SSRG International Journal of Economics and Management Studies
ISSN: 2393 – 9125 / https://doi.org/10.14445/23939125/IJEMS-V7I9P104

Volume 7 Issue 9, 32-40, September 2020

Original Article

Research and Development (R & D) and the Performance of Entreprises in Cameroon

Mathurin Patrick Mboe Bobo[1,] Moses A. Ofeh[2], Célestin Chameni Nembua[3]

[1,3] *University of Yaoundé II-Soa, Cameroon*
[2] *Higher Teacher Training College Bambili, University of Bamenda, Cameroon, Post Box 39 Bambili, Cameroon*

Received Date: 27 July 2020
Revised Date: 07 September 2020
Accepted Date: 14 September 2020

Abstract *- This article analyses the influence of R&D on the performance of enterprises in Cameroon. The influence is measured by added value and the returns of assets. The study is carried out using a sample of 40 enterprises that had made fiscal and statistical declarations at the National Institute of Statistics from 2008 to 2012, an extract of the survey of the Research Centre for International Development (RCID) carried out on the determinants of the performance of enterprises in sub-Saharian Africa in 2014. The results obtained by the quantile regression estimation show that in Cameroon, research and development (R&D), even though it is carried out only by 20% of the sample of enterprises, however, have positively and significantly influenced their performances (measured either by added value or by returns on assets).*

Keywords *- R&D, return of assets, added value, quantile regression, Cameroon.*

Classification JEL: *C21, D21, L12, O32.*

I. INTRODUCTION

According to the fundamental hypothesis of Bertrand's paradox, price is the only variable of interest to consumers as enterprises produce homogenous goods. In this case, no enterprise can fix a price above marginal cost without losing its share of the total market [26]. However, in practice, goods are differentiated, allowing producers to maintain their products' prices above marginal costs. In this regard, and contrary to the Harvard School, the famous Chicago School asserts the competitive structure due to the efficiency of best enterprises that obtain a temporal monopoly position results due to the innovation of operations. In this framework, enterprises' performance is expressed by the different interactions between their behaviours in terms of product differentiation [3]. In this regard, the literature on the influence of R&D on the performance of enterprises is plenty. In fact, since the work of [8], theoretical and empirical studies affirm a significant contribution of R & D to enterprises' performance. This is possible from the fact that R&D permits the introduction of new products on the market and facilitates the absorption of new technologies[1].

Unfortunately, and contrarily to enterprises of developed countries, those of developing countries encounter many constraints linked to the affaires[1] of their environment, which render their competitivity and performance weak in relation to their counterparts of developed countries. Cameroon, one of the countries of sub-Saharan Africa, is not left out of this observation margin. However, according to the General Census of Entreprises(GCE) reports, 11.2% of enterprises in Cameroon are less interested in R&D activities. Going on for almost a decade, the Cameroon government has shown its real engagement in trying to develop research in the country via the creation and enhancement of public structures in-charge in this domain [6]. Despite these efforts, indicators of the performance of enterprises in Cameroon, if not comparatively weak compared to those of countries like Zambia and Senegal, are rather decreasing[2]. Therefore, it is judicious to interrogate the pertinence of different strategies promoted by the government, which must be related and amplified by enterprises to their interests. From here, the question is, what is the influence of R&D on the performance of enterprises in Cameroon? The answer to this question, which will come to buttress and increase the literature on this subject matter in Cameroon, starts with the presentation of the theoretical and empirical literature, the methodology, and the analysis of empirical results obtained.

II. R&D and the performance of enterprises: a review of the theoretical and empirical literature

A. R&D and performance of enterprises: theoretical foundations

The theoretical analysis of the influence of investments in R&D on the performance of enterprises was first presented by Griliches [8] and elaborated and fitted by the microeconomic implications of the entire endogenous growth theory[2] in reaction to the weaknesses of the

[1] See Parisi et al. (2006) cited by Segarra & Teruel (2011).

exogenous growth theory of the neoclassical model proposed by [24]. These models presented a positive effect of R&D on the performance of enterprises.

a) R&D and performance of enterprises: an explanation following the model of [8]

To explain how investments in R&D ameliorate the performance of enterprises, Griliches introduced into the Cobb-Douglas production function of constant returns to scale [4] expenses in perpetual R&D (past and current) in the form of a known accumulated stock of capital[2] Later. He presented several explanations about the phenomenon which not being exhaustive could be summarised on the one hand as the transformation of these investments into new products and as the diffusion of knowledge on the other.

Concerning the direct sale of new or sensibility ameliorated products to consumers, Griliches estimated that the influence of R & D expenditure on the performance of enterprises is in the function of the market structure they operate. In this regard, if the supplier of these articles is a monopolist practising perfect discrimination in terms of price, [two,] then he would capture all the returns of innovations [8]. But to continue maintaining this position, the monopolist will utilize the resources from this discrimination to invest continuously in the improvement of the quality of the products. Otherwise, subsequent entering of similar products in the market will bring about a price fall rather than an increase of output because the fall in sales will be proportional except in the case where this price fall results in the growth of the global market. Thus, from this mechanism, [8] showed that there exists an increasing linear relationship between investments in R&D and the performance of enterprises [17].

Elsewhere, the benefits of R & D investments depend also on the sector of activity in which the enterprise operates. Therefore, according to Griliches, it is difficult to benefit in an absolute manner from all the returns of expenses in R&D due to the externalities that they encounter. In this manner, two types are distinguished: the one coming from the purchase of intermediary inputs or capital intensive in R&D when the prices of these goods do not reflect their quality ultimately in one way, and on the other, those based on the fact that they could come from the results of the research team of an enterprise accruing from other enterprises [17].

b) R&D and the performance of enterprises: an explanation through the endogenous growth theory

These explanations are based on the new theory of endogenous growth, which capitalises on innovation and presents two parallel branches: the variety of products model and the Schumpeterian model. For the first model, [22] developed two elements, namely the invention of new inputs which render the production of a final good efficient and the dissemination of knowledge from past expenses in R&D. From here, [9] on their part, introduced the innovation of amelioration of the quality of existing products, and equally, the Schumpeterian[2] growth model presented by [1] based on 'creative destruction[3]. This model influences the performance of enterprises through two effects : the monopolist benefit which is a function of the radical characteristic or not of new innovations[4] and salary paid to skilled workers due to the increase in research from one period to another, [1][5].

All these previous conceptions are synthetised in a microeconomic approach [25] in which the performance of entreprises is explained by the creation of new ones but not necessarily by improved variety of products[6]. In this connection, profit is maximised at each instance by considering the quality of products as given. Therefore, enterprises invest in R&D to improve the quality of their products. This approach brings forth the hypothesis of pure and perfect competition and also gives the possibility to enterprises to have monopolistic profits. But the activities of R&D could result in two outcomes: a non-appropriable dimension following diffusion and an entirely appropriable dimension producing profits emanating from the development of new products [25] and [16].

The first dimension is explained following the fact that a renovated enterprise can not entirely benefit from the fruits of innovation because the new theory of growth brings into existence the phenomenon of technological diffusion, which is composed of growth diffusion and profit diffusion even if it is difficult to separate them [16][7]. But these diffusions bring quite often an under-investment in R&D comparatively to the level which socially is optimal. In this regard, the government can use bonifications, patents, tax reductions and subventions to correct externalities created by precedented diffusions to encourage enterprises to invest in R&D. For the second, the development of new products or services that R&D

[2] It depends on the fact that : growth is generated through innovations ; innovations are issued from investments of the entrepreneur motivated by the interest of obtaining monopolistic profits and finally innovations by replacing the old ones thus, growth implies creative destruction (Aghion & Howitt, 2014).

[3] Who introduced the obsolence factor in the endogenous growth model (Aghion & Howitt, 1992).

[4] When an innovation is incremental, the new entreprise fixes the maximum price which satifies demand and leaves nothing to the existing ones ; which do allow them to realise profits. However, it would be possible only in the case where rival products to average cost of production are less than a unit of less qualified labor combined to less qualified established products and to the price fixed to the average cost. If the innovation is radical, then the incubator is advised not to innovate.

[5] The high salaries of the following period will go to reduce the monopolistc profits which would have contrarily been gained by entreprises that produce products of good quality.

[6] Product différentiation of an entreprise from another depends on two dimensions : the consumers have a taste for the varieties and each product is indexed a quality which must increase eventually.

[7] The first takes into consideration the reduction of production costs of rivals due to acquantance, the mobility of labor or the imperfection in the process to obtain author's rights. The second contrarily, competition allows the innovative to benefit entirely from price increase of its product because of the improvement in the quality of its products.

brings confers on the enterprise a temporary monopoly situation which it will be the only capable of supplying such products or services on the market. It could then fix a price that will be higher than the average minimum cost and therefore the marginal cost of the pure and perfectly competitive market. The principal motivation of investment in R&D of enterprises is, therefore, the creation of a competitive advantage[8] for the competitors.

B. R&D and performance of enterprises: some stylised facts

There exist a vast empirical literature on the influence of R&D on the performance of enterprises which came from the works of [8]. The results of these works are mixed due to the source of data, period of investigation, the number of observations as well as the methods used [16]. However, this analysis makes a distinction between negative and positive results by bringing into existence different conclusions. Actually, the products, services, or preceded new or improved products can lead to a temporary monopolistic benefit which impacts the growth of sales and the rentability of enterprises[8].

a)R&D and performance of entreprises : positive influence

This is the case where the returns from temporary monopoly are higher than the investment linked to the activities of R&D. According to [10], R&D can increase the performance of enterprises through the amelioration of the quality or the reduction of average costs of production of the existing products or simply by increasing either the possible quantities of the final product or the available intermediary products. This behaviour results in profits augmentation, price reduction and the reallocation of the factors of production resulting from entry or exit from the market. Elsewhere, for the same authors, R&D carried out by an enterprise, a sector of activity or a country can produce positive externalities on other enterprises, sectors of activities or countries. And such externalities are total and significant in the measure where the producer of R&D and the receiver are close together [10]. From this aspect, they distinguished two types of externalities that allow the activities of R&D to positively influence the performance of enterprises which are financial and non-financial externalities. The financial externalities come from sales of intermediary goods or new investment goods or simply improved prices reflecting at least the total value added from technical progress incorporated to other enterprises [10]. The non-pecuniary on their part come from the diffusion of knowledge of the R&D activities from other enterprises and utilised by any enterprise.

Not exhaustive, we present some frequent works which support that R&D positively influence the performance of enterprises [21]. At the origin of these works, research works carried out in this domain have started to receive support from countries of positive influence[9]. From these first results was the controversy between past and current influence of R&D expenses on the productivity of enterprises. But the debate was quickly halted by the works of [7], who, by using a large and viable database, found that: expenses in the past and current R&D have a positive and significant influence on the performance of enterprises. Also, [15] carried out a review of literature on works concerning the influence of expenses in R&D on the performance of enterprises by specifying the Cobb-Douglas in three types: estimations in panel data, in temporal and in the rate of returns in R&D. These works which could be qualified as old, focused on productivity as the measure of performance. The most recent works focused on the same indicator and arrived at the same results as the R&D and positively influencing the productivity of enterprises[10]. Reference [27], by basing on a meta-regression, found that the rate of returns on R&D and average elasticity is positive in the [19] countries but has a lower degree as compared to past studies that applied the method[11]. To this indicator, we can add the marginal profit and the growth of business affairs[12].

b) R&D and performance of enterprises: negative influence

This is the case where investment expenses in R&D are higher than relative returns. In effect, investments in R&D increase the probability of the introduction of innovations of the product and to proceed, but the probability that such investments could sufficiently increase the productivity of an enterprise is less than 1[13]. Therefore, because of the economic and technological uncertainty of such investments, enterprises could encounter a risk of insolvency due to negative returns on investment in R&D [2]. This can be due to either the non-commercialisation of new products or proceeded issues of research or through technological limitations which limit the returns of investment [14] . This phenomenon is aggravated when an enterprise is at its first experience of investment in R&D[15].

c) R&D and performance of entreprises : a non significant influence

This is the case where expenses in R&D are equal to returns obtained from the temporary monopoly or returns from uncertainty relative to investment [18]. Furthermore for these studies [18] brought into existence the linear and non-linear relations between R&D and the performance of enterprises.

[8] McDaniel (2002) cited byr Niklas & Wikberg (2015).

[9] For more details see : Mairesse & Sassenou (1991) et Reçica (2016).

[10] (Lööf & Heshmati, 2006 ; Sterlacchini & Venturini, 2013) Cited by Reçica (2016).

[11] For example : Moen & Thorsen (2013) and Stanley et al. (2013) cited by Ugur et al. (2015).

[12] See Geroski et al. (1993), Brower & Kleinknecht (1994) and Kemp et al. (2003).

[13] Griffith et al. (2006) cited by Baumann & Kritikos (2016).

[14] For the results of others who found a negative relation between expenses on R&D and the performance of entreprises, see Niklas & Wikberg (2015).

[15] Peters et al. (2013) cited by Baumann & Kritikos (2016).

III. METHODOLOGY

Econometric studies of the analysis of the influence of expenditures in R&D on the performance of enterprises are classified into two categories: those based on the Cobb-Douglas production function and those based on the cost function [16]. But the first approach is called the primal domain and the second, called dual, is not very much in use [27]. Therefore, the R&D factor and the characteristics of enterprises are generally added to the factors capital and labour in the production function [23). Elsewhere, these factors in function of availability of data are based either on the individual data and use the OLS or the quantile as the regression method [23], either on the panel data by using the methods of random or fixed effects, the OLS or generalised moments [14] ; [20]. If the econometric applications in the subject are abundant in many developed countries, there are still to be exploited in Cameroon. We now specify the regression model used as well as the data construction.

A. Model Specification of the study

This work uses the primal approach because of the availability of data and the simplicity of its application. This is thanks to [8], who elaborated two effects of the influence of R&D on the performance of enterprises: the direct and indirect effects [14]. This study considers only the direct effect because of the fewer number enterprises interested in the R&D activities and the short period of study. However, the econometric model to be estimated gives a privilege to individual data at the detriment of the panel data since data is available only for the period 2011 to 2012. The usage of this method is inspired by the works of [23], who considered a direct approach of the influence of R&D on the performance of enterprises at the detriment of the indirect approach inspired by [5]. In effect, for these authors contrarily to the latter, if it is true that R&D has an impact on innovation, it remains that the process of apprenticeship can have an impact on the performance of enterprises without necessarily leading to innovation. However, with the disagreement of [23], it is therefore decomposed into two sources which are internal and external, and expenses in R&D are unified in this study. Moreover, we have not introduced the dummy sectoral variable in the model. In this manner, the regression equation is presented as follows :

$$y_i = a + \beta_1 R\&D_i + \beta_2 size_i + \beta_3 marketshare_i + \beta_4 group_i + \beta_5 investment_i + \beta_6 export_i + \mu_i \quad (1)$$

With *me*, each individual enterprise's performance is measured by added value and by returns on asset (ROA) respectively, and μ is the error term. The continuous variables of this model are in decimal logarithm. With this model, [23] proposed two types of regression methods: the ordinary least square and quantile regressions. But the quantile regression is the most desired [17]. It is the alternative regression through the OLS when error terms are not normally distributed. In this manner, the central idea of quantile regression is to minimize the sum of absolute residuals by giving different weights to the quantiles. Further, it is a powerful tool that gives a vector of explanatory variables and characterises the entire distribution from the independent variable in a more detailed manner than the OLS [18]. Thus, as the quantile regression method specifies the conditional quantiles as a linear function of covariances, [23] suggested writing the ϑ^equantile as follows :

$$Q_\vartheta(y_i|x_i) = x_i'\beta_\vartheta + \mu'_{\vartheta i} \quad (2)$$

With y_i being the performance of enterprises measured by added value per worker and by the ROA per worker, x_i is the vector of independent variables, β_ϑ representing the vector of parameters of the associated unknown regression to the ϑ^e quantile and $\mu_{\vartheta i}$ the unknown error term. Therefore, $Q_\vartheta(\mu_{\vartheta i}|x_i) = 0$ the ϑ^e quantile of the regression is the solution of the minimisation of the sum of the following absolute residuals, which can be resolved by linear programming methods [23] :

$$\min_\beta \frac{1}{n}\left(\sum_{i:y_i \geq x_i'\beta}|y_i - x_i'\beta|\vartheta + \sum_{i:y<x_i'\beta}|y_i - x_i'\beta|(1-\vartheta)\right) \quad (3)$$

When ϑ increases from 0 to 1, the entire conditional distribution of y on x is obtained[19]; from their works, few enterprises undertake research and development activities. Thus basing only on the analysis of enterprises that carry on expenditures in R&D, our sample will encounter selectional bias. Reference [11] suggested a procedure of two stages by assuming joint normality of error terms in the two equations for resolving the problem. The quantile regression[20] is suggested as the alternative for OLS when these errors are not normally distributed. Therefore and following [23], we are going to use the semi- parametric estimation of the probability of investment in R&D which depends on the size of the enterprise. In that regard, the final equation is as follows :

$$Q_\vartheta(y_i|x_i) = x_i'\beta_\vartheta + h'_\vartheta(x_1, \gamma_0) + \mu'_{\vartheta i} \quad (4)$$

Where $h'_\vartheta(x_1, \gamma_0)$ controls the selection bias at the level of the ϑ^equantile and plays the role of the inverse of the Mill ratio; β_ϑ is then the true coefficient value which corrects the selection bias. In this paper, the OLS and the quantile regression are applied. Four conditional quantiles (0.25 ; 0.5 ; 0.75 and 0.90) are taken into consideration

[16] See Griliches (2000) for more details.

[17] It is btter applied when the distribution of the independent variable of interest is biased, it treats very well the frontiers of the distribution and lastly it can describes the conditions of complete distribution of the dependent variable (Segarra & Teruel, 2011).

[18] Seer Koenker & Hallock (2001) cited by Segarra & Teruel (2011).

[19] Buchinsky (1998) cited by Segarra & Teruel (2011).

[20] First suggested by Koenker & Bassett (1978), his idea was to minimise the sum absolute residual value by giving different weights to the quantiles (Segarra & Teruel, 2011).

and the '*bootstrap standard errors*'[21] (20 *replications*) are used. The quantile regression coefficient can be interpreted as the marginal variation of y to the ϑ^{e} conditional quantile caused by the marginal variation of a particular observation.

$$\frac{\Delta Q_{\vartheta}(y_i|x_i)}{\Delta x} \quad (5)$$

B. Hypotheses and data for the empirical analysis

a) Hypotheses

The research objective in this paper consists of validating or not validating the totality of hypotheses on the influence of expenses in R&D on the performance of Cameroonian enterprises that have regularly respected fiscal and statistical declarations (FSD) at the National Institute of Statistics (NIS) from 2008 to 2012.

To this effect and since the works of [8], the empirical literature on the influence of R&D on the performance of enterprises has presented two contradictory results: positive and negative influences. The positive influence is explained by the fact that investment in R&D stimulates innovation and develops the capacities of absorption of enterprises, permitting them to have a temporary monopoly by the differentiation of their products[22]. Contrarily, the negative influence is explained by the fact that R&D can result in a limited commercialisation effect because it is a risky and uncertain activity. All the enterprises not having the same capacities to effectively protect their innovations on the market do not benefit from their returns from an investment [23]. The studies in this discipline are quasi inexistence in Cameroon, even if they could reveal some in other developing countries[23]. Further, reports have shown the weak participation of Cameroonian enterprises in this activity. Does it mean that this activity is risky only to these enterprises ? Therefore, these hypotheses constitute the principal axes of the study.

$\boldsymbol{H_0}$**:** R&D has a positive influence on the performance of enterprises in Cameroon

$\boldsymbol{H_1}$**:** R&D has a negative influence on the performance of enterprises in Cameroon

b) Data and descriptive statistics

i) Data

To verify the above hypotheses, data were obtained from the survey of a project of the International Development Research Center (IDRC) on the determinants of the performance of enterprises in Sub-Saharan Africa, the case of Ivory Coast, Senegal and Cameroon. From this, we extracted a sample of 40 enterprises observed between 2011 to 2012 which deposited FSD at the NIS since 2008 [12]. The choice of this sample is justified by the fact that they are modern enterprises that are apt to carry out the growth process of the country.

However, literature furnishes two types of evaluations of the expenses of R&D. The first qualify the method of permanent inventory[24] and contrarily for the second[25] R&D is considered as expenses in R&D. It is this second approach that we have exploited in our study due to lack of information on the growth rate of capital. In this regard, expenses in R&D are constituted of all the expenses which are connected to R&D. Elsewhere. The database equally furnishes information on the indicators of performance: added value, and the information allows for the calculation of the returns on assets, the proxy capital per investment, the proxy labour per size of the enterprise and other characteristics of enterprises (market share, attachment to a group, export), which are necessary for the estimation of our constructed production function as shown in table 1 below:

[21] In this case, the quantile regression paramters remain constant except the error variance and degree of significance are affected.

[22] See Cohen & Levinthal (1989) cited by Segarra & Teruel (2011).

[23] For Benavente (2006) R&D has no influence on the performance of entreprises in Chile ; Mohnen (2006) found the same results in Tanzania.

[24] See Griliches & Mairesse (1984), Coe & Helpman (1995) and Moen & Burchardt (2010).

[25] For the foundation see Terleckyj (1974) cited by Los & Verspagen (2000).

Table 1. Data Description on the Influence of R&D on the Performance of Enterprises in Cameroon

Variables	Description	Signs
Dependent Variables		
Added value ROA	Log (Added value/Size of entreprise) Log (ROA/size of entreprise)	
Independent Variables		
1) Independent Variables of interest		
R&D	Personnel training expenses and investment + research cost & experimental development in establishments + Acquisitions of research development services	+/-
2- Control Variables (characteristics of enterprises)		
Capital Labor International group Market share Export	Physical investment expenses (investments) Number of permanent employees One if it is a member of the foreign group and 0 if not Business figures of enterprise/ total business figures One if enterprise exports its products and 0 if not	+/-

Source: authors, inspiration from littérature

ii) Descriptive statistics

Figure 1 below presents the logarithmic distribution of expenses of R&D per employer of enterprises of our sample. It shows some heterogeneity of the motive of investment in R&D per employer. According to [23], it could be explained by several factors: firstly, the R&D activity is risky and uncertain; consequently, the return on investment is extremely variable; thus, small enterprises need a financial capacity to start, and at last, it is not every enterprise that can effectively protect its innovations in the market to benefit from returns on investment.

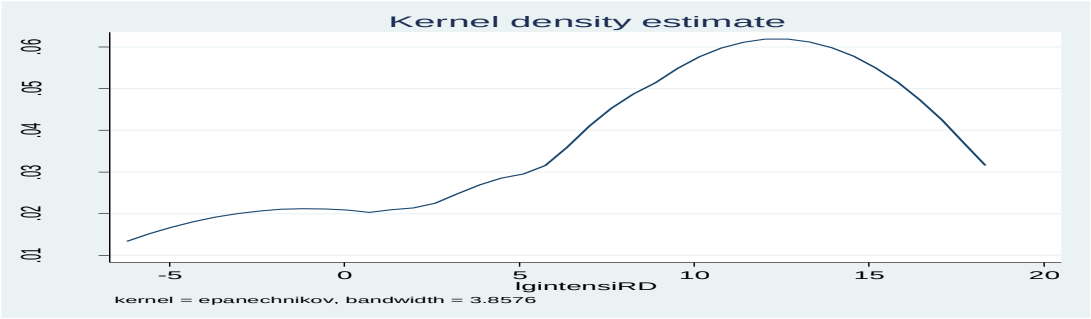

Fig. 1 Kernel Density of The Logarithm of Expenses in R&D Per Employer

Table 2 below presents the descriptive statistics of the study. It shows that eight enterprises out of forty being 20% of this investment sample, invest in R&D. 55% export and 25% belong to a group. Six of these enterprises have a negative ROA.

Table 2. Descriptive Statistics on The Expenses in R&D, Characteristics and Performance Indicators of Cameroon's Enterprises

Variable	Obs	Mean	Std. Dev.	Min	Max
Intensity AV	40	20840.95	39013.76	22.72727	203684.2
Intensity ROA	40	.0005635	.0021037	-.0012909	.0130364
Intensity R&D	40	116173.2	409982	0	1948052
Decision R&D	40	.2	.4050957	0	1
Capital	40	25525.15	47209.48	0	242896.5
size	40	130.5128	256.8052	7	1640
Market share	40	.0250039	.0589292	.0001388	.3729432
Export	40	.55	.5038315	0	1
International group	40	.25	.438529	0	1

Source : authors using Stata 13

IV. PRESENTATIONS AND EMPIRICAL ANALYSIS OF RESULTS

How do R&D influence the performance of enterprises in Cameroon? The answer to this question allows us to present an analysis of empirical results. These are arrived at from a quantile regression using Stata 13, which allowed for the control of the selection bias as the Kernel density showed that the distribution of expenses in R&D per employer is not normal. But we equally used OLS regression to compare the results. Mills Ratio was introduced in the regressions to control selection bias. The ratio presented a significant influence which showed that enterprises that spend on R&D in Cameroon do not have unobservable characteristics to be controlled. Nevertheless, we cherished results in the case of individual data in relation to those of mini-panel because of the paucity of data.

The analysis begins by observing the correlation table 3 below. From the table, it is shown that the correlation between the variables is perfect even if we noted a strong correlation between export and added value on the one hand (0.8301) and between the size of the enterprise and ROA on the other (-0.8096).

Table 3. Correlations

	AV	ROA	R&D	Capital	Size	Marketshare	Group	Export
Av	1.0000							
ROA	0.2583	1.0000						
R&D	-0.2057	0.4466	1.0000					
Capital	-0.1896	0.1438	0.6314	1.0000				
Size	-0.0687	-0.8096	-0.2363	-0.0985	1.0000			
Marketshare	0.6661	-0.4666	-0.4650	-0.1866	0.6611	1.0000		
Group	0.2076	0.3110	0.3602	0.2525	0.1509	0.2202	1.0000	
Export	0.8301	0.3820	0.1551	-0.2572	-0.0163	0.4550	0.3333	1.0000

Source: authors using Stata 13

The two-consecutive tables above show the influence of expenses in R&D on the productivity of labour measured by added value per employer (y1) in one way and by ROA per employer (y2) the other way. For the added value, the first two columns control the endogeneity and selection bias, respectively showing that expenses in R&D positively influence but not in a significant manner the productivity of enterprises in Cameroon. By comparing with the quantile regression results of columns three up to 6, the OLS marginal effects are not only inferior but are also not significant as compared to those of quantile regression.

From these findings and whatever the level of productivity, the marginal effects are significant. The elasticity is 12,2% and significant at 5% when the level of productivity is weak (column 3), increases lightly and stabilises from the median distribution (column 4 to 6) and becomes significant at 1%. This shows that the more productive Cameroonian enterprises are, the more they spend on R&D and the more they significantly influence productivity but only up to the median distribution. In effect, enterprises that invest in R&D activities in Cameroon stimulate their innovations (which are commercialised) and develop their capacities of absorption of external R&D activities brought in by other enterprises (diffusion effect). These results confirm our null hypothesis and, as found by other works[26].

Concerning the individual characteristics of enterprises, exports were excluded from the regressions due to collinearity. Belonging to an international group negatively influence an enterprise but not in a significant manner the added values of enterprises. Capital has a negative and significant influence of 5% on added value, but this falls lightly and stabilises from the median distribution. The size of the enterprise negatively influences at 1% the added value of enterprises in Cameroon. This phenomenon is accentuated with enterprises of high productivity. The results, which were confirmed by some authors[27], contradict those of [23][28]. Lastly, the market share has a positive and significant influence of 1%, and the elasticity is higher and stabilises from the marginal distribution. This result was also found by [23], showing that market share allows the enterprise to obtain autonomous financial capacities which permit it to invest in R&D and to protect its innovations [23].

Table 4. R&D and Added Value in Cameroon

	OLS		Quantile regression			
	(1)	(2)	(0.25)	(0.50)	(0.75)	(0.90)
VARIABLES	y1	y1	y1	y1	y1	y1
Proba R&D	0.00671					
	(0.0391)					
R&D		0.118	0.122**	0.127***	0.127***	0.127***
		(0.0241)	(0.0478)	(0.0410)	(0.0424)	(0.0473)
Capital	0.137	-0.279	-0.294**	-0.272**	-0.272**	-0.272**
	(0.111)	(0.0627)	(0.126)	(0.111)	(0.106)	(0.118)
Size	-0.676**	-0.797*	-0.710***	-0.827***	-0.827***	-0.827***
	(0.289)	(0.0656)	(0.0525)	(0.0680)	(0.0454)	(0.0459)
Market share	0.328*	0.893**	0.879***	0.938***	0.938***	0.938***
	(0.191)	(0.0473)	(0.0549)	(0.0434)	(0.0458)	(0.0620)
Groupe	0.0360	-0.299	-0.272	-0.411	-0.411	-0.411
	(0.797)	(0.151)	(0.313)	(0.261)	(0.300)	(0.402)
Mills ratio		Yes	Yes	Yes	Yes	Yes
[Pseudo-]R^2	0.300	0.998	0.976	0.959	0.968	0.974
Observations	40	8	8	8	8	8
Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1						

Source: authors using Stata 13

For the ROA per employer, the first two columns of table 4 control the endogeneity selection bias respectively from the OLS. This shows that expenses in R&D positively influence but in a non and significant manner enterprise in Cameroon. By comparing with the quantile regression results of columns three up to 6, the marginal effects of OLS are higher but also significant at 10% in relation to those of the quantile regression. From here, and whatever the level of ROA, the marginal effects are all significant at 1%. The elasticity of 44, 4% is stable and low, but up to the median distributions (columns 3 and 4), it increases and stabilises from the third quantile. This result confirms our null hypothesis and as was found by other works that were stipulated earlier.

Concerning the individual characteristics of enterprises, exports were excluded from the regression because of collinearity. Belonging to an international group positively influence but in a less- significant manner the added value of enterprises. Capital and the size of the enterprise, as mentioned early, influence negatively and significantly at 1% the ROA of enterprises in Cameroon. Lastly, market share also has a positive and significant influence at 1%, and the elasticity is higher and stabilises itself from the third quantile.

Table 5. R&D and ROA in Cameroon

	OLS		Quantile regression			
	(1)	(2)	(0.25)	(0.50)	(0.75)	(0.90)
VARIABLES	Y2	Y2	Y2	Y2	Y2	Y2
Proba R&D	0.0178					
	(0.0361)					
R&D		0.459*	0.444***	0.444***	0.453***	0.453***
		(0.0452)	(0.0814)	(0.0949)	(0.0861)	(0.0898)
Capital	-0.0268	-1.118*	-1.132***	-1.132***	-1.090***	-1.090***
	(0.106)	(0.118)	(0.217)	(0.252)	(0.225)	(0.237)
Size	-1.019***	-1.464*	-1.408***	-1.408***	-1.627***	-1.627***
	(0.319)	(0.123)	(0.104)	(0.116)	(0.101)	(0.108)
Market share	-0.0299	0.444	0.360***	0.360***	0.470***	0.470***
	(0.199)	(0.0888)	(0.0949)	(0.0842)	(0.0945)	(0.105)
Group	0.551	0.748	0.958	0.958	0.697	0.697
	(0.752)	(0.284)	(0.610)	(0.691)	(0.647)	(0.654)
Mills ratio		Yes	Yes	Yes	Yes	Yes
[Pseudo-]R^2	0.444	0.998	0.975	0.972	0.983	0.986
Observations	34	8	8	8	8	8
Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1						

Source: authors from Stata 13

V. CONCLUSION

Therefore for R&D, this work exploited the quantile regression as was the case for [23] even if enterprises were distinguished according to sectors of activities. From here, we found out that despite the reduced number, R&D positively and significantly influence the productivity of enterprises in Cameroon (whether measured by added value per employer or by the returns on assets per employer). Thus, enterprises that invest in R&D activities in Cameroon stimulate their innovations (which are commercialised) and develop their capacities to absorb external activities brought by other enterprises (diffusion effects). The results show that Cameroon must stimulate R&D in enterprises to permit them to come to a level in order to compete favourably with concurrent products so that in future, these enterprises can play an effective and efficient role in the development process of the country. In this regard, Cameroon must intensify enterprise/University partnerships by creating in each of them a unit of technological surveillance which will allow these enterprises to use research results from the Universities. Also, it should give subventions to enterprises that are interested in research activities.

REFERENCES

[1] Aghion, P., & Howitt, P., A Model of Growth Through Creative Destruction, Econometrica, 60(2) (1992) 323-351.

[2] Baumann, J., & Kritikos, A. S., The Link between R&D, Innovation and Productivity: Are Micro Firms Different? Discussion Papers, N°. 9734, Institute for the Study of Labor (IZA), Bonn., (2016)

[3] Bernard, J., & Torre, A., Etudes Empiriques-L'énigme du chaînon manquant ou l'absence des stratégies dans les vérifications empiriques du paradigme S.C.P, Revue d'économie industrielle., (57) (1991) 93-105..

[4] Cobb, C., & Douglas, P., A Theory of Production, American Economic Review, 18.

[5] Crépon, B., Duguet, E., & Mairesse, J., Research, Innovation, and Productivity: An Econometric Analysis at the Firm Level., Economics of Innovation and New Technology, 7(3) (1998) 115-156.

[6] Eteki Eloundou, L. S., Cadre juridique, systèmes nationaux et locaux d'innovation ; financement, relation avec le marché et les acteurs économiques : cas du Cameroun ». Forum francophone de l'innovation, Palais des congres de Namur., (2014).

[7] Griliches, Z., The discovery of the residual: A historical note'. Journal of economic literature, 34(3) (1996) 1324-1330.

[8] Griliches, Z., Issues in assessing the contribution of research and development to productivity growth, The bell journal of economics, 10(1) (1979) 92-116.

[9] Grossman,Gene M. and Elhanan., Innovation and growth in the global economy. Cambridge: M.IT. Press, Cambridge MA., (1991).

[10] Hall, B. H., Mairesse, J., & Mohnen, P., Measuring the returns to R&D, Elsevier. New York: B.H. Hall and N. Rosenberg (eds.)., (2010).

[11] Heckman J. (1979) 'Sample selection bias as a specification error'.Econometrica, 47(1) (1979) 153 – 161 https://www.jstor.org/stable/1912352

[12] INS., Recensement Général des Entreprises : RGE 2008. Document de méthodologie générale, République du Cameroun., (2009).

[13] Lööf, H., & Heshmati, A., On the relationship between innovation and performance: A sensitivity analysis, Economics of Innovation and New, 15(4-5) (2006) 317-344.

[14] Los, B., & Verspagen, B., spillovers and productivity: Evidence from U.S. manufacturing microdata, Empirical Economics, 25 (2000) 127-148

[15] Mohammad Reza Asgari, Sarah Pahlavan, Mostafa Pahlavan, "The Relationship between Capital Structure and Profitability in Commercial Banks: Evidence from Iran" SSRG International Journal of Economics and Management Studies 2(11) (2015) 7-15.

[16] Mairesse, J., & Sassenou, M., R&D and productivity: a survey of econometric studies at the firm level. Working Paper N°. 3666, Cambridge, MA 02138, National bureau of economic research 1050 Massachusetts Avenue., (1991).

[17] Moen, M. S., & Burchardt, S. M., R&D and productivity: A firm-level investigation of the Norwegian manufacturing industry". BI Norwegian School of Management. CREAM Publication., 6 (2010).

[18] Ndzana Eloundou, M. J., L'innovation dans les Petites et Moyennes Entreprises (PMEs) au Cameroun ., Thèse de Doctorat/Ph.D en Sciences Economiques, Université de Dschang, (2016).

[19] Niklas, F., & Wikberg, J., The Relationship Between R&D Spending and Firm Economic Performance: A regression study of firms in the industrial equipment manufacturing industry, Master of Science Thesis in the Management and Economics of Innovation Programme, Chalmers University of Technology, Gothenburg, Sweden., (2015).

[20] OCDE., La mesure des activités scientifiques et technologiques, Principes directeurs pour le recueil l'interprétation des données sur l'Innovation, Manuel d'Oslon, 3ème édition, Paris., (2005).

[21] Ortega-Argiles, R., & Moreno, R., Firm competitive strategies and the likelihood of survival: the Spanish case., Discussion Paper on Entrepreneur Growth and Public Policy, Max-Planck Institute of Economics, Jena Germany., (2007).

[22] Reçica, F. A., Innovation and firm performance in transition economies, with special emphasis on Kosovo, A thesis submitted in partial fulfilment of the requirement for the degree of Doctor of Philosophy, Staffordshire University., (2016).

[23] Romer, P. M. (1990, October). Endogenous Technological Change. The Journal of Political Economy, 98(5) (1990) S71-S102.

[24] Segarra, A., & Teruel, M., Productivity and R&D sources: evidence for Catalan firms, Economics of Innovation and New Technology, 20(8) (2011) 727-748.

[25] Solow, R., A Contribution to the Theory of Economic Growth, Quarterly Journal of Economics, 70 (1956) 65-94.

[26] Thompson, P., The Microeconomics of an R&D-Based Model of Endogenous Growth., Journal of Economic Growth, 6(4) (2001) 263-283.

[27] Tirole, J., The theory of industrial organization, Cambridge: MIT Press., (1988).

[28] Ugur, M., Trushin, E., Solomon, E., & Guidi, F., R&D and productivity in OECD firms and industries: A hierarchical meta-regression analysis, MPRA Paper N°68008, University of Greenwich, Durham University., (2015).