On the relationship between intellectual capital efficiency and firm value: evidence from the Nigerian oil and gas downstream sector

Ahmed Jinjiri Bala*
Department of Accounting,
Federal University, Dutsin-ma,
Email: kiruahmad@gmail.com
*Corresponding author

Aminu Hassan
Department of Accounting,
Faculty of Management Science,
Federal University, Dutsin-ma,
Email: ammhass@gmail.com

Kabiru Isa Dandago
Department of Accounting,
Faculty of Management Science,
Bayero University, Kano,
kidandago@gmail.com

Attahir Babaji Abubakar
Department of Economics,
Ahmadu Bello University, Zaria,
Email: attahirbabaji@gmail.com

Zaharaddeen Salisu Maigoshi
Department of Accounting,
Bayero University, Kano,
deenmadabo@gmail.com

Abstract

We use a multi-theory framework which combines the lenses of clean surplus theory, resource-based theory and stakeholder theory to examine the relationship between measures of intellectual capital efficiency and firm market value. We employ Prais-Winsten regression with PCSEs to estimate our model. We find that while capital employed and structural capital efficiencies significantly positively determine firm value, relational capital efficiency’s positive effect appears mild. However, human capital efficiency appears to have no-relationship with firm value. The significance of our findings is demonstrated by two key contributions to the literature. Firstly, this study is the first of its kind conducted in the Nigerian oil and gas industry. Secondly, our results provide further evidence in support of the clean surplus theory in its function of facilitating the role of accounting numbers in determining and explaining market values. These results are robust to an alternative time-series estimation at aggregate downstream sector level.

Keywords: ARDL, Clean surplus accounting, Human capital development, Intellectual capital efficiency, Labour participation rate, oil and gas downstream sector, PCSE, Prais-Winsten regression, RBT, SHT TS-CS
1. Introduction

Intellectual capital is considered the most crucial factor of production that produces highly technical man-made capital, such as machines and equipment, (Alleyne and Alexander, 2018), combines them with natural resources and manages this complex combination in such a manner that productive efficiency is maximised. The outcome of this key role enables the production of numerous goods and services needed by society, and this, in turn, leads to the generation of sales revenue, profits and creation of market values for most profit-oriented firms. Realising that domestic intellectual capital was significantly undeveloped in its oil and gas industry, and therefore, offers little contribution to the creation and retention of value (Monday, 2015), the Nigerian government introduced the local content development regulation specific to the oil and gas industry. The Act aims to develop domestic intellectual capital within the industry and strengthen its value-creation and retention abilities. This is in addition to the country’s continued increases in spendings on education, health, research and development. Furthermore, the government seriously engages in encouraging participation of the working-population group in the Nigerian economic activities. Principally, our paper aims to assess whether these efforts are yielding the targeted results. The study does this in two phases, with the first phase being the crux of the paper and the second phase playing the role of an additional analysis to reinforce the method used in the first phase and confirms its robustness. In the first phase, we examine the relationship between the four components of intellectual capital efficiency (ICE), based on the modified value added intellectual coefficient (M-VAIC) model (Ulum et al., 2014), and the market value of firms operating in the Nigerian oil and gas downstream sector. In the additional analysis part, we investigate the dynamic relationship between two macroeconomic measures of intellectual capital development (namely, expenditure on human resource development and labour force participation rate) and the aggregate market capitalisation of the Nigerian downstream sector.

The downstream sector of an oil and gas industry involves all the activities employed to transform hydrocarbons into various finished or semi-finished products such as liquefied petroleum gas, gasoline, jet fuel, asphalt, petroleum coke, naphtha, kerosene, lubricating oil, paraffin wax, and many more (Hassan, 2013). More specifically, the sector is involved in refining, transporting, marketing and distributing finished petroleum products (Wright and Gallun, 2008; Hassan, 2012). Indeed, the physical products and other services provided by the downstream sector are critical and indispensable to industrial productivity, transportation, office administration, delivery of classes in schools, agricultural activities and many more. For instance, gasoline and diesel are used to power up automobiles, standby generators and trains; motor oil is used as a lubricant for automobiles and standby generators; natural gas is used as a feedstock for fertilizer production; liquified petroleum gas (also known as propane or butane) is mainly used for cooking in Nigeria. Just to mention but a few out of the sector’s many functions in the Nigerian economy. This demonstrates that the downstream activities are so critical to the domestic economy of Nigeria that prices in other sectors are almost perfectly elastic to changes in the prices of oil-and-gas-related products. For example, an increase in the pump price of gasoline in the country often provokes protests, riots and/or general labour strike.

The complex activities which must be implemented to produce various products in the downstream sector require various persons with variety of skills, technical know-how, competence and creativity (Alleyne and Alexander, 2018) for the sector to perform its critical function within the Nigerian economy. Stressing on the indispensability of human resource for the efficient functioning of the Nigerian oil and gas industry, Monday (2015) remarks that equipment and
technologies are the products of human creativity and ingenuity and are only made to work by humans. For this reason, Monday (2015) further argues that human creative ideas and innovations are the cornerstones for the generation of successful outcomes from productive activities. More specifically, Oyewumi et al. (2017) attribute proper functioning of entities in the downstream oil and gas sector to the strength and efficient management of human resource. More recently, however, Omokugbo and Imogiemhe (2020) examine the relationship between human capital development and real economic growth in the agricultural and oil and gas sectors, and establish a significant long-run positive association in both cases. According to the authors, the implication of their finding relating to the oil and gas sector suggests that increased government expenditure on education and research and development has created value by enhancing real growth in the oil and gas industry. We suspect that this macroeconomic positive outcome is connected to the enactment and roll-out of the Nigerian local content law in 2010 as well as the unfolding implementation of its provisions in the oil and gas industry (Ado, 2013; Monday, 2015; Ovadia, 2016; Alleyne and Alexander, 2018).

Local content policies are meant to enhance the utilisation of local human capital and mineral resources in the extractive industry of most oil-producing countries (Ovadia, 2016). To this end, recognising the importance of intellectual capital in the development of its oil and gas industry, the Nigerian government enacted the Nigerian Oil and Gas Industry Content Development Act 2010 (after, NCDA). The enactment of the Act is a product of the realisation that in general there is insignificant local human capital and indigenous industrial developments in the oil and gas industry (Monday, 2015; Ovadia, 2016). In this regard, Monday (2015) notes with concern that prior to the enactment of NCDA, the intellectual capital development in the Nigerian oil and gas industry had not been significant, and therefore, payments to highly skilled services were mostly repatriated. Consequently, at the very core of the NCDA lies the focus on growing the domestic intellectual capital in both the upstream and the downstream sectors for local value creation/enhancement. For instance, section 10(1) of the Act provides that “Nigerians shall be given the first consideration for employment and training in any project executed by any operator or project promoter in the Nigerian oil and gas industry”. Regarding the local value creation and enhancement via developing and strengthening intellectual capital, the Act defines Nigerian local content as “the quantum of composite value added to, or created in, the Nigerian economy by a systematic development of capacity and capabilities through the deliberate utilisation of Nigerian human resources, material resources and services in the Nigerian oil and gas industry”. Consequently, following the implementation of NCDA, intellectual capital is expected to develop within individual firms operating in the Nigerian downstream sector to drive the creation and enhancement of their market values.

Put together, listed firms in the Nigerian oil and gas downstream sector have tremendous market value. As such, the sector’s contribution to the Nigeria’s financial sector is noteworthy as the total market capitalisation of companies in the sector quoted on the floor of the Nigerian Stock Exchange (NSE), as at October 2018, stood at 613.11 billion naira with a total 29.53 billion outstanding shares. Over the recent years, the aggregate market capitalisation of the downstream sector has been trending upward and this might be attributed, at least in part, to the development of intellectual capital in the Nigerian economy driven by government’s deliberate policies and increase in related expenditure. Following this background, as stated in the opening paragraph of this section, our paper seeks to determine whether intellectual capital mechanisms developed within the companies operating in the downstream sector of the Nigerian oil and industry affect
their market values. The rest of the paper is structured as follows. Section 2 reviews the relevant literature, develops the study’s hypotheses and discusses the theoretical framework that underpins this research. Section 3 presents the methodology of the paper. Section 4 presents the empirical results and section 5 discusses them. Section 6 concludes the paper and highlights some research limitations.

2. Literature, hypotheses and theory

2.1 Prior studies and hypotheses development

In this section, we present a synthetic review of the relevant literature leading to fine-grained discussions to serve as the bases for generating the hypotheses the paper is set to test.

2.1.1 Intellectual capital efficiency

Through the development and application of talent, ingenuity, innovation, invention, professional skills (collectively known as human resource) humans have found extraordinary ways to create advanced technologies; make equipment/machines that facilitate the harnessing of natural resources and provide highly efficient services. The results of utilising human resource to coordinate and link natural resources with other man-made capitals is the key to creating value for companies. Value-added intellectual capital (VAIC) represents a composition of key elements of human resource used to measure and evaluate the performance of human contribution to productive efficiency, value creation and value enhancement. The practice of using VAIC as a means of measuring intellectual capital was employed by researchers in the context of different business settings and countries (see, for example, Pulic, 2000; Ulum et al., 2014; Isa and Ismail, 2015; Meles et al., 2016; Singh and Narwal, 2016; Anifowose et al., 2018; Nassar, 2018; Vitalis, 2018; Lawal, et al., 2019; Bala et al., 2019). The art of measuring the efficiency of intellectual capital in this way is mainly to pave the way for examining its effect on firms’ market value. Consequently, Pulic (2000) argues that the outcomes of firm intellectual capital performance are derived from two invisible intellectual capital inputs (human capital efficiency (HCE) and structural capital efficiency (SCE)) and one visible input (capital employed efficiency (CEE)). In sum, this produces three measures of efficiency, namely the HCE, the SCE and the CEE. The value of VAIC is the sum of these three efficiency measures. Higher overall value of VAIC indicates better management’s utilisation of a firm’s value creation capability.

Ulum et al. (2016) and Ulum et al. (2017) modify the original VAIC by adding relational capital efficiency (RCE) as the third invisible intellectual capital input and called the new model Modified Value-Added Intellectual Capital (M-VAIC). We consider M-VAIC as comprehensive and, therefore, use it to measure the four components of ICE in this study.

2.1.2 Human capital efficiency and firm value

HCE is a part and parcel of the original intellectual capital measurement proposed *ab initio* by Pulic (1998, 2004). It is an essential component of the intellectual capital valuation process. Ahmad and Ahmed (2016) examine the relationship between intellectual capital and firms’ performance applying the VAIC model to measure ICE and its components, and their finding reveals that HCE significantly affects firm financial performance. Relying on the Ohlson (1995) model, Liu et al. (2009) show that HCE facilitates a great deal of incremental information in terms of firms’ value and value creation. In a similar vein, results reported by Kweh et al. (2013) show
that HCE and SCE turn out to be the most efficient ICE components concerning the enhancement of market-to-book value for companies operating the Bursa Malaysian ACE-market than those in the main market. Consistent with the finding reported by Kweh et al. (2013), Nassar (2018) also documents a significant positive relationship between HCE and market-to-book value and asset turn over (ATO) after the crisis in the real estate market of Turkey. The results of the studies reviewed in this section provide empirical evidence implying that HCE is a very important catalyst that contributes to creating and boosting firm market value. Consequently, we hypothesise that:

**H1:** Human capital efficiency affects the value of firms in the Nigerian oil and gas downstream sector.

### 2.1.3 Structural capital efficiency and firm value

As the second component of the ICE within the M-VAIC model, SCE is referred to as the resource that is embedded in an organisation. It is the intangible asset which still remains even when the organisation’s personnel have closed for the day. Various studies have examined the relationship between ICE and measures of firm value and results reported are mixed. For example, Forte et al. (2019) examines the impact of intellectual capital on firms’ financial performance and market value and their results reveal that SCE has significant negative influence on firms’ market value. In contrast, however, Janošević and Dženopoljac (2015) results show that SCE does not affect firms’ market value. However, Mohammed and Irbo (2018) document that SCE is a key contributor to value creation, as their results show that the variable has a significant positive relation with market-to-book value, return on equity (ROE) and EPS before the Turkish real estate crisis. Similarly, Chu et al. (2011) as well as Nassar (2018) have both reported significant positive relationship between SCE on the one hand, and return on assets (ROA) and ROE on the other hand. Also, Li and Zhao (2017) investigated the dynamic effect of intellectual capital on firm value using a sample of labour intensive and capital-intensive companies in China, and reported that SCE was significantly positively associated with firm market value. Despite the differences in the jurisdictions where the studies reviewed here were conducted, SCE has proved to be a key determinant of intellectual capital in the majority of the studies, and therefore, its efficiency has a replicative impact on firm market value. On this note this paper hypothesises that;

**H2:** Structural capital efficiency affects the value of firms in the Nigerian oil and gas downstream sector.

### 2.1.4 Relational capital efficiency and firm value

Relational capital is made up of resources embedded in the relationship with any of the stakeholders who influence the firms’ life. On this note, García-Merino et al. (2014) remark that stakeholder relationships are the necessary conditions for building, maintaining and renewing resources, structures and processes over time. RCE is the third construct of the modified valued-added intangible assets, as proposed by Ulum et al. (2016) and Ulum et al. (2017), to complement the two invisible intellectual capital components included in the original VAIC model (see, Pulic, 1998, 2000). When the three invisible components are combined together with capital employed (CEE) they produce the full four constructs which make up the M-VAIC. On the contribution of RCE in helping to create or enhance market value, Suraj and Bontis (2012) emphasise the use of customer capital to boost business performance. In this light, Nikmah and Irsyahma (2016) examine the relationship between ICE and firm financial performance of banks listed in the...
Indonesian Stock Exchange. M-VAIC is used to measure ICE elements and the findings reveal that RCE has a positive effect on firm market value and accounting-based financial performance. Furthermore, Yilmaz and Acar (2018) explain that RCE and CEE have a positive impact on firms’ market value. Similarly, Ngari (2014) find that components of ICE including RCE significantly positively influence firm market value. This implies that firms that maintain a cordial relationship with their clients to their satisfaction have the opportunity to achieve better business performance and in turn, increase their value. Consequently, this paper hypothesises that:

\[ H_3: \text{Relational capital efficiency affects the value of firms in the Nigerian oil and gas downstream sector.} \]

2.1.5 **Capital employed efficiency and firm value**

Physical and financial assets, operationalised by the capital employed efficiency (CEE), is the third construct of the ICE according to Pulic (1998, 2000), and the fourth in the case of M-VAIC (Ulum et al., 2016; Xu and Wang, 2019). CEE is the capital on which the intangible assets exert pressure to impact firm value. In testing this relationship, studies have reported mixed results. For instance, Ibrahim and Ogwuche (2018) document that CEE is positively related to manufacturing firms’ market value proxied by Tobin’s Q. This implies that manufacturing firms employ more of physical and financial capital compared to other intellectual capital components. On the contrary, Forte et al. (2019) find that CEE exhibit a negative relationship with market-to-book value. However, Tarigan et al. (2019) report positive and negative association in the same study when they examine the impact of intellectual capital on firm financial performance, proxied by book value ratio (BVR), ROA, ROE and growth of revenue. Thus, their results reveal that M-VAIC capital components, including CEE relate positively with financial performance but negatively with market value. On this note, Nourani et al. (2017) contend that physical and financial capital exhibit precision in determining firm performance. Therefore, this paper hypothesises as follows:

\[ H_4: \text{Capital employed efficiency affects the value of firms in the Nigerian oil and gas downstream sector.} \]

2.2 **Theoretical framework**

In examining the effect of ICE on the value of companies operating in the Nigerian oil and gas downstream sector, three theories are found to be relevant. These are the clean surplus theory (CST), the resources-based theory (RBT) and the stakeholder theory (SHT). CST provides the logic for the distinction between the income statement and the statement of changes in equity (Scott, 2015; Mourik and Katsuo, 2017). CST proposes that any item that affects changes in the book value of equity (BE) be treated in the income statement while all items that do not, which mostly arise due to transactions with the owners of equity – such as dividends, redemption of shares, rights issue, additional capital paid – are passed through the statement of changes in equity (Ohlson, 1995; Mirza et al., 2018). In this regard, Frankel (1997, p 314) draws our attention to the fact that “without owner-related transactions, the changes in BE equals to net income less dividend”. Thus, the theory creates the nexus between the BE of the current year and the previous years’ BEs by maintaining that the current year’s BE depends on the past year’s BE, the earnings and the dividends of the current period (Kusakci, 2019).
Brief and Peasnell (2013) confirm that Ohlson (1991) was the first to demonstrate how accounting information could be used in valuing security prices in the market place via the underpinnings of CST. Subsequently, Ohlson (1995) fine-grained the idea and showed how specific accounting numbers were capable of determining the market value of equity. Our paper is particularly interested in the use of CST to underpin accounting information’s ability to value equity market prices (Ohlson, 1991, 1995). Ohlson (1995) and Feltham and Ohlson (1995) establish a setting in which past accounting numbers such as BE, earnings, dividends and transitory earnings are shown to determine the market value of equity. Brief and Peasnell (2013) summarise this approach by stating that Ohlson (1995) develop a model which shows that three accounting numbers plus other information found in the financial statements affect market value. Based on this conception, we use information in the income statements and the statement of financial positions of companies in our sample to derive measurements of HCE, SCE, RCE and CEE as other pieces of information derived from accounting reports. This justifies the adoption of Ohlson model in this study to examine the relationship between the ICE components and market value of oil marketing firm in Nigeria. However, more specifically, hypotheses of this study are individually underpinned by RBT and SHT. Thus, the hypotheses related to HCE, SCE and CEE are underpinned by the proposition of RBT while the hypothesis related RCE is supported by the SHT.

The figure 1 below depicts the interlink between the theories that underpin this study.
Figure 1: Theoretical framework

Resource-based theory (RBT) explains how the success of an enterprise can be optimally utilised by its ability to acquire and keep vital resources and, in this way, be efficient (Larsson and Mörling, 2015). Elaborating further on the usefulness of the theory, Duh (2008) notes that RBT is useful in describing the long-term variances in firm value not ascribed to the industry or an economic condition. Along the same line of reasoning, Marzo (2014) argues that the logic behind RBT implies that firms with superior, scarce and difficult to imitate resources by competitors will be in a position to win the competition, and intellectual capital is the resource in question. This theory underpins the hypotheses relating to HCE, SCE and CEE.

Freeman and McVea (2001) argue that stakeholder theory is useful since it harnesses the loyalty, confidence and support of stakeholders towards the accomplishment of organisational goals. Effective management of stakeholders and meeting their information needs consolidate and improve their relationship with firms (Jones et al., 2017). It is reasonably logical to assert that stakeholders who are treated well will in turn generally respond by demonstrating support and loyalty towards the organisation. This assertion implies that when an organisation maintains a cordial relationship with its stakeholders, it tends to benefit from the support of all-encompassing stakeholders and, by extension, records an improvement in its value. This theory supports the RCE hypothesis.
3. Methodology

3.1 Population and Sample

The population of this study consists of all oil and gas firms operating in the Nigerian downstream sector as at December 2018. However, we exclude firms that fall short of our benchmarks. Thus, we exclude from our sample:

i) companies not listed on the NSE between January 2004 to 31st December 2018.

ii) companies placed on technical suspension or delisted due to merger or acquisition during the research period and/or

iii) companies which do not have adequate data regarding the variables of interest in the study.

After applying these yardsticks, eight companies emerged as the members of our sample.

It is imperative to state the reasons for covering the period 2004-2018 by our study. These reasons are as follows.

(i) The period provides the most complete data on all the variables included in the study from all the companies.

(ii) The period witnessed several transformation and regulations by the government. For example, the enactment of Nigerian Oil and Gas Industry Content Development Act 2010.

(iii) The period marks the 15-years range within which a number of democratic governments made serious commitments to improve the sector in terms of human resource development and value creation and retention.

3.2 Variables

3.2.1 Dependent variable

In this paper, Tobin’s Q is used as the measure of firm market value. Demsetz and Villalonga (2001) argue that Tobin’s Q is an important market-based measure of performance as it shows the value created for investors. It is equally used in assessing long-term performance as well as future growths due to changes in cash flows. A significant benefit of Tobin’s Q is that it accounts for both the past and expected future market performance of the firm. There are many formulae for calculating Tobin’s Q; however, this study will employ the formula used by Chung and Pruitt (1994). They expressed the formula as follows:

\[
Tobin's\ Q = \frac{MV \ of \ Equity + BV \ of \ Liability}{BV \ of \ Total\ Assets}
\]  

This formula has been widely used by many studies on intellectual capital and firm market value (Carter et al., 2003; Kosonen and Kianto, 2007; Guest, 2009; Wang, 2013).

3.2.2 Independent variables

The independent variables in this research are HCE, SCE, ECE and CEE. The summation of these components makes up the M-VAIC coefficient. The M-VAIC model, as shown by Ulum et al. (2014), collapses the four ICE measures into one index. Thus, \( M-VAIC = HCE + SCE + \)
$RCE + CEE$. RCE demonstrates the efficiency of investment from the viewpoint of the firms’ relationship with all its conceivable stakeholders.

However, to calculate each component of the ICE, there is the need to, first of all, compute the value-added component which is given by the following formula.

$$VA = OP + EC + I + T + D + A$$  \(2\)

Where:

$OP = operating\ profit$;
$EC = employee\ costs$;
$I = Interest\ Expenses$;
$T = Taxes$;
$D = depreciation$;
$A = amortisation$ (Kamath, 2015; Nadeem et al., 2017)

$$HCE = VA/HC$$  \(3\)

(Kujansivu and Lönnqvist, 2009; Pulic, 2000; Kamath, 2015).

$$SC = VA - HC$$  \(4\)

and,

$$SCE = SC/VA$$  \(5\)

(Kujansivu and Lönnqvist, 2009; Pulic, 2000; Kamath, 2015)

$RC = Advert\ expenses + selling\ and\ distribution\ expenses + marketing\ cost$  \(6\)

(Vishnu and Gupta, 2015; Scafarto et al., 2016; Sardo et al., 2018).

But RCE is calculated by dividing relational capital by the value-added, thus:

$$RCE = RC/VA$$  \(7\)

(Costa, 2012; Ulum et al., 2014)

In a company, intellectual capital cannot function on its own and needs to operate with physical and financial capital. Thus, CEE is measured by dividing VA by CE as shown in (8) below:

$$CE = physical\ capital + financial\ assets = total\ assets - intangible\ assets$$  \(8\)

$$CEE = VA/CE$$  \(9\)

(Pulić, 2000; Kujansivu and Lönnqvist, 2009; Kamath, 2015; Shiri and Mousavi, 2015)

Where:

$HC$ Human capital (Wages and salaries).

$HCE$ Human capital efficiency.

$VA$ Value added of the firm, and

$SC$ Structural capital.

$SCE$ Structural capital efficiency.

$RC$ Relational capital.
3.2.3 Control variables

i. Financial Leverage (LEV)

Financial leverage represents the advantage which debt financing offers firms. The financing choice is a vital managerial decision, for it may influence the shareholder’s value, risk and the market value of firms (Mohammed, 2017). Further, applying higher operating leverage firms may be able to leverage their underlying profitability and thus increase their market value (Nguyen et al., 2015). Consequently, studies on intellectual capital and firm value often control for the effect of financial leverage.

ii. Firm Size (FSIZE)

Firm size has been defined in the literature to refer to the total assets, the scale of operations and number of employees, among others. Larger firms are assumed to have more resources at their disposal and therefore have the wherewithal to commit them to several investment opportunities (Mohammed, 2017). Following the works of Firer and Williams (2003) and Holienka et al. (2016) the study controls for firm size.

3.3 Empirical model

Our pane dataset is analysed using Prais-Winsten OLS regression with panel corrected standard errors (PCSE) featuring Tobin’s Q as the dependent variable. However, the independent variables consist of the four components of M-VAIC, namely, HCE, SCE, RCE and CEE. Furthermore, leverage and firm size are included in the model as control variables. This study belongs to the general value-relevance literature that involves the specification of regression models by modifying the original Ohlson model. Therefore, we model the TS-CS dataset for this study based on the value-relevance model developed by Ohlson (1995) and Feltham and Ohlson (1995) specified as follows:

\[ V_t = \beta_0 + \beta_1 BE_t + \beta_2 AE_t + \beta_3 TE_t + \epsilon_t \]  

\( V_t \) Value of firm at time \( t \).
\( BE_t \) Book value of equity at time \( t \), measured as the beginning book value of equity in a particular year.
\( AE_t \) Abnormal earning at time \( t \). Following Ohlson (1995), this variable is measured as net income minus 12% charge for the use of equity capital. Note 12% is the long-term rate of return on equity.
\( TE_t \) Transitory earning at time \( t \).
\( \epsilon_t \) Stochastic error term.

Based on the arguments of Feltham and Ohlson (1995), Ohlson (1995) and Feltham and Ohlson (1999), in this study transitory earning is replaced with the M-VAIC components (Barth et al., 1999; Hassan, 2019) the econometric model for this study is specified as follows.
\[ \text{Tobin's } Q_{it} = \alpha_0 + \alpha_1 BE_{it} + \alpha_2 AE_{it} + \alpha_3 HCE_{it} + \alpha_4 SCE_{it} + \alpha_5 RCE_{it} + \alpha_6 CEE_{it} + \alpha_7 LEV_{it} + \alpha_8 FSIZE_{it} + \varepsilon_{it} \]  

(11)

4. Empirical results

4.1 Descriptive statistics and correlation matrix

The descriptive statistics, as well as the correlation matrix relating to our TS-CS dataset, are presented in Table 1 and 2, respectively.

Table 1: Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobin's Q</td>
<td>120</td>
<td>2.058</td>
<td>8.371</td>
<td>0</td>
<td>90</td>
</tr>
<tr>
<td>BE</td>
<td>118</td>
<td>25.910</td>
<td>27.411</td>
<td>-44.992</td>
<td>101.589</td>
</tr>
<tr>
<td>AE</td>
<td>120</td>
<td>-0.000</td>
<td>0.272</td>
<td>-2.169</td>
<td>1.132</td>
</tr>
<tr>
<td>HCE</td>
<td>120</td>
<td>7.139</td>
<td>11.321</td>
<td>-50.126</td>
<td>55.977</td>
</tr>
<tr>
<td>SCE</td>
<td>120</td>
<td>0.862</td>
<td>0.421</td>
<td>0.252</td>
<td>4.363</td>
</tr>
<tr>
<td>RCE</td>
<td>101</td>
<td>0.215</td>
<td>1.140</td>
<td>-10.622</td>
<td>1.590</td>
</tr>
<tr>
<td>ECE</td>
<td>120</td>
<td>0.196</td>
<td>0.178</td>
<td>-0.420</td>
<td>1.363</td>
</tr>
<tr>
<td>LEV</td>
<td>120</td>
<td>0.831</td>
<td>0.805</td>
<td>0.105</td>
<td>8.982</td>
</tr>
<tr>
<td>FSIZE</td>
<td>120</td>
<td>17.407</td>
<td>1.260</td>
<td>13.010</td>
<td>20.055</td>
</tr>
</tbody>
</table>

Table 2: Correlation matrix and Variance Inflation Factor (VIF)

<table>
<thead>
<tr>
<th></th>
<th>TQ</th>
<th>BE</th>
<th>AE</th>
<th>HCE</th>
<th>SCE</th>
<th>RCE</th>
<th>CEE</th>
<th>LEV</th>
<th>FSIZE</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
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<td>TQ</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>BE</td>
<td>-0.0751</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td>1.47</td>
</tr>
<tr>
<td>AE</td>
<td>-0.6149</td>
<td>0.0108</td>
<td>1</td>
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<td></td>
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<td></td>
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<td></td>
<td>1.10</td>
</tr>
<tr>
<td>HCE</td>
<td>0.0134</td>
<td>0.1903*</td>
<td>0.1258</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.71</td>
</tr>
<tr>
<td>SCE</td>
<td>-0.0618</td>
<td>-0.0435</td>
<td>-0.0698</td>
<td>-0.3170</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.69</td>
</tr>
<tr>
<td>RCE</td>
<td>-0.0924</td>
<td>0.1232</td>
<td>0.0806</td>
<td>0.1535</td>
<td>-0.5738</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>2.24</td>
</tr>
<tr>
<td>CEE</td>
<td>-0.0096</td>
<td>-0.0758</td>
<td>0.2312</td>
<td>0.1282</td>
<td>-0.2406</td>
<td>0.2174</td>
<td>1</td>
<td></td>
<td></td>
<td>1.30</td>
</tr>
<tr>
<td>LEV</td>
<td>-0.0125</td>
<td>-0.1495</td>
<td>0.0282</td>
<td>-0.2777</td>
<td>0.0435</td>
<td>0.1117</td>
<td>-0.049</td>
<td>1</td>
<td></td>
<td>1.58</td>
</tr>
<tr>
<td>FSIZE</td>
<td>0.0307</td>
<td>0.5035</td>
<td>-0.0702</td>
<td>0.3495</td>
<td>0.1578</td>
<td>0.2523</td>
<td>-0.2075</td>
<td>0.5405</td>
<td>1</td>
<td>2.26</td>
</tr>
</tbody>
</table>

Table 2 presents the result of the Pearson correlation coefficients among the study variables. According to Hair et al. (2010), the correlation between the independent variables is does not pose any concern until it exceeds 0.7. Considering that none of the correlation coefficients is up to 0.7 and as such we do not suspect any problem of multicollinearity in our model. Furthermore, the paper employed a formal test of multicollinearity via the Variance Inflation Factor (VIF). As noted by Angahar and Malizu (2015), a VIF value of less than 10 indicates that multicollinearity is not an issue. From the VIF values presented in the last column of Table 2, none is up to 10. Therefore, we can indeed conclude that there is no problem of multicollinearity in our model.
4.2 Fixed effects (FE) model and diagnostic tests

The study begins the analysis by presenting an exploratory fixed effects (FE) estimation to examine the relationship between variables in the empirical model. The result of this estimation is presented in Table 3. This estimation is to serve as the basis for conducting the relevant post-estimation diagnostic tests that are expected to inform the determination of the appropriate model to estimate.

Table 3 Estimates of Fixed Effect Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Std. Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>-0.029</td>
<td>0.030</td>
</tr>
<tr>
<td>AE</td>
<td>-26.25***</td>
<td>1.137</td>
</tr>
<tr>
<td>HCE</td>
<td>-0.056*</td>
<td>0.003</td>
</tr>
<tr>
<td>SCE</td>
<td>10.06*</td>
<td>5.271</td>
</tr>
<tr>
<td>RCE</td>
<td>3.297*</td>
<td>1.598</td>
</tr>
<tr>
<td>CEE</td>
<td>19.56**</td>
<td>7.282</td>
</tr>
<tr>
<td>LEV</td>
<td>0.717</td>
<td>0.859</td>
</tr>
<tr>
<td>FSIZE</td>
<td>2.044*</td>
<td>0.995</td>
</tr>
<tr>
<td>Constant</td>
<td>-45.90</td>
<td>16.12</td>
</tr>
<tr>
<td>R- Squared</td>
<td>0.651</td>
<td></td>
</tr>
</tbody>
</table>

***, **, * indicates statistical significance at 1%, 5% and 10% respectively.

4.2.1 Diagnostic checks

Further to the FE estimation, the model was subjected to some post-estimation diagnostic checks. Specifically, we subject the FE model to panel heteroskedasticity; panel serial correlation and cross-sectional dependence (or correlation) tests. It is also because of the presence of panel heteroskedasticity, and serial correlation, the standard errors of the fixed effects model are biased (see Beck 2001). Similarly, due to the presence of cross-sectional dependence (see, Table 4), the estimates of the fixed effects model are no longer robust (Beck and Katz, 1995). While the Modified Wald test is employed for group-wise heteroskedasticity, the Wooldridge test is applied for panel serial correlation. Similarly, the Pesaran test for cross-sectional dependence is used to test for the presence of cross-sectional correlation or otherwise. The results of these tests are presented in Table 4.

Table 4 Result of diagnostic tests

<table>
<thead>
<tr>
<th>Diagnostics Test</th>
<th>Statistics</th>
<th>p-value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group-wise Heteroskedasticity</td>
<td>21368.26</td>
<td>0.000</td>
<td>Present</td>
</tr>
<tr>
<td>Contemporaneous Correlation</td>
<td>1.9270</td>
<td>0.050</td>
<td>Present</td>
</tr>
<tr>
<td>Panel Serial Correlation</td>
<td>17.450</td>
<td>0.000</td>
<td>Present</td>
</tr>
</tbody>
</table>

From the results of the diagnostic tests presented in Table 4, the residuals of the estimated FE model are found to suffer from the problems of heteroskedasticity, serial correlation and cross-sectional dependence. Consequently, the estimates of the FE model are therefore biased. This necessitates the application of an estimator that accounts for these problems. The Panel Corrected
Standard Errors (PCSE) estimator accounts for these issues and is therefore employed to estimate our baseline model.

4.2.2  

*Endogeneity test*

To examine whether there exist simultaneous relationships between ICE variables and firm value, we employ the Wooldridge strict exogeneity test. The specification of the test is such that we examine whether or not the present Tobin’s Q has a significant effect on the future values of the individual ICE variables. If the effect is found to be statistically significant, we infer that feedback relationships exist from Tobin’s Q to HCE, SCE, RCE and/or CEE. This leads to the conclusion that there is simultaneous relationship between the variables, thereby signifying the existence of endogeneity problem. However, if the feedback coefficient is not statistically significant, we conclude that the ICE variables are strictly exogenous (see, Wooldridge, 2010; Nadeem et al., 2017). The results of the estimated models are presented in Table 5.

Table 5  

Wooldridge strict exogeneity test results

<table>
<thead>
<tr>
<th>Variables</th>
<th>HCE t+1</th>
<th>SCE t+1</th>
<th>RCE t+1</th>
<th>CEE t+1</th>
</tr>
</thead>
<tbody>
<tr>
<td>TQ</td>
<td>-1.077</td>
<td>0.0114</td>
<td>-0.0354</td>
<td>-0.0174</td>
</tr>
<tr>
<td></td>
<td>(0.791)</td>
<td>(0.00763)</td>
<td>(0.0280)</td>
<td>(0.0119)</td>
</tr>
</tbody>
</table>

Control variables (AE, BE, FSIZE, and LEV) and intercept term were included in the estimations.

***, **, * indicates statistical significance at 1%, 5% and 10% respectively.

Note that coefficients are reported without parentheses while standard errors are enclosed within parentheses.

From the regression results presented in Table 5, the coefficients that measure the effects of Tobin’s Q on the ICE variables is found to be statistically insignificant for all the estimated models. We could thus infer that there is no feedback relationship from Tobin’s Q to the individual measures of ICE. Therefore, the variables are not endogenously related. Since there is no endogenous relationship between the variables, we do not have to employ estimators that account for the endogeneity problem.

4.3  

*PCSE estimation results*

The Prais-Winsten regression results with Panel Corrected Standard Errors (PCSE) are presented in this section. The result of the baseline model is shown in Table 6.
Table 6 Baseline model: PCSE results

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficient</th>
<th>Panel-Corrected Std. Errors</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>-0.017</td>
<td>0.011</td>
</tr>
<tr>
<td>AE</td>
<td>-20.41***</td>
<td>0.644</td>
</tr>
<tr>
<td>HCE</td>
<td>-0.058</td>
<td>0.058</td>
</tr>
<tr>
<td>SCE</td>
<td>8.324**</td>
<td>3.531</td>
</tr>
<tr>
<td>RCE</td>
<td>1.774*</td>
<td>1.041</td>
</tr>
<tr>
<td>CEE</td>
<td>10.424***</td>
<td>1.349</td>
</tr>
<tr>
<td>LEV</td>
<td>0.853***</td>
<td>0.205</td>
</tr>
<tr>
<td>FSIZE</td>
<td>-0.044</td>
<td>0.339</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>-6.535</td>
<td>2.279</td>
</tr>
<tr>
<td>R-SQUARED</td>
<td>0.74</td>
<td></td>
</tr>
</tbody>
</table>

***, **, * indicates statistical significance at 1%, 5% and 10% respectively.

Table 6 presents the baseline model estimated using Prais-Winsten regression with PCSE. In particular, the model is estimated to correct for group-wise heteroskedasticity, contemporaneous correlation and panel serial correlation. Note that these issues might not be handled by pooled OLS or FE model (Beck and Katz, 1995). Also, feasible generalised least squares (FGLS) may not be appropriate as it has been shown to inflate the p-values when one is dealing with small TS-CS data set (Beck and Katz, 1995).

From the results of the main model presented in table 5, it can be seen that the ICE components, namely SCE, RCE and CEE have all had positive and significant impact on the firm market value measured by Tobin’s Q, with the most considerable effect exerted by CEE. Similarly, the coefficients of the Ohlson model’s principal variables (that is BE and AE) are both negative but only AE is statistically significant. This finding is in agreement with that of Omokhudu and Ibadin (2015) and contradicts the result reported by Ferraro and Veltri (2011). However, the results reveal statistically significant association between SCE, RCE and CEE, and Tobin’s Q.

SCE has a positive and significant impact on firm value at 5% level of significance. This means that an additional expenditure on the firms’ structural capital such as patents, brands, formulas etc. will make the overall business market value to increase. The finding is in agreement with that of William et al. (2019). Although William et al. (2019) argue that an alternative to market-to-book value, as a proxy for firm market value, might yield a different outcome, this study is at variance with this position as it employs Tobin’s Q. Similarly, Janošević and Dženopoljac (2015) report the same result which conforms to our finding. Based on our result, we reject the null version of H2, which states that SCE does not have significant effect on the value of the firm in the Nigerian oil and gas downstream sector, leading to the conclusion that SCE is significantly positive related to market value.

Moreover, Table 6 shows that RCE coefficient is positive and mildly significant at 10% alpha level. This result means that an increase in the firms’ relational capital, such as effective plans and
procedures to maintain long-run relations with all stakeholders leads to a minor rise in firm market value. Furthermore, the finding somewhat corroborates with the results reported by Suraj and Bontis (2012), Ulum et al. (2016), Ulum et al. (2017) and Yilmaz and Acar (2018). Consequently, this study rejects the null version of $H_3$ and concludes that RCE has mild positive impact on the value of firms in the Nigerian oil and gas downstream sector.

Additionally, from the results presented in Table 6, it is evident that CEE is significantly positively associated with Tobin’s Q at more than 99% level of confidence. This indicates that an increase in the financial and physical capital of oil marketing firms will consequently increase their market value by a significant proportion. This result agrees with prior empirical results reported by Elkabbouri and Ifleh (2016), Ibrahim and Ogwuche (2018), Nadeem et al. (2016) and Zeghal and Maaloul (2010). However, the finding is in disagreement with what is documented by Basyith (2016) and William et al. (2019). Therefore, this finding leads to the rejection of the null version of $H_4$ which states that CEE does not have a significant impact on oil and gas firms’ market value in Nigeria. We could thus conclude that CEE significantly affects firm value.

Finally, HCE is found to have an insignificant effect on the firm value. This means that we cannot reject the null hypothesis that HCE does not have a significant impact on firm value.

4.4 Robustness check: an alternative estimation

To ensure that our baseline PCSE estimation is robust, we estimate an alternative time-series model at sector level by regressing aggregate market capitalisation of the downstream sector on two macroeconomic measures of intellectual capital development using autoregressive distributed lag (ARDL) bounds approach to cointegration (Pesaran et al., 2001; Rahman and Kashem, 2017; Waziri et al., 2018). The two measures of intellectual capital used are: (i) the aggregation of Nigerian government expenditure on education, health and research and development (named HCD) and (ii) labour force participation rate in the Nigerian economic activities (named LPR). The inclusion of the first variable is consistent with Omokugbo and Imogiemhe (2020). Furthermore, labour force participation rate has been described by the world bank “as the proportion of the population aged 15 and older who actively contribute to economic growth”. Indeed, a description which portrays the variable as an appropriate indicator of the contribution of intellectual capital to an economy. Unemployment rate is another variable included in the ARDL because of its potential relationship with the dependent and the independent variables. It is important to mention here that data on expenditure on education, R&D and health were collected from the Central Bank of Nigeria (CBN). Data on unemployment rate and labour force participation rate were collected from the World Bank database.

It is essential to estimate this alternative model using indicators of intellectual capital that are different from the measures we derived from the financial statements of the firms in our sample for two reasons. Firstly, the estimation would show that the key results from our PCSE are robust to an alternative method. Secondly, the estimation neutralises the criticism labelled against measuring intellectual capital from accounting numbers in the income statement (Ståhle et al., 2011; Nadeem et al., 2019).
Following Pesaran et al. (2001), Narayan (2004) and Marques, et al. (2016) ARDL is generally modelled as below:

$$\Delta Y_t = \beta_0 + \sum_{i=1}^p \beta_i \Delta Y_{t-i} + \sum_{i=0}^q \beta_i \Delta X_{t-i} + \lambda_k X_{t-k} + \mu_t$$  \hspace{1cm} (12)

$$\Delta \log(MCP)_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta \log(MCP)_{t-i} + \sum_{i=0}^q \alpha_{2i} \Delta \log(HCD)_{t-i} + \sum_{i=0}^r \alpha_{3i} \Delta \log(LPR)_{t-i} + \sum_{i=0}^s \alpha_{4i} \Delta \log(UER)_{t-i}$$

$$+ \lambda_1(MCP)_{t-1} + \lambda_2 \log(HCD)_{t-1} + \lambda_3 \log(LPR)_{t-1} + \lambda_4 \log(UER)_{t-1} + \mu_t$$ \hspace{1cm} (13)

Table 7: Summary of ARDL(2,2,2,1) results

<table>
<thead>
<tr>
<th>Long-run Relationships</th>
<th>Dependent variable - (\log(MCP))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent variables:</td>
<td>Coefficient</td>
</tr>
<tr>
<td>(\log(HCD))</td>
<td>0.997***</td>
</tr>
<tr>
<td>(\log(LPR))</td>
<td>0.681*</td>
</tr>
<tr>
<td>(\log(UER))</td>
<td>0.275</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Short-run Relationships</th>
<th>Dependent variable: (\Delta \log(MCP))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Independent Variable</td>
<td>Coefficient</td>
</tr>
<tr>
<td>(\Delta \log(MCP(-1)))</td>
<td>1.823**</td>
</tr>
<tr>
<td>(\Delta \log(HCD))</td>
<td>2.292**</td>
</tr>
<tr>
<td>(\Delta \log(HCD(-1)))</td>
<td>-2.177**</td>
</tr>
<tr>
<td>(\Delta \log(LPR))</td>
<td>10.408**</td>
</tr>
<tr>
<td>(\Delta \log(LPR(-1)))</td>
<td>15.361*</td>
</tr>
<tr>
<td>(\Delta \log(UER))</td>
<td>2.277**</td>
</tr>
<tr>
<td>CointEq(-1)</td>
<td>-3.302**</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Model Fit and Diagnostic Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adjusted R-squared</td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
</tr>
<tr>
<td>Breusch-Godfrey Serial Correlation LM Test: -F-statistic</td>
</tr>
<tr>
<td>Heteroskedasticity Test: Breusch-Pagan-Godfrey - F-statistic</td>
</tr>
<tr>
<td>CUSUM - Structural stability</td>
</tr>
<tr>
<td>CUSUMSQ - Dynamic stability</td>
</tr>
</tbody>
</table>

***, **, * indicates statistical significance at 1%, 5% and 10% respectively.

The use of ARDL to estimate our alternative model in this study is informed and supported by a number of cogent advantages possessed by the method. Thus, the method works well with small samples; a mixed order of cointegration, I(0) and I(1), does not invalidate the model and the model avoids endogeneity and serial correlation problems (Pesaran et al., 2001; Narayan, 2004; Marques et al., 2016).
The summary of results from the short-run and long-run models estimated via ARDL procedure are presented in Table 7. Consistent with the outcomes of our PCSE model presented in Table 6, the ARDL results reported in Table 7 show that the two macroeconomic indicators of intellectual capital development have long-run relationships with market capitalisation of the downstream sector of the Nigerian oil and gas industry. It is clear from the Table that in the long-run, while human capital development (HCD) has a very significant positive relationship (at 1% alpha level) with the sub-sector’ market value (MCP), labour participation rate’s (LPR) association with MCP is mild at 10% level of significance. However, in the short-run both variables (HCD & LPR) have a significant positive relationship with the down-stream sector’s market value. This suggests that the results of our PCSE baseline model is robust to an alternative time-series estimation.

5. Discussion of results

While we report firm-level results via the Prais-Winsten regression with PCSEs as the main analysis of this paper, sector-level results are presented through the estimation of a time-series regression model using the ARDL bounds testing approach to cointegration as an additional analysis. It is imperative to state here that all the four hypotheses of this study are developed and tested at firm level.

The human HCE-related hypothesis could not be rejected following the documentation of absence of relationship between the HCE and Tobin’s Q. This result suggests that local human capital within the downstream sector is not sufficiently developed to enable the creation and retention of value in the Nigerian economy. This finding is closely related to the weak positive relationship between labour participation rate and market value at the sector level in the long-run. In the main, this implies that value creation and enhancement largely remain with the foreign workers in the industry. Thus, technical knowledge, high-level skills and advanced operational capabilities are still in the hands of the foreigners, as they are not being properly transferred to the local labour force. For this reason, till date, the Nigerian government outsources the repairs of its marginally working refineries to foreign companies. Furthermore, there are many foreign firms, operating as consultants within the upstream and the downstream sectors of the Nigerian oil and gas industry, that are unwilling to transfer technical knowledge and skills to the domestic labour force. This means that the huge remunerations and fees paid to the foreign workers and consultancy firms are mostly repatriated along with the value they create in the sector. In addition, gasoline as the major petroleum product consumed in Nigeria is mainly imported. This denotes that many skilled local employees working in the Nigerian refineries are redundant, and therefore, not contributing to any value creation.

The null version of the SCE hypothesis is rejected and this informs the documentation of the result which reveals that SCE exerts a significant positive effect on the market value. This signifies that as institutionalised system, internal processes and established mechanisms, SC cannot be expatriated. Thus, they will always be there within the oil firms in the downstream sector to continue to create value. SC elements such as patents, copyrights, organisational culture, information resource, property rights and so on will be there to create value as long as the organisation is doing well.
RCE is mildly positively related with Tobin’s Q. Indeed, the relationship is weak as we could only reject the null version of the relevant hypothesis at 10% level of significance. This finding is a reflection of the nature of firm-stakeholder relationship in Nigeria, which is only fair but far from good. In this regard, while companies in the downstream sector may be doing their best to keep cordial relationship with their primary and financial stakeholders, they may not care to do the same with other secondary and non-financial stakeholders. The relationship might have been weakened by a possible poor relationship with the society, the environment and some government agencies.

The highly significant positive relationship reported between CEE and market value, leading to the rejection of the null version of H₄, is not surprising. This is because owners of equity invest in the companies operating in the downstream sector with the anticipation that their wealth, and by extension market value, will increase. In this context, when the equity holders provide the required funding, managers are expected to employ physical and financial assets and manage them for the main purpose of increasing owners’ wealth and market value. For this reason, CEE has emerged as the component of ICE within M-VAIC exhibiting the strongest positive relationship with market value.

The results discussed in this section are largely robust to an alternative estimation presented in section 4.4.

6. Conclusion

Intellectual capital has generally received tremendous attention in recent times. This is evident from the fact that several academics have undertaken theoretical and empirical research on various aspects of the subject. Our study is motivated by the need to assess the efforts being made by the Nigerian government to stimulate development of intellectual capital with a view to enhancing and strengthening the ability of the domestic human resource to create and retain value in the Nigerian oil and gas industry. In so doing, this paper uses Prais-Winsten regression with PCSEs, as the main method of analysis, to examine the relationship between four measures of ICE (namely, HCE, SCE, RCE and CEE) and market value, measured by Tobin’s Q, at firm level. We also use ARDL to conduct additional analysis at the downstream sector aggregate level to support the results of our main analysis and demonstrate their robustness.

In sum, firstly, findings generated from our main method of analysis show two components of ICE (SCE and CEE) as having significant positive relationship with market value. Secondly, one component, RCE, is shown to have a mild positive relationship with market value. Thirdly, HCE, turns out to have no-association with market value of firms operating in the Nigerian oil and gas downstream sector. These results are evidently robust to alternative method whose results reveal that two macroeconomic measures of intellectual capital development (namely, HCD and LPR) are both significantly positively related to aggregate market capitalisation of the downstream sector in the short-run. However, while HCD has a significant positive long-run relationship with the sector’s aggregate market capitalisation, LPR’s positive relationship with the market capitalisation is mildly significant in the long-run.

Regarding theoretical contribution, our study has provided additional evidence in support of clean surplus theory in its function of facilitating accounting numbers to determine and explain market values. We have done this in a novel fashion by designing and using a theoretical framework that
depicts an interlink between clean surplus theory, as it broadly postulates the use of accounting information to valuate equity, and RBT and SHT as they specifically predict how HCE, SCE, CEE and RCE may affect market value.

This study is limited to the downstream sector of the Nigerian oil and gas industry. As such its findings might not hold for the entire economy. Secondly, the study focuses on firms listed on the Nigerian stock market. Therefore, these results might not hold for other African countries. Future studies may wish to look at the possibility of undertaking similar research on oil-rich West African or all African countries’ oil and gas downstream sector.

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