Nigerian Journal of Management Studies
Vol. 18, No. 2, 2018, 78-89

Testing the Gibrat's Law: A Dynamic Panel Analysis of Firm Size and Firm Growth Nexus in Nigeria

By

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Abstract
The Gibrat's law posits that firm growth is dependent only on stochastic or random factors but independent of firm size. This study uses balanced micro panel data and applies the dynamic Generalized Method of Moment (GMM) estimator to ascertain the veracity of this claim with respect to Nigeria. Employing a sample of 63 non-financial firms quoted on the Nigerian Stock Exchange (NSE) between 2012 and 2016, this study provides evidence of a negative robust nexus between firm size and firm growth during the period under investigation. By implication, small firms grow faster than larger firms. Moreover, the existence of other predictors of firm growth, such as previous year's growth, internal finance, leverage, management efficiency and previous year's sales, further invalidates the Gibrat's law with respect to Nigeria. Public policy thus targeted at promoting firm growth in Nigeria should take cognizance of these facts.

Keywords: Firm Size; Firm growth; Gibrat's law; Panel data; GMM estimators

1. Introduction

Economic dynamics of firm growth has received considerable attention globally over the years. This is not surprising since firms produce the wealth of nations and as such are the engine of growth of economies. Many firm growth models have thus been formulated, including stochastic firm growth models which emphasize the importance of stochastic factors in the behaviour of firms. The most celebrated stochastic firm growth model is the Gibrat's (1931) famous law of proportionate effect, which indicates that firm growth is independent of initial firm size. This means that: "the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry - regardless of their size at the beginning of the period" (Mansfield, 1962, p. 1031). Firm size is however dependent on stochastic or random factors which are not dependent on each other (Audretsch, Klomp, Santarelli and Thurik, 2004). The stochastic growth rates are also assumed to be normally distributed and independent of one another across firms and over time.

Gibrat's law (GL) has motivated many studies to the extent that majority of the research on firm growth are devoted to determining the effects of firm size and firm age on the growth of the firm (Audretsch et al., 2004; Teruel, 2007). Indeed, the law "…has proven to be a useful benchmark for empirical work" (Coad and Hölzl, 2010, p. 4). The manufacturing sector, however, has been the main focus of researchers over the years while few studies examine more than two sectors. Very few researchers have also investigated the GL with respect to the service industries, prompting Audretsch, et al. (2004) to question the omission. Their study of five hospitality industries in the Netherlands for the period of 1987 to 1991, however, fail to reject the GL in only one of the five hospitality industries. Similar mixed and inconclusive results for the service industry are common (Becchetti and Trovato, 2002; Piergovanni, Santarelli, Klomp, and Thurik, 2003) while validation of the law in the service industry is uncommon except for Hardwick and Adams (2002), Pfaffermayr and Bellak (2002), Del Monte and Papagni (2003), Geroski, Lazarova, Urga and Walters (2003) and a few others.

In general, most studies rejected the GL as most researchers are in agreement with the stylized fact of a robust negative nexus between firm size and firm growth. This implies that smaller firms grow faster than larger firms (Maçãs Nunes and Serrasqueiro, 2009; Fotopoulos and Giotopoulos (2010), Resende and Cardoso (2013), Daunfeldt and Elert (2013), Fiala and Hedija, 2015).

Although the GL, and by extension, the firm size and firm growth nexus has been extensively studied, majority of the extant studies are however cross country or country case studies with emphasis on advanced economies. A gap therefore exists in the literature for an empirical investigation of the test of

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the GL focusing on a developing country like Nigeria. Also, a large number of studies testing the GL have concentrated either on the manufacturing sector or the service industry and excluded other sectors. This study fills the lacuna by incorporating firm operating in virtually all sectors of the economy in the test of the veracity of the GL.
The broad objective of this study is therefore to test the GL by ascertaining the impact of firm size on firm growth in Nigeria. This study also contributes to the studies on the economic dynamics of the firm in Nigeria by presenting a study of firm growth that incorporates the varying roles of key firm characteristics of size and age to the growth of Nigerian firm as well as internal finance, management and organizational efficiency.
This paper is divided into six sections. Following this introductory section, we review extant literature on firm size and firm growth nexus in section two. The methods used in this study are stated in section three while results of our data analysis are presented in section four. We thereafter discuss the results and their implications in section five and finally conclude and recommend policy action in section six.

2. Review of Literature

2.1.1 Type of Estimation of the Gibrat's law (GL)

The famous Gibrat's (1931) law of proportionate effect, which indicates that firm growth is independent of firm size, has generated a great deal of empirical studies. The simplicity of the law is no doubt a contributory factor. Comparing empirical studies of the GL is however demanding because of wide differences in samples and the methodologies applied (Audretsch et al., 2004; Teruel, 2007).
In general, the GL is empirically tested using the static approach (Mansfield, 1962) and the dynamic approach (Chesher, 1979). The static approach involves grouping firms according to their initial size and then divide them into quartiles. The growth rates of each quartile are then estimated; GL is confirmed if there are no significant differences in the growth rates among the groups. Many studies have also used static econometric techniques to establish the relationship between the growth of the firm and the initial firm size. The dynamic approach, which is commonly employed by recent studies, follow Chesher's (1979) persistence of growth, which involves ascertaining whether past firm growth significantly impacts current firm growth. A variant of the persistent of growth literature examines the impact of past firm growth on future firm growth. If there is growth persistence, then GL holds.
Following some excellent reviews (Audretsch, et al. 2004; Piergovanni et al., 2003; Teruel, 2007), extant empirical studies on the GL can be categorized into six (6), based on their samples and methods of analysis. There are however, studies that empirically test the GL using different samples, thereby falling into two or more categories:
- Static 1: Empirical studies that apply the static method to analyze surviving and non-surviving firms.
- Static 2: Empirical studies that apply the static method to analyze only surviving firms.
- Static 3: Empirical studies that apply the static method to analyze surviving firms that surpass the minimum efficiency size (MES).
- Dynamic 1: Empirical studies that apply the dynamic method to analyze surviving firms only.
- Dynamic 2: Empirical studies that apply the dynamic method to analyze surviving firms that surpass the MES.
- Dynamic 3: Empirical studies that apply the dynamic method to analyze the post- entry growth of new firms.

For the static 1 group, their samples consist of all firms in a given industry, including non-surviving firms. GL find support in the study by Fariñas and Moreno (2000) but is rejected by (Heshmati, 2001; Lotti, Santarelli and Vivarelli, 2001; Machado and Mata, 2000). Results of many studies in the group are, however, mixed and hence inconclusive (Mansfield, 1962; Acs and Audretsch, 1990; Piergovanni et al., 2003; Audretsch et al., 2004).
Among the empirical studies that apply the static approach to test the GL, using only surviving firms (the static 2 group), very few studies (Klette and Griliches; 2000; Lensink, van Steen, and Sterken, 2005) validate the Gibrats law. Majority of the extant studies in the group however reject the GL, showing the existent of an inverse relationship between firm size and firm growth. This implies that small firms grow faster than large firms (Hoogstra and Van Dijk, 2004; Peña, 2004; Audretsch and Lehman, 2005; Niefert, 2005; Nkurunziza, 2005). Others are however mixed and hence inconclusive (Acs and Armington, 2001; Demar, Davidsson and Gartner, 2003; Piergiovanni, et al., 2003).

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In the third group (Static 3) are studies that tested the GL using surviving firms that are big enough to surpass the minimum efficient scale (MES) of a particular industry during the period under investigation. A few earlier studies confirm the GL (Simon and Bonini, 1958; Buckley, Dunning, and Pearce, 1984) while another small number (Hall, 1987; Bourlakis, 1990; Faggio and Konings, 2003) reject the law, showing an inverse robust relationship between firm size and firm growth. Mixed results are, however, found by some researchers (Mansfield, 1962; Droucopoulos, 1983).

The dynamic method has also been employed by researchers to test the GL. Three groups are identified: studies that focus on surviving firms (Dynamic 1); surviving firms that surpass the MES (Dynamic 2); and post- entry growth of new firms (Dynamic 3). Among the Dynamic 1 group, only Del Monte and Papagni (2003) confirm the GL, in a study of 659 manufacturing firms in Italy between 1989 and 1997. Majority of the studies in this group however invalidate the GL (Machado and Mata, 2000; Fotopoulos and Louri, 2004) while others are, however, inconclusive (Heshmati, 2001; Piergiovanni et al., 2003).

In the dynamic 2 group are empirical studies that test the GL using surviving firms that surpass the minimum efficiency size (Dynamic 2). Bottazzi, Dosi, Lippi, Pammolli and Riccaboni (2001), for instance, fail to reject the GL in 150 big pharmaceutical firms in Canada, France, Germany, Italy, Spain, the United Kingdom, and the United States, between 1987 and 1997. The GL is also confirmed by Pfaffermayr and Bellak (2002) in their investigation of 700 big manufacturing firms in Austria between 1996 and 1999. Moreover, the study of Geroski, Lazarova, Urga and Walters (2003) validates the GL using a sample of 147 big listed firms in the United Kingdom from 1955 to 1985. On the contrary, several empirical studies in the group reject the GL (Amirkhalkhali and Mukhopadhyay, 1993; Amaral et al., 1997; Goddard, Wilson, and Blandon, 2002). The results of the empirical test of the GL by Hart and Prais (1956) are however inconclusive.

The last group of the empirical studies of the firm size and firm growth nexus is the dynamic 3 group. Many studies in this group however reject the GL, showing that firm growth is strongly and negatively related to firm size (Dunne, Roberts and Samuelson; 1989; Reid, 1995; Almus and Nerlinger, 2000) and that small firms grow faster than larger firms. Some studies in the group have recorded mixed results. For instance, Santarelli (1997) rejects the GL in the hospitality industries in fourteen of the twenty regions in Italy. Similar results include Audretsch, Santarelli and Vivarelli (1999), Lotti et al. (2001), Lotti et al. (2003).

2.1.2. Econometric Techniques in Testing the Gibrat's law

Several econometric techniques have been applied to ascertain the firm size and firm growth nexus, and in the process, test the veracity or otherwise of the GL. Starting from Mansfield (1962), most empirical studies testing the GL have used the Ordinary Least Square estimation (OLSE) technique. A lot of these studies reject the GL (Pfaffermayr and Bellak, 2002; Correa, Acosta, González and Medina, 2003; Hoogstra and van Dijk, 2004). There are others that apply the OLSE but control for sample selection bias and heteroscedasticity (Lotti, Santarelli, and Vivarelli, 2002; Santarelli and Vivarelli, 2002; Reichstein and Dahl, 2004). The Heckman sample selection model is commonly used in the literature. These corrections are necessary considering the limitations of the OLSE. Hall (1987) in his study, applies the OLS technique, tests for nonlinearity, and control for sample selection, measurement errors and heteroscedasticity.

More recent studies have employed both static and dynamic panel data techniques in estimation. For example, Das (1995); and Voulgaris, Asteriou and Agiomirgianakes (2003) use the static panel fixed effects (FE) method while Geroski and Gugler (2001) employ both the static pooled and FE techniques. On his part, Niefert (2005) apply the panel FE and first differenced dynamic panel data to take care of time invariant, unobserved heterogeneity. Generally, the panel FE involves removing the unobserved time-invariant fixed effects from the dependent variable and exogenous regressors prior to estimation (Wooldridge, 2002; Baltagi, 2005). The dynamic panel approach generally used to test the GL is the panel Generalized Method of Moments (GMM), an Instrumental Variable (IV) approach. Del Monte and Papagni (2003); Oliveria and Fortunato (2003a, 2003b, 2004a); are among the studies that apply the GMM to test the GL. Also, Oliveria and Fortunato (2004b, 2005) use the panel GMM and its variant, the GMM-SYS estimation technique. Studies by Oliveira and Fortunato (2003a) and Geroski et al. (2003) also use the panel unit root techniques in their analysis.

The OLSE has also been combined with other techniques in the literature: Machado and Mata (2000) apply the GLS plus a normality test to invalidate the existence of the GL; Heshmati (2001) uses OLSE, the Generalised Least Square (GLS) estimation technique and the within and between estimations;

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Shanmugam and Bhaduri (2002) apply the OLS and panel FE; Nkurunziza (2005) employs the OLS, panel FE, and panel GMM techniques plus a selection procedure suggested by Heckman (1979); Audretsch and Lehman (2005) combine the OLSE with the Two Stage Least Square (2SLS) Instrumental Variable (IV) approach. All these show a robust negative nexus between firm size and firm growth.

Other methods have also been used in the literature to test the GL. For instance, Scherer, Harhoff and Kukies (2000); Bottazzi et al. (2001); and Goddard, Wilson and Blandon (2002) use the Monte Carlo methods in their studies. On their part, Fariñas and Moreno (2000); and Fotopoulos and Louri (2004) apply the non-parametric kernel density estimation approach and quantile regressions while Lotti, Santarelli and Vivarelli (2003); and Wagner (1994) use the probit model.

In the main, although the GL's is invalidated in this study, it provides a guiding framework for the understanding of major characteristics of the empirical investigation of firm size and firm growth.

3. Methods

3.1. Research Design

This study employed ex post facto research design to ascertain the impact of firm size on firm growth in Nigeria. The following sections describe the sampling, statistical, and operational designs employed in this study.

3.2. Population and Sample

This study has a population of 114 non-financial firms that are quoted on the NSE, representing about 66.67 percent of the entire quoted 171 firms as at February, 2018. This researcher thus constructs a sampling frame of 114 non-financial firms (representing 66.67 percent of the population) and a sample size of 63 (or 55.26 percent of the sample frame). Besides, this study employs the stratified sampling technique with variable sampling fraction and follows the NSE sectoral classification. Sampled firms consist of private non-financial firms that are commercially active in Nigeria and have been in operation for at least five years, including 2012 to 2016. They also have submitted their mandatory audited 2016 annual financial statements to the NSE by February, 2012 and operate in all sectors clearly classified by the NSE, except financial services.

3.3. Data and Data Collection Method

Data used in this study are from secondary sources. To ensure currency of data and be consistent with the five year period commonly used in financial planning (Van Horne, 2002; Ross, Westerfield, Jaffe and Jordan, 2007; Pandey, 2011), time series data obtained from published annual reports of sampled firms from 2012 to 2016 are employed in this study. There are no missing values for all firms in the data set.

3.4. Model Specification

Following the Gibrat Law (1931) the dynamic bivariate model of the firm size and firm growth nexus in Nigeria is of the following form:

$$Growth_{it} = \sum_{j=1}^{n} \propto_{it} + \sum_{j=1}^{n} \beta SIZE_{it} + \eta_i + \mu_{it} \quad (1)$$

Where GROWTHit is the growth rate of firm i at time t; SIZEit is the size of firm i at time t; η1 is the unobserved time-invariant fixed effects; and μit is the error term of firm i at time t.

Moreover, we gauge the robustness of the independent partial correlation between firm size and firm growth using the following model:

$$Growth_{it} = \sum_{j=1}^{n} \propto_{it} X_{it} + \sum_{j=1}^{n} \beta SIZE_{it} + \eta_i + \mu_{it} \quad (2)$$

Where GROWTHit is the growth rate of firm i at time t; Xit is a set of control variables; αit is a vector of coefficients on the variables in Xit; β is the estimated coefficient of the size of firm i at time t (SIZEit); η1 is the unobserved time-invariant fixed effects; and μit is the error term of firm i at time t.

The firm growth function is posited to have the following form:

$GROWTH_{it}$ = f (SIZE, $GROWTH_{t-1}$, AGE, LEV, INTERFIN, ME, OE, $SALES_{t-1}$) (3)

Where firm growth depends on firm size, previous year's growth, firm age, leverage, internal finance, management efficiency, operating efficiency and previous year's sales.

Following from equation 3 above, a dynamic panel model showing the effect of firm size on firm growth is thus formulated as follows:

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$GROWTH_{it} = \alpha_{it} + \beta_1 GROWTH_{it-1} + \beta_2 SIZE_{it.} + \beta_3 AGE_{it} + \beta_4 LEV_{it} + + \beta_5 INTERFIN_{it} + \beta_6 ME_{it} + \beta_7 OE_{it} + \beta_8 SALES_{it-1} + \eta_i + \mu_{it}$ (4)

Where:

$GROWTH_{it}$ = growth rate of firm i at time t, measured as the growth rate of sales or turnover

$GROWTH_{it-1}$ = growth rate of firm i at time t_{-1}, measured as the growth rate of sales or turnover in the previous year.

$SIZE_{it}$ = the size of firm i at time t, proxied by total assets.

AGE_{it} = the age of firm i at time t, which is the difference between the current year and the year of incorporation. It shows the number of years the firm has been active in the business sector since its inception.

LEV = Leverage of firm i at time t, measured as the ratio of debt to equity

$INTERFIN_{it}$ = internal finance, the retained earnings of firm i at time t.

ME_{it} = the management efficiency of firm i at time t, measured as net profit margin (net profit after taxes as a percentage of sales). It shows how efficiently the management of the firm uses its resources.

OE_{it} = the operating efficiency of firm i at time t, measured as the ratio of total assets to sales. The lower the ratio, the more efficient is the utilization of assets by management.

$SALE_{it-1}$ = sales or turnover of firm i at time t-1. This is the previous year's sales.

α_0 and β_i, i = 1,…, 8 are parameters estimated.

η_1 = the unobserved time-invariant fixed effects

μ_{it} = the error term of firm i at time t.

We expect "a priori", β_1, β_2, β_3, β_5, β_6, β_7, $\beta_8 > 0$ while β_4, and <0.

In the tradition of growth econometrics, the variables are in logarithmic form.

3.4.4. Analytical Variables:

Indicators of firm growth and firm size:

There is no consensus on the use of either absolute or relative growth measure or the choice of growth indicators in the literature. In this study, the growth of the firm and is measured as the percentage change in sales. This measure is consistent with indicator used in the standard percentage of sales approach to financial planning (Demirguc-Kunt and Maksimovic, 1998; Van Horne, 2002; Ross et al., 2007). Following Segarra and Teruel (2009) this study employs total assets as the indicator of size of the firm.

Control Variables: The percentage of sales approach to financial planning posits that the determinants of sustainable growth of a firm are: the ratio of total assets to sales (measuring operating efficiency), Net Profit Margin (a measure of management efficiency), retention rate of earnings (retained earnings or internal finance), debt to equity ratio (indicating the capital structure), and previous year's sales (Higgins, 1984; Van Horne, 2002; Ross et al., 2007; Pandey, 2011). Following from this, we use Leverage of the firm (LEV), internal finance (INTERFIN), management efficiency (ME), operating efficiency of the firm (OE), and previous year's sales (SALEit-1) as control variables. Finally, firm age (AGE) is also used as control variable because extant literature show that there are links between it and firm growth (Shanmugam and Bhaduri, 2002; Becchetti and Trovato, 2002; Peña, 2004; Audretsch and Lehman, 2005; Yasuda, 2005; Calvo, 2006). The age of the firm is measured as the difference between the current year and the year of incorporation. It shows the number of years the firm has been active in the business sector since its inception.

3.5 Model Estimation Techniques

In order to ascertain the impact of firm size on firm growth in Nigeria, this study employs the Generalized Method of Moments (GMM) formulated by Hansen (1982) and developed for dynamic panel model by Arellano and Bond (1991), and Arellano and Bover (1995). The GMM estimation technique typically addresses the issue of endogeneity of independent variables and controls for simultaneity bias and reverse causality. This study employs the dynamic panel GMM estimator designed for use in a panel with a large number of cross section and a short time series. In estimation, a first difference transformation (as in Arellano and Bond, 1991) is applied to the specification to remove cross section fixed effects. Characteristically, the lag of the dependent variable is included as a regressor while period dummy variables are used to control for period fixed effects. Specifically, the Arellano-Bond type dynamic panel instruments with lagged values of the dependent and other predetermined variables that vary by observation is specified. Moreover, the Arellano-Bond 2-step estimation approach with White period GMM weighting matrix is applied while the robust White period weight from final iteration is used to compute the standard errors.

The general test of model adequacy for the dynamic panel GMM estimator suggested by Arellano and Bond (1991) is the Sargan's (1958) J-test (or J statistic) or test for over-identifying restrictions. Under the null

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hypothesis that the over-identifying restrictions are valid, the Sargan J statistic for GMM panel data is distributed as$\chi^2(\rho - k)$, where k is the number of estimated coefficients and ρ is the instrument rank. The null hypothesis is that the model is "valid" while the alternative is that the model is "invalid" and that the data do not come close to meeting the restrictions. The null hypothesis is rejected at 95% confidence level if the J -statistic is greater than the chi-square critical value. In this study, we employ an efficient GMM estimation that typically uses period-specific sets of instruments corresponding to lagged values of the dependent and other predetermined variables.

4. Results

In this chapter, the analysis of the impact of firm size on firm growth of Nigerian firms between 2012 and 2016 is presented.

4.1: Descriptive Analysis

Table 1 shows the descriptive summary statistics of the variables used in this study, including the mean, median, skewness and kurtosis. The average growth rate (GROWTH) achieved by sampled firms during the period under consideration is 9.95%. The highest rate of growth during the period was 453% while the lowest growth rate stood at -83%. Figures for previous year's sales (SALES-1) indicated that N51,348 million worth of sales on the average was recorded (maximum, N65,100 million; minimum, N26 million) by sampled firms.

Table 1: DESCRIPTIVE STATISTICS OF VARIABLES IN THE FIRM AGE AND FIRM GROWTH NEXUS IN NIGERIA: 2012 – 2016

	GROWTH	LEV	SIZE	AGE	INTERFIN	ME	OE	SALES-1
Mean	9.949492	2.379524	63249032	43.68254	7014163.	-16.03603	3.164889	51348283
Median	5.540000	1.400000	12682283	45.00000	1435796.	4.090000	1.240000	9808273.
Maximum	453.1000	73.28000	1.53E+09	94.00000	1.42E+08	138.3000	175.0400	6.51E+08
Minimum	-83.00000	-343.1700	58600	7.000000	-2.00E+08	-2224.190	0.110000	26261.00
Std. Dev.	48.07141	21.97352	1.54E+08	19.32526	25431174	155.6069	12.19405	89941460
Skewness	5.173359	-11.94469	5.859260	0.049400	-1.971479	-10.91679	11.23539	2.867077
Kurtosis	43.42816	196.6345	44.39890	2.407815	29.01742	140.7157	142.6038	13.18314
Jarque-Bera	22857.07	499603.6	24296.90	4.730838	9088.445	255180.6	262423.2	1792.572
Probability	0.000000	0.000000	0.000000	0.093910	0.000000	0.000000	0.000000	0.000000
Sum	3134.090	368.6400	1.99E+10	13760.00	2.31E+10	-5051.350	13227.50	1.62E+10
Sum Sq. Dev.	725610.2	289.4379	7.44E+18	117268.3	1.03E+19	7603039.	1.06E+08	2.54E+18
Observations	315	315	315	315	315	315	315	315

Source: Author's computation (2018)

For internal finance (INTERFIN), an average sum of N7,014 million was retained by non-financial firms (maximum, N142000 million; minimum, representing a loss of N200000 million). Average size of sampled firms, measured by total assets stood at N63,249 million while the maximum size and the minimum recorded size during the period stood at ₦1,527,908 million and ₦ 58.600 million respectively. Also, the average age of sampled firms is about 44 years (maximum, 94; minimum 7) while leverage of 2.38 (maximum, 73.28; minimum -343.17) were recorded by the firms. The summary statistics also indicated an average management efficiency (ME) of -16.03603 (maximum, 138.30; minimum -2224.19); and mean organizational efficiency (OE) of 3.16 (maximum, 175.04; minimum 0.11). Furthermore, the Jarque-Bera

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statistics of the series in the panel data and its p-value indicate that virtually all the series are normally distributed and that the panel data series exhibit white noise process properties.

Table 2: Correlation between variables in the firm size and firm growth nexus in Nigeria: 2002 – 2016.

	GROWTH	LEV	SIZE	AGE	INTERFIN	ME	OE	SALES-1
GROWTH	1	0.086225	0.032032	-0.06163	-0.0625	0.160328	-0.13838	0.0328
LEV	0.086225	1	-0.00126	-0.01289	-0.03144	0.006014	0.001871	0.011015
SIZE	0.032032	-0.00126	1	-0.07626	0.074751	0.084288	-0.03508	**0.75973**
AGE	-0.06163	-0.01289	-0.07626	1	0.103133	0.14365	-0.20702	0.063492
INTERFIN	-0.0625	-0.03144	0.074751	0.103133	1	0.115681	-0.05405	0.251501
ME	0.160328	0.006014	0.084288	0.14365	0.115681	1	-0.94803	0.097089
OE	-0.13838	0.001871	-0.03508	-0.20702	-0.05405	-0.94803	1	-0.09079
SALES-1	0.0328	0.011015	**0.75973**	0.063492	0.251501	0.097089	-0.09079	1

The correlation matrix shows interactions between variables used in this study. In all there are 64 interactions out of which only one corelation involving SALES-1 and SIZE (0.75973) were detected. This is indicative of possible existence of multicollinearity between these variables. As noted by Rachev, Mittnik, Fabozzi, Focardi and Jasic (2007) multicollinearity could be resolved by orthogonalization of variables. The process was duly carried out in this study by the GMM estimator.

TABLE 3: Results of the impact of firm size on firm growth in Nigeria: The dynamic panel generalized method of moments (Gmm) estimation.

Dependent Variable: GROWTH

Independent Variables	Coefficient	Std. Error	t-Statistic	P. Value
SIZE	-0.0000000719	0.0000000228	-3.161017	0.0018***
GROWTH(-1)	-0.181414	0.066223	-2.739446	0.0068***
AGE	0.794193	1.938077	0.409784	0.6824
LEV	0.080515	0.019051	4.226208	0.0000***
INTERFIN	-0.00000113	0.000000143	-7.925477	0.0000***
ME	0.120839	0.035664	3.388224	0.0009***
OE	0.914479	0.729660	1.253296	0.2117
SALES-1	0.000000701	0.0000000728	9.621491	0.0000***
Mean dependent var	-5.655644	S.D. dependent var		52.22533
S.E. of regression	48.75225	Sum squared resid		430197.5
J-statistic	12.58200	Instrument rank		15
Prob(J-statistic)	0.082972			

Source: Author's computation 2018

Note: (1) *** denotes significance at 1 %; ** denotes significance at 5 %; * denotes significance at 10 %.

(2) The cross-section fixed effect is removed by first differences transformation

(3) White period instrument weighting matrix

(4) White period standard errors and covariance (no d.f. corrected)

(5) Instrument specification: @dyn(growth,-2) liq-1 lev-1 size-1 age-1 tang-1 exterfin-1 interfin-1 me-1 oe-1 roe-1 sales-1 er-1 gdp-1

(6) Transformation: Orthogonal Deviations

(7) Constant added to instrument

Results of the GL test and the impact of firm size on firm growth in Nigeria using the dynamic panel GMM approach are presented in table 3. The coefficient of SIZE with a t-statistic of -3.161017 and a p-value of 0.0018, firm size (SIZE) is shown to have a significant but negative impact on firm growth in Nigeria at 5

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percent level of significance. This implies that small firms grow faster than larger firms in the country. Similarly, previous year's growth (GROWTHt-1: t stat -2.739446; p. value 0.0068) and internal finance (INTERFIN: t stat -2.926303; p. value 0.0038), negatively but significantly influence firm growth in the country at 5 percent level of significance.

Also, results in table 3 indicate that leverage (LEV: t stat 4.226208; p. value 0.0000), management efficiency (ME: t stat 3.388224; p. value 0.0009) and previous year's sales (SALESt-1: t stat 9.621491; p. value 0.0000), are positive predictors of firm growth in Nigeria at 5 percent level of significance during the period under consideration. The positive effect of leverage is indicative of Nigerian firms generally adopting appropriate mix of debt and equity in their capital structure to power growth. On the contrary, results show that the age of the firm (t stat 0.409784; p. value 0.6824) and organizational efficiency (OE: t stat 1.253296; p. value 0.2117), although rightly signed are inconsequential in the dynamics of firm growth in Nigeria during the review period.

The dynamic panel GMM estimator further show that the J-statistic, Prob (J-statistic) and the instrument rank are 12.58200, 0.082972 and 15 respectively. Since the J -statistic of 12.58200 is less than the critical value of the $\chi^2(\rho - k)$ distribution of 14.4494, this study fails to reject the null hypothesis (Ho) of over-identifying restrictions at 95% confidence level. This validation of the Sargan's (1958) test of over-identifying restrictions therefore confirms the model adequacy of this study.

5. Discussion.

In this study, the dynamic GMM approach is applied to panel data of surviving firms for the period 2012 to 2016 to test the veracity of the GL. Results of this study presented in table 3 show that firm size is a predictor of firm growth in Nigeria at 5 percent level of significance. This is contrary to the prediction of the celebrated GL that firm growth is dependent only on stochastic or random factors but independent of firm size. Our findings thus confirm results of most studies that have tested the GL (Teruel, 2007; Daunfeldt and Elert, 2013; Fiala and Hedija, 2015).

Besides, results of this study are in agreement with the stylized fact of the existence of a robust negative nexus between firm size and firm growth (Teruel, 2007; Lotti et al., 2009; Santarelli and Vivarelli, 2009; Fotopoulos and Giotopoulos, 2010; Daunfeldt and Elert, 2013; Fiala and Hedija, 2015). This implies that small firms grow faster than larger firms.

An explanation for the inverse relationship between size and growth is provided by diseconomies of scale that larger firms face as they expand beyond a threshold. Notable among these diseconomies, on the supply side, are financial and organizational constraints. The Penrose effect (Penrose, 1959) for instance identifies limited capacities of existing management of a large firm as a constraint to its growth. Also, the learning and selection models identify the level of efficiency as a key determinant of firm's growth and survival. A firm does not know its level of efficiency until it enters the market. In the market, the most efficient firms grow more rapidly, until achieving a minimum efficient size. Inefficient firms will however depart eventually (Jovanovic, 1982). Thus, small firms grow faster than larger firms since the former are in the early process of discovering their efficiency levels.

Moreover, this study shows that previous year's growth, internal finance, leverage, management efficiency and previous year's sales are other predictors of firm growth in Nigeria in complete violation of the GL's claim that only stochastic factors influence firm growth.

6. Conclusion

In this study we provide empirical test of the Gibrat's law which posits that firm growth is dependent only on stochastic or random factors but independent of firm size. To ascertain the veracity of this claim with respect to Nigeria, we use balanced micro panel data and apply the dynamic Generalized Method of Moment (GMM) estimator. Employing a sample of 63 non-financial firms quoted on the Nigerian Stock Exchange (NSE) between 2012 and 2016, this study provides evidence of a negative significant relationship between firm size and firm growth during the period under investigation. This implies that small firms grow faster than larger firms. Moreover, the existence of other predictors of firm growth, such as previous year's growth, internal finance, leverage, management efficiency and previous year's sales, further invalidates the Gibrat's law with respect to Nigeria. Public policy thus targeted at promoting firm growth in Nigeria should take cognizance of these facts.

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