an annual population growth rate of 2.37% (PopulationData.net, 2019), the population of the country is expected to reach 24940484 inhabitants by December 2020.

Cameroon is mainly an agrarian economy. As of 2001, the agricultural sector employs 70% of the population compared to 13% for the industrial sector and 17% for the services sector (Central Intelligence Agency [CIA], 2020). Yet the informal sector of economic activities accounts for 90% of the total active population in the economy and contributes 20% to 30% in GDP of the country (Mbodiam, 2017).

Figure 1: Geographical Map of Cameroon



Source: PopulationData.net (2019). Cameroun. Retrieved February 07, 2020 from <https://www.populationdata.net/pays/cameroun/>

3.2. Data Sources, Variables and Tools of Analysis

The data used in this study are obtained from the World Bank (2017) World Development Indicators [WDI] database for the Cameroon economy on inefficiency variables, total economy regional aggregates database on output or GDP, labour and labour productivity for the period 1970-2015. The data for capital stock, exchange rate and the rate of replacement investment for the economy of Cameroon were sourced from Timmer *et al.* (2015). Compilations were also done based on Liao *et al.* (2002) to compute the values for output elasticities of labour and capital, shares of labour and capital in income, TP, RTS, TECH, SECH, and ALOECH. The Battese and Coelli (1992) and Nishimuzu and Page (1982) functions were used to estimate and decompose GTFP before establishing the series of GTFP components for the period of review. The Maximum Likelihood [ML] estimation technique (Fisher 1912, 1921, 1922a, 1922b) was also used to generate the estimated variables of the stochastic production function applied in analysis. Tables, percentages, graphs and E-views econometric package of data analysis were utilised to analyse and interpret data generated for the study.

3.3. Measurement Procedures

The methodology for measuring GTFP using the stochastic frontier analysis employs a stochastic production function following Battese and Coelli (1992). This function is given in (1).

$$Y_{it} = \exp(X_{it}\beta + V_{it} - U_{it}) \dots \dots \dots (1)$$

Y_{it} is the production or observed output quantity of the i th unit in year t . \exp is an exponential specification of the model. X_{it} represents the observed inputs quantities of the i th unit at time t . β corresponds to the vector of parameters to be estimated. V_{it} is the random variables or the error components of the i th unit at time t reflecting the effect of statistical noise, while U_{it} is a non negative random variable that captures time varying TE.

Following Coelli *et al.* (1998), TE_{it} of production for the i th unit or sector at time t can be expressed. This is given in (2).

$$TE_{it} = E[\exp(-U_{it}) \div (V_{it}U_{it})] \dots \dots \dots (2)$$

TECH_{it} for the production unit between two adjacent periods t and s is calculated as the ratio of TE_{it} at time t divided by TE_{is} at the time s. This is represented by (3).

$$TECH_{it} = TE_{it} \div TE_{is} \dots\dots\dots(3)$$

An index of TP_{it} for the producing unit between two adjacent periods t and s can also be calculated using the estimated parameters of the frontier production function. In this process, the partial derivatives of the production function with respect to times t and s are evaluated. The calculation is done through (4).

$$TP_{it} = \left[\left(1 + \frac{\partial f(X_{is}, s\beta)}{\partial s} \right) \right] * \left[\left(1 + \frac{\partial f(X_{it}, t\beta)}{\partial t} \right) \right]^{0.5} - 1 \dots\dots\dots(4)$$

To obtain an index for GTFP_{it} in the economy, the index of TECH_{it} is multiplied by the index of TP_{it}. This is represented in (5).

$$GTFP_{it} = (TECH_{it}) * (TP_{it}) \dots\dots\dots(5)$$

Based on the frontier analysis requirements, the first derivative of the production function in (1) with respect to time t is regarded as TP_{it}. This is represented in (6).

$$GTFP_{it} = TP_{it} - \frac{dU_{it}}{dt} \dots\dots\dots(6)$$

Consequently, TP_{it} equation can be written mathematically. This is expressed in (7).

$$TP_{it} = \beta_t + \beta_{iL} (\ln L_i) + \beta_{iK} (\ln K_i) + \beta_{it} t \dots\dots\dots(7)$$

β_t represents the constants. β_{iL}, β_{iK}, β_{it} are the coefficients for labour, capital and time, respectively. lnL_i and lnK_i are the natural logarithm of the variables labour and capital, correspondingly. t represents an index for time, while $\frac{dU_{it}}{dt}$ is the change in the inefficiency variables with time.

On one hand, it necessary to recall that the coefficients of the parameters in (7) are obtained based on the results of ML estimation of the stochastic production function found in Appendix A. When the values are slotted into (7) for the different years, a series of TP_{it} is obtained for the whole period of review. On the other hand, the values of the inefficiency function variables are obtained in Appendix B. The respective values are added for each year throughout the study period to establish a series of TECH_{it} variable. The algebraic manipulations are conducted to obtain the growth rates of the variable over time. At the end of the process, the requirements specified in (6) are applied to obtain the series of GTFP_{it} rate of the economy for the study period.

The methodology for decomposing GTFP into its various components starts with the use of a stochastic production function proposed by Nishimuzu and Page (1982). This is given in (8).

$$Y_{it} = f(X_{it}, t) e^{(-U_{it} + V_{it})} \dots\dots\dots(8)$$

Taking the natural log of (8), the functional relationship of the equation becomes linear. This is expressed in (9).

$$\ln Y_{it} = \ln f(X_{it}, t) - U_{it} + V_{it} \dots\dots\dots(9)$$

A total differentiation of (9) with respect to time t offers the possibility to arrive at the various components of GTFP. This is mathematically done through (10).

$$\frac{d \ln Y_{it}}{dt} = \frac{\partial \ln f(X_{it}, t)}{\partial t} + \left[\sum_j \frac{\partial \ln f(X_{it}, t)}{\partial X_{jt}} \left(\frac{dX_{jt}}{dt} \right) \right] - \left(\frac{dU_{it}}{dt} \right) + \left(\frac{dV_{it}}{dt} \right) \dots\dots\dots(10)$$

Differentiating the stochastic frontier function with respect to time t gives TP which is represented by the first term on the right hand side of (10). When the stochastic frontier function is differentiated with respect to the individual variables [X_{jit}] concerned, the elasticity of production for the ith input is obtained. This is represented by the second term on the right hand side of (10).

Accordingly, the elasticity of production for labour in a firm at time t can be expressed as $\frac{\partial \ln f(X_{it}, t)}{\partial \ln L_{it}}$, while

the elasticity of production for capital in that firm can be expressed as $\frac{\partial \ln f(X_{it}, t)}{\partial \ln K_{it}}$. Therefore, the elasticity of

production of the function can be represented by E_{ji} . The third term on the right hand of (10) represents TECH which captures the change in the distance between the actual output level [AOL] and the potential output level [POL] at the frontier. A TECH value preceded by a positive sign explains that the distance between AOL and POL is increasing over time, thus describing a situation of inefficiency in the firm. A TECH value preceded by a negative sign shows that the distance between AOL and POL is decreasing over time, thus describing a situation of increasing efficiency or decreasing inefficiency in the firm. The fourth term of (10) captures the change in the random variables over time. When TP and elasticity of production expressions are substituted into (10), the function becomes (11).

$$\frac{d \ln Y_{it}}{dt} = TP + \left[\sum_j E_{ji} \left(\frac{dX_{it}}{dt} \right) \right] - \left(\frac{dU_{it}}{dt} \right) + \left(\frac{dV_{it}}{dt} \right) \dots \dots \dots (11)$$

Representing the rate in output $\frac{d \ln Y_{it}}{dt}$ by \bar{Y}_{it} the function in (11) transforms. Thus, it becomes (12), where

$\sum_j E_{ji}$ represents RTS in the production process.

$$\bar{Y}_{it} = TP + \left[\sum_j E_{ji} \left(\frac{dX_{it}}{dt} \right) \right] - \left(\frac{dU_{it}}{dt} \right) + \left(\frac{dV_{it}}{dt} \right) \dots \dots \dots (12)$$

Conceptually, GTFP can be defined as the contribution to output growth not explained by physical inputs of the production process. This is presented in (13), where S_j represents the share of input j in production costs.

$$GTFP = \bar{Y}_{it} - \left[\sum_j S_j \left(\frac{dX_{it}}{dt} \right) \right] \dots \dots \dots (13)$$

When (12) is substituted into (13), GTFP transforms into (14). Yet it is necessary to recall that

$\lambda_j = \frac{E_{ji}}{\sum_j E_{ji}}$ (Ratio of elasticity of production to RTS) corresponds to the share of inputs in income.

$$GTFP = TP + \left[\sum_j E_{ji} \left(\frac{dX_{it}}{dt} \right) \right] - \left(\frac{dU_{it}}{dt} \right) + \left(\frac{dV_{it}}{dt} \right) - \left[\sum_j S_j \frac{dX_{it}}{dt} \right] \dots \dots \dots (14)$$

Substituting the input share and RTS into (14) and rearranging it, the equation metamorphoses. It then becomes (15), which is the model proposed by Nishimuzu and Page (1982) to decompose GTFP.

$$GTFP = TP - \left(\frac{dU_{it}}{dt} \right) + \left\{ (RTS - 1) \left[\sum_j \lambda_j \left(\frac{dX_{it}}{dt} \right) \right] \right\} + \left\{ \sum_j \left(\lambda_j - S_j \left(\frac{dX_{it}}{dt} \right) \right) \right\} + \left(\frac{dV_{it}}{dt} \right) \dots \dots \dots (15)$$

When the growth rates of the various factor inputs (L and K) are incorporated into (15), the equation yields a decomposed function into the various components of GTFP. This is displayed in (16).

$$GTFP = TP - \left(\frac{dU_{it}}{dt} \right) + \left\{ (RTS - 1) \left[\lambda_L \frac{\bar{L}}{L} + \lambda_K \frac{\bar{K}}{K} \right] \right\} + \left\{ \sum_j \left(\lambda_j - S_j \left[\lambda_L \frac{\bar{L}}{L} + \lambda_K \frac{\bar{K}}{K} \right] \right) \right\} + \left(\frac{dV_{it}}{dt} \right) \dots \dots \dots (16), \text{ where } \bar{L} \text{ and } \bar{K}$$

stand for the growth rate of labour and capital, respectively.

The various decomposed components of GTFP in (16) are as follows. TP is represented by the first term on the right hand side of the equation. The second term on the right hand side of the equation represents TECH. The third term on the right hand side of the equation captures SECH, while the fourth term on the right hand side of the equation accounts for ALOECH.

Once these values are obtained, those of the determinants of TFP can be computed following the main equation for decomposition. Then, a series for each of the component factors or determinants for the period 1970-2015 can be established to discern the respective role played by each factor to GTFP in the economy. Studies that followed the approaches of Battese and Coelli (1992) to estimate GTFP and Nishimizu and Page (1982) to decompose GTFP include Sebas and Shumway (2014), O'Dennell (2012), Jin *et al.* (2010), Kousmanen and Sipiläinen (2009), Idris (2007), Limam and Miller (2004), and Färe *et al.* (1994).

The methodology for determining the role of RNDSH on GTFP follows the method used by Pires and Garcia (2012) where RNDSH are calculated as a residual in which the contributions made by the various components to GTFP are subtracted from GTFP. This is explained through (17) and (18).

$$GTFP = TP + TECH + ALOECH + SECH + RNDSH \dots \dots \dots (17)$$

$$RNDSH = GTFP - TP - TECH - ALOECH - SECH \dots \dots \dots (18)$$

The values of the variables in (18) are then computed to determine the value associated with RNDSH variable at every time *t*. A similar exercise is done for the study period to obtain the series of RNDSH behaviour over time.

4. Data Analysis and Discussion of Results

This section focuses on the results obtained from the various investigations in line with the slated specific objectives to attain. The results obtained from the investigation are analysed and discussed with respect to each specific objective, captured under separate subheadings. Yet it necessary to mention that negative signs are deliberately omitted from all discussions reporting the findings of this investigation so as to avoid a cumbersome presentation of the results in the main text of the study.

4.1. Estimation of GTFP Index for the Cameroon Economy

Table 1 presents the estimates of TP, TECH, and GTFP index for the Cameroon economy for the period 1970-2015. Given the objective pursued in this sub section, specific attention is directed to the fourth column of the table where GTFP index is captured. Over the period of study, it is observed that GTFP assumes a fluctuating pattern of downs and ups with the lowest and highest values at 12.78 in 1994 and 16.16 in 1978, correspondingly. A horizontal summation of GTFP index across the period of review translates to a positive value of 2.097 despite the fact that 59% [27 years out of 46 years] of the period of review is negatively affected compared to 41% [19 years out of 46 years] of the period of review that is positively affected. The following reasons could justify the observed fluctuating pattern of GTFP in the country's economy. One, although TE performs poorly on the average for the whole study period, in some sub periods, it contributes very positively to GTFP in the economy. Between 1986 and 1994, TE made a very positive contribution towards GTFP which was neutralised by the negative contribution of TP, thus resulting in an overall negative values for GTFP index over that same period. Two, it is important to note that some of the economic reforms instituted by GoC after the 1986 economic crisis yielded very positive results between 2002 and 2005. This good performance was, however, short lived with the advent of the global financial and economic crisis of 2008. Three, the positive trend of GTFP after the 2008 global financial and economic crisis, that is, from 2011 to 2015 was mostly caused by ALOECH rather than factors such as TP and TECH.

Table 1: Estimate of TP, TECH and GTFP Index for the Cameroon Economy, 1970-2015

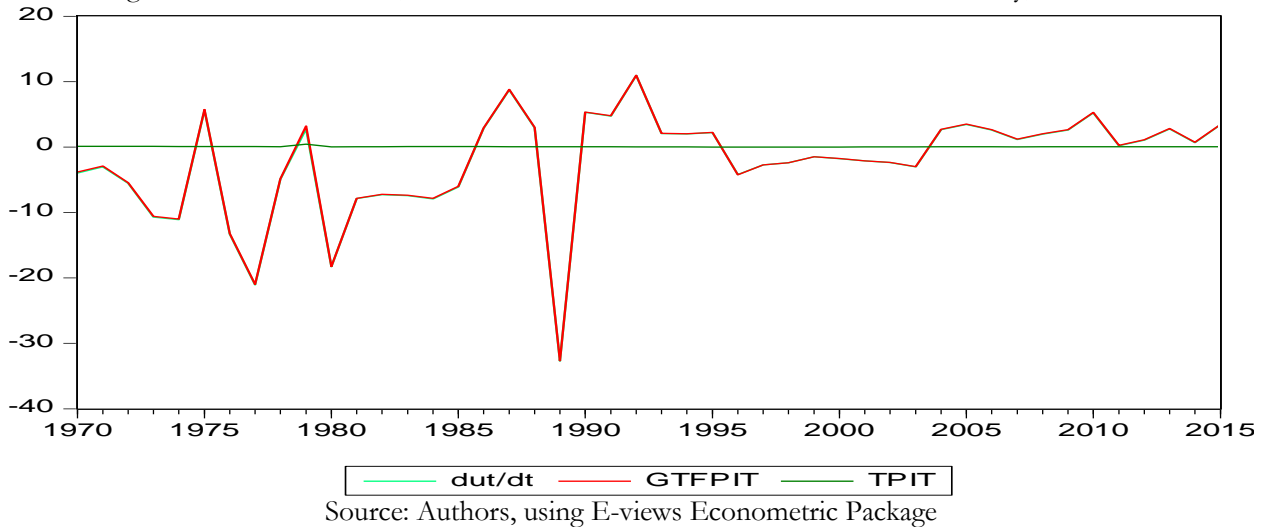
Year	TP	TECH	GTFP Index
1970	-0.87413	-0.87413	2.394158
1971	-0.87562	-3.66227	2.786646
1972	-0.87739	-4.17663	3.299246
1973	-0.87938	1.582139	-2.46152
1974	-0.88027	-8.52631	7.646043
1975	-0.87959	-12.9533	12.07372
1976	-0.87991	6.395863	-7.27577
1977	-0.88308	-7.41952	6.536439
1978	-0.88719	-17.0483	16.16114
1979	-0.88924	-1.17548	0.28624
1980	-0.88558	2.470116	-3.3557
1981	-0.87882	-16.8833	16.00449
1982	-0.87295	-15.7657	14.89278
1983	-0.86814	-11.4933	10.62513
1984	-0.86524	-6.79356	5.928323
1985	-0.86465	-3.19441	2.32976
1986	-0.86552	9.9348	-10.8003
1987	-0.866	9.446861	-10.3129
1988	-0.8664	10.51642	-11.3828
1989	-0.86716	3.159947	-4.02711
1990	-0.86758	1.378344	-2.24592
1991	-0.86702	7.983202	-8.85022
1992	-0.86741	3.322123	-4.18954
1993	-1.29396	7.317218	-8.61117
1994	-1.29	11.49251	-12.7825
1995	-0.87498	-9.07545	8.200471
1996	-0.87526	0.644009	-1.51927
1997	-0.87048	0.379348	-1.24982
1998	-0.86717	1.182544	-2.04972
1999	-0.86455	-0.04338	-0.82117
2000	-0.86077	0.657262	-1.51804
2001	-0.85406	0.105706	-0.95976
2002	-0.84721	-0.65002	-0.19719
2003	-0.84141	-1.99325	1.151846
2004	-0.83604	1.814834	-2.65087
2005	-0.83174	-1.53607	0.704325
2006	-0.8333	-0.02003	-0.81326
2007	-0.83166	1.979948	-2.8116
2008	-0.82353	1.498901	-2.32244
2009	-0.81881	0.773496	-1.59231
2010	-0.81655	2.306087	-3.12264
2011	-0.81545	0.551193	-1.36664
2012	-0.81452	-2.17802	1.363502
2013	-0.8146	-1.00516	0.190561
2014	-0.39735	-0.68862	0.291276
2015	0.400781	0.400781	-1.47921
1970-2015	-38.680889	-39.86258	2.096706

Source: Authors, using Results of Maximum Likelihood Estimation

4.2. Evolution of GTFP over Time for the Cameroon Economy

The evolution of the estimated GTFP index for the Cameroon economy for the period 1970-2015 is portrayed in Figure 2. It is observed that throughout the study period, there is a very high variability in the trend of GTFP. Its value is negative in most of the study period, that is, from 1990 to 1995 with occasional increases in 1975, 1978, and 1987. From 2004 to 2015, the growth of productivity revolved around an average value of zero. The highest positive growth in productivity was witnessed in 1987 and 1994 with a growth rate of about 10%. This was largely due to the structural adjustment programme [SAP] put in place following the economic crisis of 1986 and the devaluation by 50% of CFA Franc currency in 1994 that helped in boosting productivity following the increase in the demand for home products. The economy suffered a serious decline in GTFP in the order of 20% in 1977, 18% in 1980, and 30% in 1988. However over the period 1996-2005, there was a slight decrease of less than 5%, which improved to less than 2% over the period 2005-2011 and by 2014 the index was close to zero [0.09%]. The declining trend reversed upwards in 2015. Two main reasons explain this erratic behaviour of GTFP over time: (i) the absence of good policies to sustain high levels of productivity growth, and (ii) the effects of adverse external shocks that spread into the domestic economy due to its high degree of openness. The direct consequence of these shortfalls is that the economy will not be able to sustain its growth process if deliberate efforts are not put in place to boost productivity and internal mechanisms implemented to increase the level of resilience to external shocks

Figure 2: Evolution of TP, TECH and GTFP Index for the Cameroon Economy, 1970-2015



4.3. Decomposition of GTFP for the Cameroon Economy

Table 2 displays GTFP decomposition for the Cameroon economy for the period 1970-2015. The contributions of the various GTFP determinants are converted into percentage terms to enable a better appreciation of the magnitude of their influence on the annual average GTFP in the economy. Table 2 shows that the annual average rate of GTFP was 1.31255% [Column 2, Row 7] for the period of review. This explains that productivity growth has mainly been negative for the period. Based on sub periods observations, it is observed that the same negative trend persists all through, except for the period 1990-1999 where GTFP was positive. The positive performance of GTFP achieved between 1990 and 1999 could be associated with the implementation of structural reform programmes such as the devaluation by 50% of CFA Franc currency in 1994 and production enhancement policy in the economy. Furthermore, it is noticed that the positive growth in TFP during that sub period emanated mostly from the performances of TECH and ALOECH, with the later playing a lead role.

Table 2: GTFP Decomposition for the Cameroon Economy: Share Contribution of Determinants, 1970-2015

Period	GTFP (%)	TP	TECH	SECH	ALOECH	RNDSH
1970-1979	-1.77934	-0.01063	-0.45527	-0.64254	0.651919	-1.32
1980-1989	-2.61212	-0.01187	-1.00204	-0.34344	0.62746	-1.88
1990-1999	1.6548	-0.2598	0.352084	-0.55663	0.4795	0.6396
2000-2009	-2.5908	0.00298	0.60175	-0.8903	1.103912	-1.773
2010-2015	-1.2353	0.0063	0.61039	-0.36289	0.268172	-0.7134
1970-2015	-1.31255	-0.0546	0.02138	-0.55916	0.62619	-1.00936

Source: Authors, using Information from Maximum Likelihood Estimation Results in Table 1

Table 3 shows that, in the period 1970-1979, the greatest contribution is done by ALOECH with a positive contribution of 37%. TP reduced GTFP by 1% only, TECH reduced GTFP by 26%, while SECH reduced it by 36%. In that period, the greatest hindrance to GTFP is caused by RNDSH which caused a decrease of 74.2%. In the post crisis period from 2010-2015, a slightly different picture was observed due TECH highest contribution of 49.41%, followed by ALOECH performance of 22% against TP positive contribution of only 0.5%.

Over that sub period, RNDSH contributed negatively to the turn of 58%, while SECH reduced GTFP by 29.4% by the end of 2015. Over the whole period of review, RNDSH with a negative contribution of 49.6% are rated the greatest reducers of GTFP.

Generally for the period 1970-2015, GTFP was greatly stimulated by ALOECH which made an average contribution of 32.22%, followed by TECH with an average contribution of 10.15%. TP, SECH and RNDSH all contributed negatively to GTFP in the order of 3.26%, 30.112% and 49.6%, respectively. This implies that, the reallocation of workers between and within the sectors and increasing TE in production processes constitute solid grounds to consolidate in order to promote GTFP in the economy. The economy has to make substantial efforts to increase the level of investments in order to enhance the level of innovations in the country. Other challenges to overcome include the encouragement of small and medium size enterprises [SMSEs] development accompanied with increased vigilance in the supervision and control of work processes. By taking the role of RNDSH in GTFP into account, it can be deduced here that the Cameroon economy offers very little resilience to external shocks. Consequently, the process of GTFP and output expansion for the economy of the country can be destabilised easily without prior notice at any time.

With respect to the effects of the different crisis on GTFP, this study shows that the oil crisis of 1973 and 1979 caused the annual GTFP of the country to decline by about 2% between 1970 and 1979. In the decade 1980-1989, the 1985-1986 economic crisis caused the annual GTFP to shrink by about 3%. This negative performance was mainly due to lack of TP or insufficient investments in the economy, lack of efficiency in the production process, limited size of skilled workers and managerial staff, and RNDSH in the economy. Sum up, it can be inferred that the efforts put in place by GoC and other stakeholders to improve productivity in the economy yielded very limited positive results.

The global financial and economic crisis of 2008 caused a decline in GTFP by 2.6% on the average for the period 2000-2009 which is very similar to that of the 1986-1987 crisis. This, however, was mainly caused by the scale effect and RNDSH which persistently contributed negatively at the rate of 68.43% to GTFP of the country. A careful observation of GoC and stakeholders' behaviour before the 2008 crisis demonstrates that GoC and stakeholders learnt from previous crises and made significant efforts towards TP improvement, inefficiency abatement, and effective allocation of productive resources in the economy. This implies that more deliberate efforts are needed to minimise the effects of RNDSH in the economy.

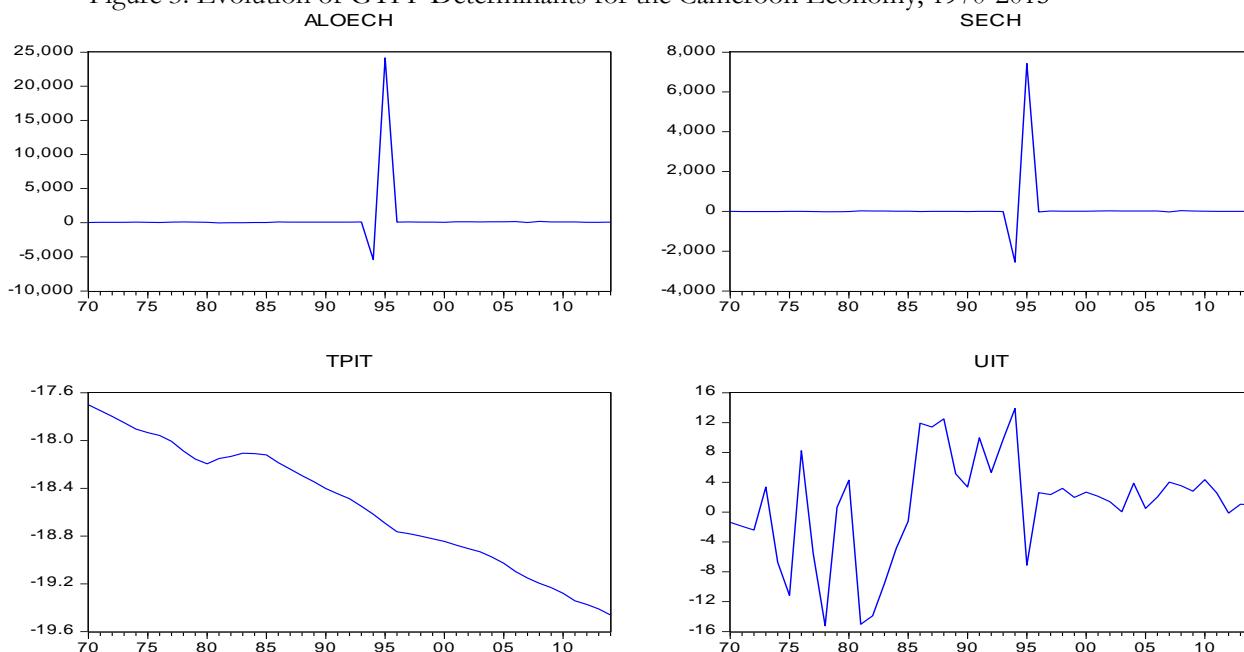
Table 3: GTFP Decomposition for the Cameroon Economy: Percentage Contribution of Determinants, 1970-2015

Period	GTFP (%)	TP (%)	TECH (%)	SECH (%)	ALOECH (%)	RNDSH (%)
1970-1979	-1.77934	-0.60	-25.59	-36.11	36.64	-74.18
1980-1989	-2.61212	-0.59	-49.80	-17.07	31.18	-71.97
1990-1999	1.6548	-15.70	21.28	-33.64	28.98	24.49
2000-2009	-2.5908	0.12	23.22	-34.36	42.61	-68.43
2010-2015	-1.2353	0.49	49.41	-29.38	21.71	-57.73
1970-2015	-1.31255	-3.256	10.1488	-30.112	32.224	-49.564

Source: Authors, using Information from Table 1

Figure 3 shows the evolution of TFP components over time from 1970-2015. It is observed that ALOECH [First box at top left hand side of Figure 3] and SECH [Second box at top right hand side of Figure 3] assume similar trends over time for the period of review. On the average, ALOECH and SECH played little role in productivity growth in the economy except during the period 1995-1996 where they made a significant positive contribution. TP [Third box at bottom left hand side of Figure 3] continuously trends downwards, while the trend for TECH [Fourth box at bottom right hand side of Figure 3] is very erratic from 1970-2015. The following reasons can be advanced to explain the erratic behaviour of TFP components over time in the country’s economy. Firstly, the absence of independently holistic developmental policies that can enhance productivity growth in the country, obstinate dependence on most industrialised countries [MICs]’ foreign development aids and assistance, partial attention on the development of human capital as well as the non implementation of measures to reduce inefficiency in production in the economy.

Figure 3: Evolution of GTFP Determinants for the Cameroon Economy, 1970-2015



Source: Authors, using E-views Econometric Package

4.4. Role of RNDSH in GTFP in the Cameroon Economy

Table 4 describes the role RNDSH play in GTFP in the Cameroon economy for the period 1970-2015. The results show that RNDSH are potential reducers of GTFP even though more attention has often been placed on the other determinants such as TP, ALOECH, SECH and TECH. From the table, it is observed that RNDSH [Column 7] played a significant negative role on GTFP than all other determinants in the economy for the period under review. From 1970-1989, RNDSH retarded productivity growth by about 74% [$-79.18 -71.97 = -146.15 \div 2 = -73.75 \approx -74$] on the average. Although RNDSH contributed very positively to productivity growth to the turn of 24.5% between 1990 and 1999, the negative trend of their contribution to productivity growth still continued in the following decades up to 2015 with an average score of 64% [$-68.43 -57.73 = -126.16 \div 2 = -63.8 \approx -64$]. Since RNDSH represent unexpected internal and external surprises that hit an economy, the productivity growth process for the Cameroon economy will be constantly destabilised given the pattern observed in Table 4, unless deliberate efforts are put in place to minimise their effects on the economy of the country. For instance, the devaluation of CFA Franc currency in 1994 triggered a very high external demand for Cameroon's products. This positive shock caused GTFP to increase but the observed trend was negatively obstructed due to lack of sustainable policies on productivity improvement issues.

Table 4: Percentage Contribution of RNDSH to GTFP in the Cameroon Economy, 1970-2015

Period	GTFP (%)	TP (%)	TECH (%)	SECH (%)	ALOECH (%)	RNDSH (%)
1970-1979	-1.77934	-0.60	-25.59	-36.11	36.64	-74.18
1980-1989	-2.61212	-0.59	-49.80	-17.07	31.18	-71.97
1990-1999	1.6548	-15.70	21.28	-33.64	28.98	24.49
2000-2009	-2.5908	0.12	23.22	-34.36	42.61	-68.43
2010-2015	-1.2353	0.49	49.41	-29.38	21.71	-57.73
1970-2015	-1.31255	-3.256	10.1488	-30.112	32.224	-49.564

Source: Authors, using Information from Table 1

4.5. Synthesis and Comparison of Findings

Similarities and differences can be underlined between this study and previous ones on the subject matter under discussion. These are elucidated in the following paragraphs.

In terms of similarities, it is observed that the same set of factors affect GTFP in world economies. The reallocation of workers from less productive to more productive sectors [ALOECH] as well as efficiency gains [TE] are identified as the major promoters of GTFP in economies where the level of TP is very low and the effects of RNDSH are recurrent. One fascinating finding on the subject matter investigated is the weight RNDSH exert on GTFP in economies of the world. RNDSH reduce GTFP by about 50% in the Cameroon economy in the present case, while in Pires and Garcia (2012) they shrink GTFP by 367% in Mexico, 128% in Jordan, roughly 5% in US and 53% in Japan, respectively despite the positive growth rates contribution registered with other TFP determinants in the case of Japan and US. This suggests that the openness of these economies to foreign trade is instead negatively impacting on GTFP, hence the necessity of serious checks and balances on trade offers and traded goods in these economies. As a result, these economies have to make substantial investments in their productive resources to mitigate the negative productivity growth challenges registered in their economies. Conversely, the differences in TP, the rate of technology diffusion, Research and Development [R & D] efforts and the rate of innovation play a significant role in giving a competitive trade advantage to a country over another. This is in line with Romer (1990), Aghion and Howitt (1992) who explained that the presence of subsidies on R & D and the abundance of skilled labour diminish the marginal cost of conducting R & D which helps to increase the rate of development in innovation and TFP.

As regards the differences between this study and other studies, these are quite evident. One, the study of Pires and Garcia (2012) spans the period 1950-2000, while this study covers the period 1970-2015. The 1950s to 1970s characterised periods of heavy protectionism of domestic industries in MICs, which withheld technology

diffusion into economies, especially towards less industrialised or developing countries [LICs]. This justifies the low levels of TECH of 10.15% recorded in Cameroon over the period 1970-2015 for this study compared to 6.04% and 6.12% registered in MICs such as US and Canada, correspondingly over the period 1950-2000 in Pires and Garcia (2012) where interest was placed on how GTFP occurs with very little attention given to the evolution of its components over time as done in this study to provide insightful information about the dynamics of GTFP in an economy and possible directions for policy intervention. Two, economic theory explains that TECH and economies of scale [EOS] are strongly related. This study offers empirical justifications that are in consonance with O'Donnell (2012) who explained that TP is directly related to SECH and whenever a country experiences a very low and insignificant improvement in TP coupled with low levels of efficiency, EOS will also suffer and vice versa.

5. Conclusion, Recommendations, and Further Areas of Research

This paper mainly focuses on GTFP index and its decomposition for the Cameroon economy over a period of 46 years, that is, from 1970 to 2015. It upholds that inefficiencies and the presence of adverse internal and external shocks in the production process are highly responsible for the decline in productivity and even the growth of output in the economy of the country. Having witnessed across time the 1973 oil crisis, mid 1980s economic crisis and 2008 global financial and economic that affected the economic performance of the Cameroon economy differently at varied degrees, it is evidenced that the 1980s [1986-1994] economic crisis remains the worst economic crisis ever experienced by the Cameroon economy since 1970 as GTFP registered the lowest negative score of roughly 3% compared to the 1973 oil crisis and the 2008 global financial and economic crisis.

Based on the findings of the study, the following recommendations are advanced. One, there is the need for GoC to put more efforts on GTFP increase by efficiently allocating the country's limited productive resources and reducing inefficiency in production in the economy. Besides, substantial efforts should be made to diversify exports of the economy so as to check and balance the openness of the economy for reciprocal gains with the rest of the world and limit the vulnerability of the economy to undue external shocks. Two, it is necessary for GoC to place more efforts on human capital development and the expansion of modern technology endowed capital equipment in order to effectively manage productive resources and reduce inefficiency in the production process. Three, structural reforms such as increase in the remuneration of workers to boost internal demand, creation of favourable conditions to increase the capacity to absorb technological knowhow for better innovations should be introduced in the various sectors of the economy to ensure their growth and limit the variability of labour productivity between sectors so to sustain any achieved level of GTFP in the long run. Four, more efforts should be made to improve the performance of factors such as SECH and TECH that are currently affecting GTFP negatively through improvement in production process management, introduction of good organisational changes and marketing practices adopted to the needs of domestic enterprises. Five, a shift in paradigm from the traditional low value added and low wage production activities to high value added and higher wages production structures with updated technology should be embraced to enable domestic firms to produce medium to high technology competitive products. This necessitates an immediate need for high level entrepreneurship, education, training, and more involvement in R & D in the economy.

Given the emphasis of this study on the whole economy of Cameroon, it is obvious that its analysis and discussions were based on aggregate data and variables. Yet it is possible to conduct a similar study on each of the three sectors of economic activities [Agriculture, industry and services] or on any subsector of the economy of the country. In this case, the efficiency variables and the variables that make up the various components will be specific to the sector or subsector(s) concerned. A further line of research can focus on examining the relative role of individual components of GTFP and that of RNDSH in the different sectors of the Cameroon economy. Also, the effects of individual RNDSH on GTFP in the Cameroon economy may be investigated in another study.

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Appendices

Appendix A: 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****
Variance Parameters					
Gamma	γ	0.99942	0.0058876	169.7498	0.00000****
Sigma(σ ²)	(σ ²)	0.00027635	0.00003	9.7429	0.00000****
Sigma.sq.U	σ ² (U)	0.0008	0.0003	3.278064	0.00000****
Sigma.sq.V	σ ² (V)	0.000012913	0.0001359	0.09019	0.9243
Sigma	σ	0.0042151	0.0017129	2.4607	0.013865*
Sigma.U	σ (U)	0.0285182	0.00043152	6.556178	0.00000****
Sigma.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	0.01848	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 above 1%, *** Significance at 1%, ** Significance at 5%, * Significance at 10%

Appendix B: 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
EXCHRATE	δ_2	0.0013622	0.024066	0.0566	0.954861
ATPDW	δ_3	1.2442	0.026296	4.9497	0.00000***
EXRUELEC	δ_4	-0.27724	0.10185	-2.7221	0.006488**
ROINFLT	δ_5	-0.0051727	0.0030428	-1.7000	0.089136
SOGAFIN	δ_6	-0.2841	0.07892	-3.6001	0.00032***
TRAOPEN	δ_7	-0.0074199	0.021784	-0.3406	0.733391
FINDEV	δ_8	-0.0046477	0.013741	-0.3382	0.735188
RTECHDIFF	δ_9	0.0042151	0.0017129	2.4607	0.013865*
REINVEST	δ_{10}	0.74316	0.040640	18.2864	0.0000****
		Variance Parameters			
Gamma	γ	0.99942	0.0058876	169.7498	0.00000****
Sigma(σ^2)	(σ^2)	0.00027635	0.00003	9.7429	0.00000****
Sigma.sq.U	$\sigma^2(U)$	0.0008	0.0003	3.278064	0.00000****
Sigma.sq.V	$\sigma^2(V)$	0.000012913	0.0001359	0.09019	0.9243
Sigma	σ	0.0042151	0.0017129	2.4607	0.013865*
Sigma.U	$\sigma(U)$	0.0285182	0.00043152	6.556178	0.00000****
Sigma.V	$\sigma(V)$	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 above 1%, *** Significance at 1%, ** Significance at 5%, * Significance at 10%