HUMAN CAPITAL EFFICIENCY AND PROFITABILITY OF LISTED OIL AND GAS FIRMS IN NIGERIA

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Abstract

This study examined the effect of Human Capital Efficiency on profitability of listed oil and gas firms in Nigeria covering a period from 2006 to 2018 using ex-post facto research design. From a population of 12, 9 firms were selected purposively on the basis of data availability and period of listing. Secondary data was sourced from annual audited financial reports of sampled firms as well as from Nigerian Stock Exchange (NSE) facts sheets. The dependent variable is profitability which was computed as Return on Assets (ROA) while the independent variables are Human Capital Efficiency (HCE), Value Added Intellectual Coefficient (VAIC), and Firm Size (FIZ). The regression result revealed that both HCE and VAIC had significant positive effect on ROA. Stemming from this, the study concludes that human capital is very vital in determining the profitability of listed oil and gas firms in Nigeria. The major recommendation of the study was that management of oil and gas firms should strategically invest more in human capital through continuous manpower development as well as provision of adequate incentives to boost productivity and by extension increase profitability.

Keywords: Human Capital, Profitability, Return on Assets, Oil and Gas firms, Value Added Intellectual Coefficient, Human Capital Theory

Introduction

One of the principal objectives of most business firms is to achieve optimum profitability. Profitability helps in the sustenance, growth and expansion of firms by way of ploughing back the profit. Survivability as well as dividend pay-out procedure of a firm is determined by the firm's long-term profitability (Parvutoiu, Popescu & Grigoras, 2010). It is therefore, imperative that firms hold highly the strategies and prospects of business for profit optimisation. Firms utilise variety of resources to attain desired level of profitability and enhanced competitive advantage. Among these assets are physical, financial and human capitals. Appropriate combination of these assets will culminate in favourable outcome. Vital among these assets is the human capital because the power of initiative, expertise and administration lies within human capabilities. The issue of human capital efficiency cannot be overemphasised as it determines the success or otherwise of a firm. No matter the investment in physical and financial assets, if a firm's investment in human capital is not adequate, profitability could still be far reached.

The Nigerian oil and gas firms have been of tremendous influence in the growth and development of the economy. It is evident that this sector has made the most contribution to the federal treasury in terms of revenue generation. Reports given by the Central Bank of Nigeria (CBN) attests that, in the fourth quarter of 2018, the gross oil revenue was N1,465.31 billion representing 60.7% of Nigeria's total revenue (CBN, 2018). This is an indication that the remaining sectors jointly contributed 39.3% of the total revenue of Nigeria. Invariably, the Nigerian oil and gas is a formidable sector, nonetheless, in spite of its remarkable achievements, the sector is faced with series of challenges. One of such challenges is the need for capacity utilisation which could however be enhanced by building and maintaining functional refineries in Nigeria. Recent records show that there are only four functional refineries situated in Port-Harcourt, Warri, Kaduna and Eleme-New Port Harcourt (Tsegha, 2013). These refineries have combined capacity of 445,000 barrels per day, and are operating at about 26% capacity utilisation (Onuegbu, 2016). Fluctuation in oil prices possibly stemmed from inadequate capacity utilisation. It has been argued that prices of petroleum product could be better regulated with functional refineries in the nation (Amanze-Nwachukwu & Okafor, 2018).

Prominent among the challenges in the Nigerian oil and gas sector are those of human capital concerns. A case in point is the issue of inadequately trained employees manning highly technical aspects of a firms operation. Obviously, this has adverse effect on the performance of the business and hinders effective service delivery (Maduagwu, Kifordu & Ogbo, 2016). Also, the practice of 'casualization' of workers, otherwise known as contract staffing is also common among firms in this sector, which has led to series of dispute between those termed as precarious workers and management of the firms (Alike, 2018). Due to these issues, employees tend to lose confidence in the system thereby resulting in a decline in efficiency. Ultimately, it leads to decrease in profitability of the firms concerned.

Besides, although some studies on human capital and profitability have been carried out in Nigeria like those of Ali (2015), Ocheni (2018) and Inyada (2018); it is still necessary to direct focus on the oil and gas sector which has not been given much attention in this regard. Moreover, the coverage period of these studies did not exceed 2016; this current study intends to fill these gaps. Thus, the objective of this study is to examine the effect of human capital efficiency on profitability of listed oil and gas firms in Nigeria. The hypotheses of the study are given as:

H_{01}: Human capital efficiency does not have significant effect on profitability of oil and gas firms in Nigeria

H_{02}: Value added intellectual coefficient has no significant effect on profitability of listed oil and gas firms in Nigeria.

Literature Review

Human capital is an indispensable asset of any business entity. This is because every other asset owned by an organisation requires human initiative to function effectively. Ramezan (2011) described

human capital as individual tacit knowledge ingrained in employees' minds which consists of a mixture of their attitude, innovation and proficiency. For this reason, Pulic (2008) suggested that HC should be treated as investment rather than cost, since the knowledge acquired by employees eventually culminates in value creation. Value in itself is an important factor in the survival, hence, firms in a knowledge base economy require adequate strategy to cope with this paradigm. This calls for firms to appropriately utilise available resources to create value and enhance competitive advantage (Pratama, Innayah & Darmawan, 2019). One way to achieve value creation is by increasing the firm's intellectual capital with specific attention on human capital. In this study, Human capital efficiency was used to measure the additional value created from investment in human capital by the Nigerian oil and gas firms.

Human Capital Efficiency is one of the components of Value Added Intellectual Coefficient (VAIC), a model developed by Pulic (2008) for measuring intellectual capital (IC). VAIC was designed to enable management and other stakeholders adequately monitor and evaluate the efficiency of investment in IC as it relates to value creation using accounting-based values (Rahim, Atan, & Kamaluddin, 2017). Although VAIC has its shortcomings which include inability to appropriately deal with negative operating value; and non-inclusion of Research and Development expenditures (Chu, Chan & Wu, 2011; Joshi, Cahill, Sidhu & Kansal, 2013). VAIC has however been identified by several scholars as a veritable model for measuring IC since it derives its data from audited financial statement of firms, thus making it reliable and consistent. Some researchers whose works have provided evidence on the viability of VAIC include Ocheni (2018), Ogbodo, Amahalu and Abiahu (2017), Anyanwu, Ezu, Osadume and Ananwude (2017), Ozkan, Cakan and Kayacan (2016), Inyada (2018) and Khan (2018).

VAIC is subdivided into components namely, Human Capital Efficiency (HCE), Structural Capital Efficiency (SCE) and Capital Employed Efficiency (CEE). This study however focuses on HCE. HCE is the ratio of value added to human capital investment. Basically, HCE refers to the extent of value added to a firm as a result of investment in its employees (Anyanwu, Ezu, Osadume &Ananwude, 2017). HCE indicates the human capital performance of a firm, hence, the ratio of the value added by intellectual capital (Ewereoke, 2018). HCE is the level of the value-added generated per monetary unit invested in the employees of a firm (Kleynhans & Sekhobela, 2015). HCE shows how much value has been created from a monetary unit invested in human capital, (Rezaei, 2014).

Investment in human capital can increase the value of the firm since employee competencies usually culminate in increased profit. Profitability of firms is of utmost importance in the growth and development as well as survival of business firms. Apparently, the financial strength of an entity can be measured by its profits (Popoola, 2018). Profitability is considered ultimate measure of a firm's economic success in relation to its investments (Usman, Okpanachi, Nyor &Yahaya, 2018). Hence, it is noteworthy to state that the higher the profits of a firm the better the stability of the firm and the higher its potential for growth. Although, Tulsian (2014) argued that profitability is only an absolute term, as such profit does not guarantee efficiency of a firm; hence, high profit may not always be a thorough indication of a firm's optimum success, other measures could be employed to augment the results from

profitability measures. Notwithstanding, Banga and Brorsen (2019), using technical analysis suggest a strong relationship between and efficiency. Operating efficiency is often used to measure a firm's financial soundness. Operating efficiency relates to a firm's ability to maximise owners' funds which depends ultimately on the profits earned. The profitability of a firm is commonly measured by profitability ratios (Venkateswararao, 2018).

Profitability ratios measure the earning ability of a firm; hence, it measures the extent to which a business generates profit from the factors of production. Return on assets (ROA) is one of the commonly used ratios for measuring a firm's profitability, which is calculated by dividing net income by total assets (Isanzu, 2015). ROA therefore indicates a firm's profitability in relation to its total assets, as such, appraises the competence of management in generating profit from the assets of the firm (Nedelcu, Banacu & Frasineanu, 2014).

The theory underpinning this study is Human capital theory (HCT), this is because the theory provides suitable explanations to the concepts entailed in this study. HCT is founded on the premise that the degree of investment a firm makes on human capital is dependent on the estimated future returns or profits from such investments. From Bassey and Tapang (2012), investments in human capital include all costs associated with enhancing employee productivity, such as cost of incentivising and training. In this way, efforts should be made by firms to enhance the skills and expertise of employees so as to ensure maximum efficiency of their human resources.

Extant studies on this subject include those of Ali (2015) which studied eight Nigerian banks over a period of eight years (2006 to 2013); the study found out that HCE had significant positive effect on ROA. Daikwo (2015) examined six quoted pharmaceutical firms in Nigeria for five years from 2009 to 2013; the study revealed that HCE had significant positive effect on ROA. Isanzu (2015) studied thirty-one Tanzanian banks from 2010 to 2013; it was discovered from the study that VAIC and HCE had significant positive impact ROA. In Saudi Arabia, Al-Musali and Ku -Ismail (2014) focused on eleven banks from 2008 to 2010 and found out that VAIC and HCE had significant positive effect on ROA. Ozkan, Cakan and Kayacan (2016) studied 44 banks in Turkey from 2005 to 2014; it was discovered from the study that HCE had significant positive influence on ROA.

In Pakistan, Ahmad and Ahmed (2016) studied 78 listed firms in the financial industry from 2008 to 2013, it was discovered from the study that HCE had significant positive impact on ROA. Sidharta and Affandi (2016) examined 205 Indonesian banks from 2011 to 2013; the study revealed that HCE had significant influence on ROA. Khorasanian (2016) studied eight Iranian banks for a period of six years from 2010 to 2015; the study showed that HCE positively affects ROA. Mbugua and Rotich (2014) examined ten listed Kenyan commercial banks with a coverage period from 2009 to 2013; it was discovered from the study that human capital had significant negative impact on ROA. Mohammad, Bujang and Hakim (2018) focused on forty-one Malaysian construction firms from 2011 to 2015 using regression analysis; the study revealed that VAIC had significant positive impact on ROA; whereas, HCE had negative impact on ROA.

Tarigan, Listijabudhi, Hatane and Widjaja (2019) centred on Indonesian listed firms and discovered that, VAIC had significant influence on ROA while HCE was insignificant. Baye, Douanla and Fonkem (2014) examined financial institutions in Cameroon for two years (2007 to 2008) and found out that HCE had insignificant influence on ROA. Khan (2018) focused on fifty-one firms in the Indian Information Technology sector from 2006 to 2016; from the study it was discovered that VAIC had significant positive impact on ROA while HCE did not have significant effect on ROA. Basically, most of these researchers study a combination of two or more of the intellectual capital components entailed in the VAIC model. However, very few studies with specific focus on Human Capital Efficiency (HCE) include that of Rahim, Atan and Kamaluddin (2017) which centred on HCE and its effect on ROA using 19 Malaysian technological firms for the year 2009; the study revealed that HCE had significant positive effect on ROA.

Methodology

This study employed *ex-post facto* research design using quantitative data sourced from published audited annual reports of oil and gas firms. The population of this study consists of the 12 oil and gas firms listed on the floor of the Nigerian Stock Exchange. The sample of the population is 9 firms selected on purposive basis. The sampled firms were selected on the basis of availability and accessibility of relevant data for the coverage period of 2006 to 2018. These firms include: Coniol Plc, Eterna Plc, Japaul Oil &Maritme Services Plc, Oando Plc, Forte Oil Plc, MRS Oil Plc, 11 Plc, Total Nigeria Plc and Capital Oil Plc.

Profitability is the dependent variable for this study and it is proxy by Return on Assets (ROA). Human capital is the independent variable for this study and it is measure by Human Capital Efficiency (HCE). HCE is one of the components of Value Added Intellectual Coefficient (VAIC), a model for computing intellectual capital as a whole. For the purpose of analysis in this study, VAIC was also included in the model to ensure thoroughness.

The regression model built for this study is given as:

$$ROA_{i,t} = \beta_0 + \beta_1 HCE_{i,t} + \beta_2 VAIC_{i,t} + \beta_3 FIZ_{i,t} + \varepsilon_{i,t}$$

Where:

$ROA_{i,t}$ = Return on assets, an indicator of the profitability of individual firms at time t. ROA is measured as profit before tax divided by Total Assets (Baye &Douanla, 2014)

$HCE_{i,t}$ = Human Capital Efficiency, an indicator of human capital performance determined by the ratio of the value added to investment in human capital (training costs and other employee benefits) of individual firms at time t (Pulic, 1998; Mohammad, Bujang& Hakim, 2018).

$VAIC_{i,t}$ = value added intellectual coefficient computed by adding the three major components of intellectual capital: Human capital efficiency (HCE) , Structural Capital Efficiency (SCE) and Capital Employed Efficiency (CEE) (Pulic, 2008).

HCE = $\frac{\text{Value Added}}{\text{Human Capital}}$ where: Human Capital (HC) = Total investment to enhance performance of employees, these include cost of training and provision of other benefits.

SCE = $\frac{\text{Structural Capital}}{\text{Value Added}}$, where: SC = VA – HC

CEE = Book value of the net asset for a company (Pulic, 2008; Baye & Douanla, 2014).

Value Added (VA) = Total output – Total input. VA represents the value added efficiency of the firms.

Total input = total costs and expenses incurred by the firm during that particular fiscal year. Total output =total income from all products and services sold during the particular fiscal year (Pulic, 2008; Ikapel, 2016).

$FIZ_{i,t}$ = Firm size represented by log of total assets of individual firms at time t (Deep & Narwal, 2014).
β_0 = Constant term (intercept)
β_1 to β_3 = Coefficients to be estimated
$\varepsilon_{i,t}$ = Error term associated with individual firms at time t.
i = Sampled firms (9)
t = Period coverage (13 years)

A priori, the human capital variables, that is human capital efficiency and value added intellectual coefficient are expected to positively impact profitability, i.e. HCE > 0 and VAIC > 0.

Results And Discussion

Table 1 presents summary of data properties as it relates to listed oil and gas firms in Nigeria. Observing from the table, there are 117 observations stemming from the panel data which entails 9 oil and gas firms over a period of 13 years, indicating that the dataset is strongly balance. This is so because there were no missing data regarding the firms over the coverage period.

ROA shows a mean value of 0.027, which connotes that Nigerian oil and gas firms made an average profit of approximately 3% from their investments in assets. Likewise, during the period under review, a firm made a remarkable profit of 44% on total assets, whereas a loss of 71% was also incurred by a firm, which is represented by the negative minimum mean. The volatility of the data is 0.131 which explains the disparity in value of ROA, ranging from high percentage profits to the huge losses recorded.

Table 1
Summary of Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	Skewness	Kurtosis
ROA	117	0.027	0.131	-0.713	0.441	-2.036	12.801
HCE	117	3.850	4.811	-30.082	15.813	-3.194	23.439
VAI_C	117	6.285	8.246	-28.031	45.986	1.631	13.093
FIZ	117	7.960	0.648	6.508	9.464	0.716	3.151

STATA 14 output

Also, from Table 1, HCE presents a mean, minimum mean, maximum mean, and standard deviation of 3.850, -30.082, 15.813 and 4.811 respectively. These values depict additional value made by firms as a proportion of its investment in human capital. In this case, the additional value produced by investment in human capital on the average is 3.850; also, the data has a high variance of 4.81 from the mean value. This owes to the fact that the data includes an observation with negative or diminished value of 30.082, whereas an additional value of 15.813 was derived by the sampled firms on the maximum.

VAIC has mean value of 6.285, while minimum mean, maximum mean and standard deviation are given at -28.031, 45.986 and 8.246 respectively. This is an indication that the sampled firms increased in value with 6.29 on the average from investment in intellectual capital (which also encapsulates human capital). More so, during the period of analysis, a firm had a remarkable increase in value added of 45.986, whereas, a firm had a diminished value of 28.031 represented by the negative sign.
Firm size (FIZ) has a mean of 7.960, depicting that the average assets owned by listed oil and gas firms in Nigeria between 2006 and 2008 was 7.960 (in logarithm expression). Whereas, the minimum and maximum values were given as 6.508 and 9.464 respectively, this accounted for the variance of 0.648 in the dataset. Still on Table 1, only the skewness of HCE (-3.194) conforms to the cut-off point of +3; while the kurtosis of FIZ (3.151) falls short of the threshold of +10 (Kline, 2005). These are indications of non-normality of data distributions.

Table 2
Shapiro Wilk W Test for Normality

Variable	Obs	W	V	Z	Prob>z
ROA	117	0.818	17.144	6.358	0.000
HCE	117	0.753	23.292	7.043	0.000
VAIC	117	0.742	24.345	7.142	0.000
FIZ	117	0.921	7.404	4.479	0.000

STATA 14 output

The Shapiro Wilk W test in Table 2 also confirms the non-normality of data distribution for this study, owing to the observation that the probability values (p-values) of all the variables are significant at 1%.

Table 3
Correlation Matrix

Variables	ROA	HCE	VAIC	FIZ
ROA	1.000			
HCE	0.582	1.000		
	0.000			
VAIC	0.242	0.491	1.000	
	0.009	0.000		
FIZ	-0.235	0.045	0.298	1.000
	0.011	0.627	0.001	

STATA 14 output

The bivariate correlation matrix in Table 3 shows positive correlation between ROA and HCE, also between VAIC and ROA; implying that both pair of variables move in the same direction. Invariably, this outcome suggests that an increase in HCE and VAIC will equally lead to an increase in ROA. However, FIZ portrays an inverse relationship with ROA, such that any increase in FIZ could lead to a decline in ROA. It can also be observed from the table that HCE, VAIC and FIZ are not collinear within the threshold of 0.8 (Hair, Black, Babin, Anderson &Tathan, 2010). The absence of multicollinearity of the variables of this study can also be confirmed from Table 4 using the Variance Inflation Factor (VIF).

Table 4
Summary of Diagnostic Tests

Tests	**Results**		
Multicollinearity	**Variable**	**VIF**	**1/VIF**
	VAIC	1.460	0.683
	HCE	1.340	0.748
	FIZ	1.110	0.898
	Mean VIF	1.300	
	Chi^2		**Prob.**
Heteroscedasticity	32.460		0.000
Hausman Specification	2.300		0.513
Lagrangian Multiplier	70.640		0.000

STATA 14 output

Based on observation from Table 4, it is evident that there is absence of multicollinearity among the dependent and control variables (VAIC, HCE and FIZ) since all of them have VIFs less than the threshold of 4; besides, their tolerance level (1/VIF) is less than 1.0 (Tabachnick & Fidell, 2007). Furthermore, the result from Breusch-Pagan test for heteroscedasticity reveals that the variables are heteroscedastic since the chi2 is high (32.460) and the probability value (p-value) is 0.000, making it significant at 1%. This is so because the null hypothesis for this test is that variables are homoscedastic, which in this study the hypothesis is rejected.

The dataset was subjected to three estimations, the pooled ordinary least square (OLS), fixed effect estimation and random effect estimation. By extension, Hausman specification test was performed on both the fixed effect and random effect to determine the best fit estimation for this distribution. The result of Hausman test depicts a chi2 value of 2.300 and p-value of 0.513 which represents non-significance of the outcome of the test. To this end, random effect estimation is preferred to fixed effect. Moreover, there was an appraisal of the random effect estimation and the pooled OLS to determine the most appropriate of the estimation using Breusch-Pagan Lagrangian multiplier test (L-M test). From result of the L-M test, it is obvious that random effect is selected for analysis in this study; reason being that the Chi2 shows a value of 70.640 and the p-value is given at 0.000 which is significant at 1%.

Having established that random effect regression is considered the most suitable estimation for analysis, this study however employed robust random effect regression to address the problems of heteroscedasticity and non-normality of the data distribution that were earlier identified. Hence the analysis used standard errors to make the data distribution more fit for inferential purposes.

Table 5
Random Effect Regression Result

ROA	Coef.	Robust Std. Err.	Z	Prob.
HCE	0.013	0.006	2.240	0.025
VAIC	0.002	0.001	3.310	0.001
FIZ	-0.086	0.023	-3.680	0.000
_CONS	0.654	0.188	3.480	0.000
R-squared	0.409			
Adj R-squared	0.393			
Prob> F	0.000			

STATA 14 output

Table 5 presents a summary of the robust random effect regression results. As observed from the table, the model summary shows R-squared value of 0.409, indicating that approximately 41% of the attributes of the dependent variable (ROA) was jointly explained by HCE, VAIC and FIZ, hence 59%

could be explained by other variables not captured in this study. The overall p-value for this analysis is significant at 1%, making the estimation generally suitable for inference.

HCE shows a coefficient value of 0.013 and a p-value of 0.025, connoting that HCE has positive and significant effect on ROA at 5% level of significance. This outcome is contrary to the null hypothesis earlier projected by this study which states that HCE does not have significant effect on profitability of listed oil and gas firms in Nigeria. Thus, upon this evidence, the null hypothesis is rejected. This outcome suggests that, holding all other variables constant, a unit increase in investment in human capital leads to approximately 2% increase in profit of the listed oil and gas firms in Nigeria; hence, increased investment in human capital leads to increased profit. On this basis, it is therefore imperative to optimise investment in human capital to maximize profitability in this sector. This finding is in line with those of Ali (2015); Daikwo (2015); Isanzu (2015); Al-Musali and Ku -Ismail (2014); Ozkan, Cakan and Kayacan (2016) and Khorasanian (2016), but contrary to those of Anyanwu, Ezu, Osadume and Ananwude (2017); Mbugua and Rotich (2014); Mohammad, Bujang and Hakim (2018); and Tarigan, Listijabudhi, Hatane and Widjaja (2019).

The coefficient and p-value of VAIC are 0.002 and 0.001 respectively, indicating significance at 1%. On this note, the hypothesis for VAIC is rejected and the study infers that VAIC has significant effect on profitability of listed oil and gas firms in Nigeria. The implication of this is that, holding all other variables constant, a unit increase in VAIC results in approximately 1% increase in profitability of Nigerian oil and gas firms. This finding is in consonance with those of Isanzu (2015); Al-Musali and Ku -Ismail (2014); Mohammad, Bujang and Hakim (2018); Tarigan, Listijabudhi, Hatane and Widjaja (2019); and Khan (2018).

Conversely, FIZ portrays a significant inverse effect on ROA with coefficient of -0.078 and p-value of 0.001 which is significant at 1%. Thus, it is evident that a unit increase in total assets of oil and gas firms leads to approximately 8% decrease in profits of the firms concerned. Invariably, this outcome could be as a result of inadequate management of these assets, hence caution should be exercised when acquiring and managing assets in the oil and gas sector to minimise adverse effect and possibly reverse the trend.

CONCLUSION AND RECOMMENDATION

The object of this study was to examine the effect on human capital efficiency on profitability of listed oil and gas firms in Nigeria in the period 2006 to 2018. Return on Assets (ROA) was used as measure for profitability (the dependent variable); human capital was the independent variable measured by Human Capital Efficiency (HCE) and Value Added Intellectual Coefficient (VAIC); while firm size (FIZ) was used as a control variable. Based on the findings of this study, there is sufficient evidence to conclude that human capital efficiency is very vital in determining the profitability of oil and gas firms in Nigeria. This finding therefore validates the Human Capital Theory (HCT) upon which this work is founded. Evidence from this study uphold the premise supporting HCT which suggests that, when

proper investment is made on human capital, the resultant effect is maximum efficiency which increases the value of the firm in terms of profitability.

Apparently, investment in human capital is an indispensable factor that will give oil and gas firms desired level of profitability. On this note, it is imperative for management and policy makers of oil and gas firms to improve profitability by strategically investing in human capital. Apt implementation of suitable training strategies will improve assimilation of knowledge on operational techniques which will culminate in increase manpower efficiency and effective service delivery. Besides, deployment and placement of employees should be on the bases of acquired skills and specialisations, to enable employees operate efficiently in their areas of expertise. These actions will help to harness the innate potentials and capabilities of employees in terms of human capital efficiency which will bring about advancement in business operation with increased profitability.

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Appendix A - Data of Listed Oil and Gas Firms in Nigeria

PANEL	YEAR	HCE	VAIC	ROA	FIZ
1	2006	6.894	9.446	0.050	7.918
1	2007	7.076	10.419	0.046	7.913
1	2008	6.217	7.882	0.038	7.939
1	2009	5.326	6.844	0.030	8.094
1	2010	5.166	6.614	0.039	8.008
1	2011	4.740	6.192	0.043	8.012
1	2012	4.011	5.324	0.007	8.197
1	2013	4.197	5.508	0.031	8.176
1	2014	2.951	3.987	0.010	8.203
1	2015	4.651	5.958	0.027	8.108
1	2016	3.745	4.945	0.052	7.919
1	2017	3.723	4.927	0.027	7.930
1	2018	3.921	4.895	0.022	7.830
2	2006	0.603	42.695	0.001	7.647
2	2007	7.692	12.982	-0.003	7.688
2	2008	1.638	2.666	-0.048	6.927
2	2009	-1.594	-0.107	-0.164	6.959
2	2010	8.249	9.667	0.125	6.967
2	2011	6.481	8.078	0.122	7.168
2	2012	6.480	7.879	0.043	7.521
2	2013	5.538	6.659	0.059	7.261
2	2014	5.362	6.484	0.097	7.269
2	2015	4.297	5.338	0.046	7.456
2	2016	12.518	14.068	0.076	7.501
2	2017	7.385	8.672	0.059	7.682
2	2018	4.733	5.916	0.037	7.726
3	2006	5.292	7.300	0.073	6.522
3	2007	4.888	7.595	0.148	6.508
3	2008	6.817	7.888	0.043	7.370
3	2009	4.318	5.226	0.043	7.382
3	2010	3.469	4.376	0.043	7.398
3	2011	3.957	4.903	0.053	7.436
3	2012	-1.605	-0.080	-0.203	7.512
3	2013	7.448	8.617	0.012	7.589
3	2014	2.012	2.637	-0.058	7.588
3	2015	-1.578	-0.229	-0.233	7.530
3	2016	-30.082	-28.031	-0.713	7.476
3	2017	-10.227	-9.305	-0.467	7.447
3	2018	-6.163	-4.876	-0.277	7.383
4	2006	12.257	14.850	0.025	8.175
4	2007	4.616	5.623	0.077	7.948
4	2008	9.797	11.481	0.067	8.204
4	2009	10.674	12.406	0.097	8.143
4	2010	7.086	8.455	0.075	8.511
4	2011	4.409	5.702	0.037	8.603
4	2012	5.841	7.162	0.028	8.712
4	2013	5.398	6.489	0.001	8.772
4	2014	-7.422	-7.947	-0.099	8.951
4	2015	3.711	5.498	-0.035	8.976

4	2016	8.240	9.756	-0.063	8.996
4	2017	15.813	17.303	0.020	9.017
4	2018	7.657	8.603	0.010	9.031
5	2006	5.034	9.446	0.034	7.853
5	2007	8.071	10.419	0.164	7.636
5	2008	5.684	8.963	0.100	7.855
5	2009	0.441	-0.799	-0.102	7.944
5	2010	0.849	0.707	-0.041	7.839
5	2011	-2.753	-1.642	0.441	7.655
5	2012	3.681	4.497	0.027	7.629
5	2013	7.724	8.915	0.062	8.020
5	2014	7.964	9.204	0.043	8.144
5	2015	7.054	8.244	0.058	8.085
5	2016	6.414	7.666	0.038	8.148
5	2017	9.887	11.205	0.072	8.168
5	2018	3.470	4.330	0.005	8.151
6	2006	4.129	5.800	0.014	8.204
6	2007	2.082	3.028	0.193	7.191
6	2008	1.418	2.237	-0.021	7.161
6	2009	3.423	5.377	0.105	7.216
6	2010	3.694	4.683	0.070	7.614
6	2011	3.006	3.933	0.030	7.829
6	2012	4.993	6.024	0.007	7.745
6	2013	7.477	8.582	0.021	7.818
6	2014	6.582	7.694	0.022	7.762
6	2015	10.027	11.181	0.022	7.825
6	2016	9.097	10.288	0.028	7.910
6	2017	3.358	4.161	-0.016	7.794
6	2018	1.412	1.747	-0.043	7.526
7	2006	1.985	4.125	0.103	7.390
7	2007	1.843	4.683	0.080	7.342
7	2008	1.656	4.187	0.159	7.301
7	2009	2.505	4.162	0.184	7.344
7	2010	2.710	4.459	0.240	7.378
7	2011	5.855	8.435	0.186	7.509
7	2012	4.771	6.482	0.113	7.556
7	2013	2.505	3.739	0.126	7.610
7	2014	4.188	5.686	0.172	7.692
7	2015	2.428	3.442	0.128	7.733
7	2016	4.317	5.673	0.195	7.790
7	2017	4.611	5.746	0.179	7.873
7	2018	5.185	6.370	0.194	7.849
8	2006	4.393	1.780	0.064	7.707
8	2007	5.421	0.020	0.090	7.729
8	2008	3.670	1.526	0.119	7.738
8	2009	2.979	1.717	0.096	7.810
8	2010	3.359	1.464	0.106	7.737

8	2011	2.825	1.341	0.100	7.769
8	2012	3.073	1.473	0.093	7.881
8	2013	3.815	1.705	0.102	7.900
8	2014	3.240	1.608	0.058	7.980
8	2015	3.124	1.348	0.078	7.922
8	2016	5.269	1.725	0.149	8.136
8	2017	3.641	1.062	0.109	8.033
8	2018	4.064	1.175	0.091	8.122
9	2006	1.0284	30.3269	-0.0149	9.4532
9	2007	1.1606	35.1834	-0.0131	9.4639
9	2008	0.991	24.897	-0.017	9.353
9	2009	0.878	45.986	-0.101	9.354
9	2010	0.777	2.279	-0.125	9.395
9	2011	1.014	3.019	0.002	9.352
9	2012	1.034	2.484	0.020	9.328
9	2013	5.328	6.550	-0.247	9.270
9	2014	4.037	5.155	-0.067	9.230
9	2015	2.513	3.233	-0.034	9.216
9	2016	5.921	7.755	-0.258	9.116
9	2017	4.360	6.090	-0.138	9.053
9	2018	-4.917	-4.007	-0.066	9.042

Appendix B- STATA Output
Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
roa	117	.0270427	.130688	-.713	.441
hce	117	3.849556	4.810818	-30.082	15.813
vaic	117	6.284738	8.245579	-28.031	45.986
fiz	117	7.960497	.6484148	6.508	9.4639

ROA

	Percentiles	Smallest		
1%	-.467	-.713		
5%	-.233	-.467		
10%	-.101	-.277	Obs	117
25%	.001	-.258	Sum of Wgt.	117
50%	.039		Mean	.0270427
		Largest	Std. Dev.	.130688
75%	.093	.194		
90%	.149	.195	Variance	.0170794
95%	.186	.24	Skewness	-2.035974
99%	.24	.441	Kurtosis	12.88105

HCE

	Percentiles	Smallest		
1%	-10.227	-30.082		
5%	-2.753	-10.227		
10%	.777	-7.422	Obs	117
25%	2.505	-6.163	Sum of Wgt.	117
50%	4.188		Mean	3.849556
		Largest	Std. Dev.	4.810818
75%	5.855	10.674		
90%	7.964	12.257	Variance	23.14397
95%	9.887	12.518	Skewness	-3.193738
99%	12.518	15.813	Kurtosis	23.43882

VAIC

	Percentiles	Smallest		
1%	-9.305	-28.031		
5%	-1.642	-9.305		
10%	.707	-7.947	Obs	117
25%	2.666	-4.876	Sum of Wgt.	117
50%	5.623		Mean	6.284738
		Largest	Std. Dev.	8.245579
75%	8.244	30.3269		
90%	11.205	35.1834	Variance	67.98957
95%	17.303	42.695	Skewness	1.630896
99%	42.695	45.986	Kurtosis	13.09238

FIZ

	Percentiles	Smallest		
1%	6.522	6.508		
5%	7.161	6.522		
10%	7.301	6.927	Obs	117
25%	7.53	6.959	Sum of Wgt.	117
50%	7.839		Mean	7.960497
		Largest	Std. Dev.	.6484148
75%	8.151	9.354		
90%	9.053	9.395	Variance	.4204418
95%	9.352	9.4532	Skewness	.7163452
99%	9.4532	9.4639	Kurtosis	3.151352

```
panel variable:  panel (strongly balanced)
 time variable:  year, 2006 to 2018
         delta:  1 unit
```

Test for Normality

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
roa	117	0.81799	17.144	6.358	0.00000
hce	117	0.75272	23.292	7.043	0.00000
vaic	117	0.74153	24.345	7.142	0.00000
fiz	117	0.92140	7.404	4.479	0.00000

Correlation Matrix

	roa	hce	vaic	fiz
roa	1.0000			
hce	0.5824	1.0000		
	0.0000			
vaic	0.2415	0.4906	1.0000	
	0.0087	0.0000		
fiz	-0.2345	0.0454	0.2975	1.0000
	0.0109	0.6266	0.0011	

Test for Multicollinearity

Variable	VIF	1/VIF
vaic	1.46	0.683357
hce	1.34	0.746184
fiz	1.11	0.898154
Mean VIF	1.30	

Test for Heteroscedasticity

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of roa

         chi2(1)      =    32.46
         Prob > chi2  =   0.0000
```

Pooled Ordinary Least Square (OLS)

Source	SS	df	MS
Model	.809546707	3	.269848902
Residual	1.17165972	113	.01036867
Total	1.98120642	116	.017079366

Number of obs	=	117
F(3, 113)	=	26.03
Prob > F	=	0.0000
R-squared	=	0.4086
Adj R-squared	=	0.3929
Root MSE	=	.10183

roa	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
hce	.0156189	.002272	6.87	0.000	.0111177	.0201202
vaic	.0006424	.001387	0.46	0.644	-.0021056	.0033903
fix	-.0549602	.0153852	-3.57	0.001	-.0854412	-.0244793
_cons	.4003905	.1214433	3.30	0.001	.1597895	.6409915

Fixed Effect Estimation

```
Fixed-effects (within) regression               Number of obs      =       117
Group variable: panel                           Number of groups   =         9

R-sq:                                           Obs per group:
     within  = 0.4319                                         min =        13
     between = 0.2658                                         avg =      13.0
     overall = 0.3560                                         max =        13

                                                F(3,105)           =     26.60
corr(u_i, Xb)  = -0.1957                        Prob > F           =    0.0000
```

roa	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
hce	.0123417	.0020703	5.96	0.000	.0082366	.0164467
vaic	.002133	.0012199	1.75	0.083	-.0002859	.0045519
fix	-.1055808	.0305932	-3.45	0.001	-.1662415	-.0449201
_cons	.8066027	.2434289	3.31	0.001	.3239282	1.289277
sigma_u	.07553247					
sigma_e	.08195264					
rho	.45930078	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(8, 105) = 8.68                     Prob > F = 0.0000
```

Random Effect Estimation

```
Random-effects GLS regression                   Number of obs      =       117
Group variable: panel                           Number of groups   =         9

R-sq:                                           Obs per group:
     within  = 0.4296                                         min =        13
     between = 0.3100                                         avg =      13.0
     overall = 0.3822                                         max =        13

                                                Wald chi2(3)       =     82.79
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

roa	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
hce	.0127452	.0020394	6.25	0.000	.0087481	.0167424
vaic	.0819728	.0012064	1.64	0.102	-.0003918	.0043373
fiz	-.086429	.0248534	-3.48	0.001	-.1351409	-.0377172
_cons	.6535988	.1990024	3.28	0.001	.2635613	1.043636
sigma_u	.07138149					
sigma_e	.08195264					
rho	.43138421	(fraction of variance due to u_i)				

Hausman Specification Test

	---- Coefficients ---- (b) fe	(B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
hce	.0123417	.0127452	-.0004036	.0003564
vaic	.002133	.0019728	.0001603	.0001811
fiz	-.1055808	-.086429	-.0191517	.0178396

```
                 b = consistent under Ho and Ha; obtained from xtreg
  B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test:  Ho:  difference in coefficients not systematic

            chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                    =        2.30
          Prob>chi2 =      0.5125
```

Lagrangian Multiplier Test

```
Breusch and Pagan Lagrangian multiplier test for random effects

        roa[panel,t] = Xb + u[panel] + e[panel,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                     roa |   .0170794        .130688
                       e |   .0067162       .0819526
                       u |   .0050953       .0713815

        Test:   Var(u) = 0
                             chibar2(01) =     70.64
                          Prob > chibar2 =    0.0000
```

Robust Random Effect Estimation

```
Random-effects GLS regression                   Number of obs      =       117
Group variable: panel                           Number of groups   =         9

R-sq:                                           Obs per group:
     within  = 0.4296                                         min =        13
     between = 0.3100                                         avg =      13.0
     overall = 0.3822                                         max =        13

                                                Wald chi2(3)       =     18.63
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0003

                                 (Std. Err. adjusted for 9 clusters in panel)
```

roa	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
hce	.0127452	.0056919	2.24	0.025	.0015894	.0239011
vaic	.0019728	.0005969	3.31	0.001	.0008029	.0031426
fix	-.086429	.0234545	-3.68	0.000	-.132399	-.040459
_cons	.6535988	.1877242	3.48	0.000	.2856662	1.021532
sigma_u	.07138149					
sigma_e	.08195264					
rho	.43138421	(fraction of variance due to u_i)				