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The explanatory value of intrinsic equity valuation models for share price variations: A survey of recent approaches

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Abstract

Over the past six decades, a considerable amount of research has been conducted to better understand the explanatory ability of intrinsic equity valuation models to account for variations in equity share prices or returns, in which the accounting-based Ohlson residual income valuation framework has been the primary focus. Meanwhile, several variants of this model have emerged, the foremost of which typically comprises the decomposition of the Ohlson residual income variable into substitute accounting earnings variables, such as the traditional bottom-line earnings variable or, more recently, alternative earnings performance measures, of which earnings before interest, tax, depreciation and amortisation (EBITDA) is a particular case in point. However, there appears to be a lack of consensus about the variables of interest and the most appropriate model to define the predicted interconnections between accounting values and share prices or share price returns. In light of this lack of accord, the aim of this study was to examine the recent literature with regard to the approaches and evidence pertaining to the Ohlson model and the recent variants thereof that are based either on traditional or alternative earnings performance measures, with a view to answering the following research questions: 1. Which econometric model results in the best explanation of the association between accounting information and share prices? 2. Consequently, which variable, when combined with equity book values, seems to provide the most persuasive evidence of association with equity share prices: EBITDA, earnings or residual income? To answer these questions, a systematic literature review was conducted. The criteria were that the studies had to have at least two explanatory variables of interest in accounting for share price variations or returns, with one of them being equity book values and the other being any earnings performance measure, such as residual income, earnings, EBITDA, or combinations involving transformations of these. The review entailed a critical evaluation of the methodologies, model specification and model output against the reported findings, inferences and conclusions. The results revealed that the original Ohlson (1995) model, the Collins *et al.* (1997) and the recent EBITDA variations yielded equally valid demonstrations of the association of accounting information with share price variations. Consequently, depending on the choice of model, all three variables, EBITDA, earnings and residual income, appear to possess an equal amount of explanatory power to account for variations in equity share prices. The study's major contribution is to clarify the explanatory power of Ohlson-based models and the specification of variables, as well as methodological and analysis issues that could inform future research in the field.

Keywords: EBITDA; equity valuation; Ohlson (1995) residual income valuation framework; value relevance; alternative performance measures; fundamental valuation; intrinsic equity valuation.

JEL classification codes: M41; G10, G12; G14; G11; G32

1 Introduction

The question of the explanatory power of intrinsic equity valuation models to account for variations in equity share prices or returns has received considerable attention from numerous researchers of capital markets in the accounting, finance and economic fields over the past six decades. In recent years, the accounting-based Ohlson (1995) residual income valuation framework has been the primary econometric model of choice among researchers in this field, who have typically operationalised it in attempts to answer a wide range of research questions regarding the interconnections between intrinsic equity valuation models, their variables and the market value of equity shares or share price returns (see, e.g., Zheng, Wang, Song, Wu, & Zhai, 2020; Kuo, 2017; Leccadito & Veltri, 2015; Durán-Vázquez, Lorenzo-Valdés & Castillo-Ramírez, 2014; Qi, Wu & Xiang, 2000; Lee, Chen & Tsai, 2014; Lee, Lin, & Yu, 2013; Liu & Liu, 2010). Meanwhile, several variants of the Ohlson (1995) model have also emerged in recent years, the foremost of which range from decompositions of Ohlson's (1995) residual income variable into substitute accounting earnings variables, such as the traditional bottom-line earnings variable to those based on alternative earnings performance measures. The most notable early variant, which has been widely examined in the recent literature, is the Lintnerian linear price-levels formulation of Collins, Maydew and Weiss (1997), who considered the role of the residual income variable in the Ohlson (1995) model. Collins *et al*. (1997) proposed an alternative price-model variant that regressed share prices on equity book values and reported earnings. Lately, variants specifying alternative earnings performance measures have also been offered as an alternative. A case in point is the EBITDA-based model specification recently advanced by authors such as Stenheim *et al.* (2018), Nhleko and Schutte (2019) and Nhleko, Schutte and Steyn (2020). The latter argued that the Collins *et al*. (1997) traditional bottom-line earnings component could be logically disaggregated into EBITDA.

Notwithstanding the significant strides that have been made in the theoretical understanding of the link between intrinsic equity share valuations and their market values or returns in the area of capital markets-based accounting research over the years, there appears to be a lack of consensus about both the variables of interest and the most appropriate model to define the predicted interconnections between accounting values and share prices or returns. To compound this conundrum, practical methodological and econometric challenges persist in relation to the empirical validation of these models (see, e.g., Aledo Martínez *et al*., 2020; Nhleko, Schutte & Steyn, 2020; Canitz *et al*., 2017; Gow, Ormazabal & Taylor, 2010; Petersen, 2009; Beaver, 2002; Holthausen & Watts, 2001; Barth, Beaver & Landsman, 2001). Moreover, although the stream of studies utilising the Ohlson model or its variations has continued to enlarge, there is a paucity of literature reporting on either examination of the explanatory ability of such models and their variables in account for variations in equity share prices or returns, or their analysis approaches.

Consequently, the aims of the current study were: to survey the current literature to ascertain the most recent approaches to the explanatory power of accounting-based intrinsic equity valuation models; to identify the most promising practical methodological and econometric model specification solutions that could inform future research in this field, and to determine which variable shows the most promise. Notably, given the findings from several previous studies regarding the significance of the equity book value variable to account for share price variations or returns (see, e.g., Hayn, 1995; Collins *et al.*, 1997; Dechow *et al.*, 1999; Myers, 1999; Barth *et al.*, 1998; Francis, Schipper & Vincent, 2003; Karathanassis & Spilioti, 2003; Pope & Wang, 2005; Swartz & Negash, 2006; Kwon, 2009; Keener, 2011; Spilioti & Karathanassis, 2012), the scope of the current study was limited to the variations of the Ohlson (1995) model that specified this variable together with

some other earnings variable. In light of the above, the research questions that guided this study were: 1. Which econometric model results in the best explanation of the association between accounting information and share prices? 2. On the basis of the answer to question one, which earnings variable, when combined with equity book values, seems to provide the most persuasive evidence of association with equity share prices: EBITDA, earnings or residual income? To answer these questions, a systematic review of studies conducted from 1 January 2010 to 31 December 2020 were sourced via EBSCO Discovery Service (EDS). In particular, the models specified in the studies had to have at least two explanatory variables of interest in accounting for share price variations or returns, with one of them being equity book values and the other being any earnings performance measure. Although the findings were largely discordant due to the methodological and econometric challenges associated with the various analysis approaches, the three abovementioned earnings variables were equally valid in terms of explaining share prices in conjunction with book value. Thus, the main contribution of this study is providing clarity with respect to the explanatory power of Ohlson-based models and the specification of variables, as well as methodological and analysis issues that could inform future research in the field.

The remainder of this review is structured as follows: Section 2 is an exposition of the relevant conceptual-theoretical framework. The research design is outlined in Section 3. Section 4 comprises a description of the findings of the study. Finally, the study conclusions are presented in section 6.

2 The Conceptual-Theoretical Framework

Ohlson (1995) posited a valuation framework that predicts that the market value of an equity share can be functionally related to a linear regression of residual earnings, equity book values and some "other" relevant information variable. The conceptual formulation of Ohlson's (1995) valuation framework is premised on a robust and compelling synthesis of the foundations of valuation theory and contemporary finance hypotheses regarding capital asset pricing, as well as dividend irrelevancy. It also systematically combines these theoretical foundations with the methodological assumptions of clean surplus accounting and a linear information dynamic (Nhleko, Schutte & Steyn, 2020).

The hypothesis that accounting information variables can be related to equity share prices, and are hence value relevant, owes its conceptual foundations to a combination of both valuation theory and the related hypothesis of market efficiency (see, e.g., Barth, Beaver & Landsman, 2001; Ota, 2003; Beisland, 2009; Klimczak, 2009:3). As Williams (1938) first argued, the principle that the intrinsic value of any asset can be determined by discounting its expected future cash flows at an appropriate interest rate is nowadays well-established within the finance and economics fields. The efficient market hypothesis (EMH), on the other hand, has its conceptual underpinnings in asset pricing theory. Its premise is that, within the context of capital markets, equity share prices fully adjust to reflect all the available information about the value of a company (Fama, 1970; Clarke, Jandik & Mandelker, 2001).

Previously, Francis and Schipper (1999) rationalised that, in a reasonably efficient capital market, equity share prices will, over the long term, drift towards their intrinsic equity values. The practical implication of this proposition is that it ultimately serves to buttress the methodological approach of logically relating accounting-based intrinsic valuations of equity shares to their market values or returns. This perspective is consistent with Ohlson's (1995:665) postulation that the intrinsic value of a company's equity share is an unbiased estimator of its equity share price.

Thus, the perspective of the current study is located within the well-established conceptual-theoretical underpinning of the value relevance framework (Amir, Harris & Venuti, 1993; Barth, Beaver & Landsman, 2001; Ota, 2003; Beisland, 2009; Klimczak, 2009).

3 Research method

In an attempt to enhance the quality of the findings by providing rigorous, reliable, transparent and replicable review results, and to guard against the risk of bias, the researcher applied Deyner and Tranfield's (2009) five-step principle for conducting synthetic scientific reviews, in combination with Shirmer's (2018) sequential synthetic literature analysis framework.

The EBSCO Discovery Service (2020) (EDS) system was utilised to perform the searches and manage the selection and evaluation process. EDS can find books, journal articles and online resources. Furthermore, it facilitates limiting the search results to online items and available sources, marks and evaluates search materials, and stores information in a private storage area (EBSCO Discovery Service, 2020). The EDS system searches several academic databases and, at the time of this research, the index included databases such as JSTOR, Scopus, Academic Search Premier, Africa-Wide Information, Business Source Premier, Cambridge Journals Online, EconLit, Emerald Online, ProQuest Theses & Dissertations Full Text, SAePublications, SAGE journals online, SCIELO, ScienceDirect, Wiley online journals, Springerlink journals, Taylor & Francis journals (EBSCO Industries Inc, 2020). The survey period covered a 10-year period, from 1 January 2010 to 31 December 2020.

Consequently, the systematic literature survey began with determining the potential terms and variables of interest specified in a typical Ohlson (1995) model or its variants based on a preliminary review of the model specifications of prior related research. To qualify to be considered a variant of the Ohlson (1995) model, the adopted valuation equation was expected to comprise at least two explanatory variables of interest in accounting for share price variations or returns, with one of them being equity book values and the other being any earnings performance measure, such as residual income, earnings, EBITDA, or combinations involving transformations of these. Moreover, since capital markets-based accounting examinations are often referred to as "value relevance" research, it was considered necessary to include this term as well.

Studies that provided evidence based on approaches that entailed only relative valuations or univariate regressions (see, e.g., Kim & Ritter, 1999, Barton, Hansen & Pownall, 2010; Gray & Vogel, 2012) were excluded. Furthermore, studies in which only predictive applications of these models (*cf.* Skogsvik & Skogsvik, 2010; Tswei & Kuo, 2012; Kuo, 2016; Leccadito & Veltri, 2015; Zheng, Wang, Song, Wu & Zhai, 2020) or only equity-option pricing applications were examined (*cf.* Liu & Liu, 2010) were also eliminated. The search terms that were decided upon, which were configured to accommodate all known English spelling variations, are shown in Table 1 below.

Table 1: Boolean search operators applied

{"book value*" OR "equity book value*" OR "BV" OR "net asset value*" OR "net asset*" OR "owners equity"
AND
"residual income" OR "EBITDA" OR " earnings" OR "earnings before interest tax depreciation and amorti*ation"
AND
"share price*" OR "stock price*" OR "stock price return*" OR "stock return*" OR "share return*" OR "share price return*" OR "equity valuation*" OR "valuation*" OR "value relevance"}
OR
"Ohlson model" OR "Ohlson (1995) model" OR "residual income valuation" OR "residual income framework"

The search criteria were as follows: the results had to be available from the EBSCO Discovery Service (2020) in full text in English. Furthermore, the articles had to be recent; namely, they had to have been published in the 10 years between 1 January 2010 and 31 December 2020. Finally, the relevant papers also had to be peer-reviewed reports of primary research contained in academic journals, conference materials, forthcoming publications, such as those in production or awaiting publication, and working papers.

The texts returned by both a database and manual search are shown in Table 2 below.

Table 2: Study selection and inclusion

Total number of studies identified by the literature search	**118**
Exact duplicates identified by the database search system	(30)
Exact duplicates identified by manual review	(44)
Non-English studies identified by manual review	(3)
Studies excluded on the basis of title alone	NIL
Studies excluded on the basis of abstract alone	(2)
Studies excluded on the basis of both title and abstract being not relevant	NIL
Studies excluded on the basis of full-text not available	NIL
Subtotal of remaining studies	**39**
Studies identified from reference lists and grey literature	7
Studies excluded on basis of full-text	(14)
Total number of studies that met the selection and inclusion criteria	32

As indicated in the above table, of the 118 initial articles identified, several were removed: 74 because they were exact duplicates, three because they were not in English and two because their subject matter was irrelevant to this study. This yielded a subtotal of 39 articles, to which a further seven studies were added from reference lists and grey literature (*cf.* Gregory & Denniss, 2018), resulting in 46 articles. Finally, a further 14 articles were eliminated due to their methodologies being discordant with the explanatory applications. Consequently, 32 research articles were reviewed. This entailed critically examining the methodology, the model specification and results reported in each study, and comparing each researchers' inferences, findings and conclusions with a view to determining which model and variables explained the associations better and which ones were

flawed. Thereafter, the studies were categorised according to the three models identified for the purpose of reporting which of them showed the most promise and the flaws evident in each model.

4. Findings and discussion

The literature survey yielded inconsistent findings, suggesting that the answers to the research questions might not be straightforward. Moreover, the results of the studies examined herein were confounded by significant econometric and methodological conundrums, which complicated the interpretation of the results. However, it was evident that certain empirical approaches seemed to yield the promise of further breakthroughs.

In the first part of this section, evidence of the explanatory power of the traditional Ohlson (1995) model is presented. In the second part, evidence relating to the Collins e*t al.* (1997) price-levels variant is examined, and empirical evidence relating to the EBITDA variant is explored in the third subsection. In each of these three subsections, evidence of the validity of the econometric models in accounting for share prices or returns is examined, together with any methodological and econometric challenges noted. Finally, any promising aspects of the adopted approaches that were identified are explored.

Evidence relating to the traditional Ohlson (1995) residual income framework

Five studies were identified in which the empirical validity of the traditional Ohlson (1995) model could be examined in terms of its ability to account for share prices or returns. The first of these, by Qi *et al.* (2000)[1], was an exploration of the cointegration of the Ohlson (1995) model variables based on Engle and Granger's (1987) cointegration theory, following a related earlier methodology coined by Campbell and Shiller (1987) in the context of the valuation of equity shares. The major weakness of this study is that its results were inconclusive; they provided insufficient support for the validity of the cointegration of the Ohlson (1995) model variables. A study by Valdés and Vázquez (2010), who adopted a related analysis approach to Qi *et al.* (2000), suffered a similar fate.

This lack of empirical support for the direct cointegration of the residual income, equity book values and share price variables, when examined in terms of the traditional cointegration theory, presents a significant paradox since the fundamental premise of Ohlson (1995) model is the stationarity and long-run equilibrium of its variables. Moreover, this lack of cointegration seems to fly in the face of the evidence provided by several related studies that have lent support for the validity of the Ohlson (1995) model based on alternative analysis techniques, such as cross-sectional ordinary least squares (OLS) regressions (see, e.g., Collins *et al.*, 1997; Francis & Schipper, 1999; Keener, 2011).

Against this backdrop, researchers Lee, Chen and Tsai (2014) and Lee, Lin and Yu (2013) adopted alternative cointegration strategies. The former examined the applicability of a panel cointegration solution. Using data observations obtained from Compustat industrial databases and the University of Chicago's Centre for Research in Security Prices (CRSP) for a sample of 380 companies for the 1986–2004 period, they tested a null hypothesis of no panel cointegration for the Ohlson model variables. They found that their null hypothesis could not be rejected at the 5% statistical significance level for all the sectors included in their examination. On this basis, Lee *et al*. (2014) concluded that

[1] Specific selection from reference lists.

the book value of equity and residual income variables were significant in explaining long-run variations in equity share prices.

Lee *et al.* (2013) investigated the fractional cointegration of the Ohlson (1995) model variables. They hypothesised the practical possibility of a slow but mean-reverting process, such that the order of integration (*d*) among the Ohlson (1995) model variables would fall above 0 but less than 1. In particular, the researchers claimed that, for their unique case of fractional cointegration to be met, *d* had to fall between 0 and 0.5. In order to estimate the residuals of the Ohlson (1995) model, they applied a Gaussian technique mooted by previous researchers that entailed raising *d* to the power of μ, which they set to values of between 0.7 and 0.9 at 0.05 arbitrary adjustment increments. They found that the actual estimates of *d* were indeed consistently higher than 0 but less than 1 across differing powers of μ at both the 1% and 5% statistical significance levels. In particular, it was revealed that when μ was set to a value of 0.90, the proportion of sample companies that were fractionally cointegrated reached a maximum of between 87% and 89% at the 5% statistical significance level. Consequently, Lee *et al*. (2013) concluded that the process by which variations in market value were explained by the variables of equity book value and residual income was slow but mean-reverting.

In contrast to the abovementioned analysis approaches, Spilioti and Karathanassis (2012) employed panel data analysis techniques to evaluate the validity of Ohlson's (1995) equity valuation model in relation to the FTSE-100 index of the London Stock Exchange during the 1992–2007 period. Their analysis revealed that the Ohlson model specification accounted for 50% of the variation in the equity share prices, with a corresponding F-ratio of 11.17, which was indicated to be significant at the 1% statistical level. Furthermore, all the model variables' coefficients were positive and statistically significant at the 1% level.

Challenges and weaknesses

While the studies by Lee *et al.* (2014), Lee *et al.* (2013), and Spilioti and Karathanassis's (2012) appeared to provide support for the validity of the Ohlson (1995) model within the context of capital markets, it appears that each of them was dogged by several unanswered methodological questions. The most notable of these related to the treatment of scale and negative earnings, even in instances when the reported descriptive statistics were indicative of a potential model misspecification challenge. In the Qi *et al.* (2000) study, in particular, several data observations were arbitrarily excluded as outliers without any clear theoretical justification being advanced.

Moreover, none of the researchers divulged sufficient details regarding the testing of their econometric model assumptions. Finally, while the researchers sometimes reported solutions to time-series dependence, it was not evident in any of these studies how the challenge of cross-sectional dependence was addressed.

To compound matters, an inherent difficulty posed by the formulation of Ohlson's (1995) residual income variable requires initially estimating and applying an implied cost-of-capital rate at the company-level cross-section. The practical methodological approaches often applied to determine such discount rates are a subject of intense controversy among practitioners of this line of research (see, e.g., Somchai & Khanthavit, 2011; Iñiguez, Reverte & Amor-Tapia, 2012).

Summation

While early direct cointegration attempts, as applied by Qi *et al.* (2000) and Valdez and Vázquez (2010), suffered significant methodological drawbacks, the evidence seems to suggest that the recent panel (Lee *et al.*, 2014) and fractional cointegration approaches (Lee *et al.*, 2013) are inherently effective solutions that provide sufficient support for the validity of the equilibrium of the accounting and financial variables. Considered together, the results of these studies all seem to point towards the empirical validity of the Ohlson (1995) model variables.

Evidence relating to the Collins *et al*. (1997) formulation

The traditional Collins *et al.* (1997) model is arguably one of the widely examined variants of the Ohlson (1995) residual income framework. This variant is premised on the fundamental assumptions that, while the Ohlson (1995) model includes the term $\frac{(1+r_{it})}{r_{it}}$ for discounting earnings, allowing discount rates to vary across companies does not significantly improve the model's explanatory power. On this basis, a company's equity share price can simply be related to a functional regression of equity book values and reported earnings. It has previously been demonstrated (*cf.* Ota, 2003) that Collins *et al*.'*s* (1997) formulation is simply the mathematical equivalent of the return model specification previously first posited by Easton and Harris (1991). This practical observation implies that the alternative return model specification can also be logically related to an intrinsic equity valuation framework.

In the current literature survey, it was identified that several researchers had applied the Collins *et al.* (1997) model to answer a wide range of research questions relating to the association between accounting, financial and other information variables. All these studies appear to strongly validate the Collins *et al*. (1997) specification in explaining share prices across market sectors, across geographical regions, in developing, developed and emerging economies, and also under divergent accounting frameworks, reporting standards and legal systems, in both the short and the long run. Moreover, the model also seems to apply to both companies whose shares trade at a premium and those whose shares trade at a discount. However, it is not clear if the model holds true in the presence of audit failures or in instances in which dividends or operational cash flows are specified as the "other" information variable together with earnings.

For instance, in the study by Durán-Vázquez *et al* (2014), it was indicated that a variant of the Collins *et al.* (1997) model that specified the Piotroski score[2] as the "other information" variable and its lagged value were applicable in the context of the Mexican Stock Exchange for the 2005 to 2011 period, because they could account for practically significant variations in equity share prices, with

[2] The traditional Piotroski score that Durán-Vázquez *et al.* (2014) applied is the sum of nine performance indicators that differentiate a company with sound financial performance indicators from those with poor financial performance indicators (Piotroski, 2000). Piotroski (2000) had posited this score as a fundamental valuation strategy to identify companies with a high probability of financial returns – the so-called "top performers" – from those that were likely to yield lower returns – or "underperformers". According to Piotroski (2000), his score (PIO) can be specified as follows:

$$PIO_{jt} = ROA_{jt} + \Delta ROA_{jt} + CFO_{jt} + Accrual + \Delta Margin_{jt} + \Delta Turn_{jt} + \Delta Lever_{jt} + \Delta LIQUID_{jt} + \Delta EQOFFER_{jt}.$$

Piotroski (2000) had previously asserted that this score's independent variables are dichotomous dummy variable proxies of a company's ability to generate profits. Thus, they are assigned a score of 1 if their value is positive, or NIL if not. ROA is defined as the proxy for return on assets; ΔROA is the change in return on assets; CFO is cash flow from operations scaled by total assets; $\Delta Margin$ is the change in the gross margin; $\Delta Turn$ is the change in turnover; $\Delta Lever$ is the negative change in leverage or NIL; $\Delta LIQUID$ is the change in current ratio; $\Delta EQOFFER$ is assigned a value of one if there was no equity issuance in the previous period, or otherwise a zero, and $Accrual$ is the difference between ROA and CFO. Thus, in effect, the Piotroski score has a numeric value that can range closer to 9 for the top performers to closer to NIL for the underperformers.

all the model coefficients being shown to be statistically significant at the 5% level based on a dynamic auto-regressive panel model.

Similarly, the evidence of researchers such as Clarkson, Hanna, Thompson and Richardson (2011), Chebaane and Othman (2014), Beisland and Knivsfla˚ (2015), Suadiye (2012) and Eng *et al.* (2013), who examined the validity of the Collins *et al.* (1997) model specification to account for equity share prices within the context of divergent accounting regimes, demonstrated that practically significant associations existed between the model variables and equity share prices. In addition, the results of Almujamed and Alfraih (2019), Mostafa (2016) and Boonlert-U-Thai, Saudagaran and Sen's (2020) were also unanimous in confirming the applicability of the Collins *et al.* (1997) model within the context of developing and emerging economies.

By contrast, Bepari (2015) set out to examine the relative and incremental value relevance of equity book values during the GFC, as well as the non-crisis period. He discovered that the Collins *et al.* (1997) specification could account for practically significant associations to equity share prices during both periods.

Aleksanyan and Karim (2013), on the other hand, utilised a pooled cross-sectional regression model to investigate the value relevance of the earnings and equity book value of companies whose share prices traded at a "premium" to equity book values (premium companies) against those whose share prices traded at a "discount" to equity book values (discount companies), as well as the differences between profit-making premium and discount companies' value relevance against their loss-making premium and discount counterparts. They reported an R-squared of 39.5% for the profit-making premium companies, compared to 31.8% for the loss-making premium companies, an R-squared value of 71.6% for profit-making discount companies and 72.2% for loss-making discount companies.

Murwaningsari *et al.* (2015) and Ratnaningrum and Widagdo's (2019) sought to establish the validity of the Collins *et al.* (1997) variant in the presence of earnings management studies. The results of both these studies indicated a practically significant association between the particular Collins *et al.* (1997) models they specified and equity share prices, even in the presence of earnings management.

Dan, Brown and McCullough (2011) set out to examine the value relevance of earnings and equity book values in the presence of audit failures, as indicated by restatements of financial statements. Their results indicated significantly lower R-squared values for the audit failure group than the control group, regardless of whether or not the sampled companies employed a big four audit firm.

Meanwhile, Su and Liu (2012), Chiang *et al*. (2017) and Chandrapala (2013) seem to have gone a bit further than just validating the Collins *et al.* (1997) model. They also demonstrated the significance of the effects of corporate governance on equity share prices when specified as the "other" information variable.

Al-Hares *et al.* (2012), Bawono, Ramadhanti and Kurniawati (2020); Makrani and Abdi (2014), and Alkali, Kegudu and Zuru (2018) examined the specification of other non-accrual, cash-based variables such as dividends distributions and operational cash flows in addition to the earnings and equity book value variables. Their collective evidence demonstrated a significant association of accounting information with equity share prices when cash flows or dividends were specified as explanatory variables in the Ohlson (1995) model or the Collins *et al*. (1997) variant. However, the

most dominant thread in this regard was that, while cash flows and dividends seemed to be relevant explanatory variables when specified together with equity book values, specifying the latter variable as additional "other" information variables in the presence of the earnings variable was likely to result in model misspecification.

Kadri (2016) and Ahmadi and Bouri (2018) examined the value relevance of earnings and equity book value variables in the banking and financial sectors. Ahmadi and Bouri (2018) examined the value relevance of earnings and equity book values in the Tunisian banking and financial sectors, while Kadri (2016) compared the value relevance of Islamic and conventional banks in Malaysia. The collective empirical evidence of these studies indicates that the Collins *et al.* (1997) model sufficiently explains equity share prices or returns in these sectors. This evidence should be considered significant because it dispels the proposition that financial companies and banks should be excluded from examinations of value relevance, as is often the case with the sampling methodologies of capital market-based accounting studies.

Challenges and Weaknesses

Notwithstanding the contributions of each of the abovementioned studies regarding the evidence of association of the Collins *et al*. (1997) model variables to equity share prices or returns, they all appeared to suffer significant methodological deficiencies. These can be summarised as follows:

a) The sampling methodologies were often subject to arbitrary decisions, such as exclusions of data observations as outliers without sufficient theoretical foundation. For instance, Mostafa (2016), Boonlert-U-Thai *et al.* (2020), Chiang *et al.* (2017), Bepari (2015), Aleksanyan and Karim (2013), Al-Hares *et al.* (2012), Murwaningsari *et al.* (2015) and Clarkson *et al.* (2011) omitted several empirical data observations, such as those relating to finance, banking, insurance, investment companies or the utility sectors, from their analyses because they considered them to be outliers. Spilioti and Karathanassis (2012) also excluded all data observations from the 2008 financial period and subsequent years from their analysis based on a supposition that doing so would assist them in steering away from any modelling disturbances related to the 2008 GFC. By contrast, the typical methodological responses of other researchers who encountered similar circumstances (see, e.g. Al-Hares *et al.,* 2012; Bepari, 2015) was to either measure or control for the GFC's impact.

b) Pooled cross-sectional linear regression models were often used without a clear demonstration of how the econometric assumptions of poolability underlying such models were satisfied, namely those of the homogenous slope coefficients. In the current literature survey, this challenge was found to be the case in respect of several studies, such as Eng *et al.* (2013), Chebaane and Othman (2014), Almujamed and Alfraih (2019), Mostafa (2016), Boonlert-U-Thai *et al.* (2020), Chandrapala (2013), Aleksanyan and Karim (2013), Al-Hares *et al.* (2012), Makrani and Abdi (2014), Ratnaningrum and Widagdo (2019), Ahmadi and Bouri (2018), Kadri (2016), Dan *et al.* (2011).

c) Linear regression models were often applied without clear indications of how the econometric assumptions of linearity, normality and homoscedasticity were achieved. For example, in the case of the studies by Durán-Vázquez *et al.* (2014), Beisland and Knivsfla˚ (2015), Eng *et al.* (2013), Chebaane and Othman (2014), Mostafa (2016), Boonlert-U-Thai *et al.* (2020), Su and Liu (2012), Chandrapala (2013), Chiang *et al.* (2017), Aleksanyan and Karim (2013), Al-Hares

et al. (2012), Makrani and Abdi (2014), Alkali *et al.* (2018), Bepari (2015), Ratnaningrum and Widagdo (2019), Murwaningsari *et al*. (2015), Ahmadi and Bouri (2018), Kadri (2016), Dan *et al.* (2011), insufficient information was provided regarding how the assumptions of their modelling specifications were met.

d) Researchers typically neglected to examine and control for the impact of scale and negative earnings on the empirical results, even in instances when these were apparent from the descriptive statistics. This seemed to be the case for the studies of Suadiye (2012), Clarkson *et al.* (2011), Eng *et al.* (2013), Chebaane and Othman (2014), Boonlert-U-Thai *et al.* (2000), Su and Liu (2012), Al-Hares *et al.* (2012), Makrani and Abdi (2014), Alkali *et al.* (2018), Murwaningsari *et al*. (2015), Ahmadi and Bouri (2018) and Dan *et al.* (2011). With respect to the studies of Chiang *et al.* (2017), Bepari (2015) and Kadri (2016), although attempts were made to control for the challenge of negative earnings, it was not evident that the researchers also controlled for the impact of scale, which was apparent from their descriptive statistics. In the Kadri (2016) study, the researcher also utilised undeflated statistics for the variables of market capitalisation, equity book value and earnings. The procedure is likely to have exacerbated the modelling challenge of scale effects. However, the researcher was silent in this regard.

e) Inferences and conclusions were often made in the face of either practically non-significant coefficients of determination or non-significant, unintuitive or contradictory response coefficients. For example, while Suadiye (2012) sought to examine the effect of adopting international financial reporting standards (IFRS) on the value relevance of earnings and equity book values on the Istanbul Stock Exchange, his results demonstrated that, when earnings and equity book value variables were regressed on the response share price variable during the pre-IFRS implementation 2000–2002 period, the coefficients of both explanatory variables were predictably positive. However, his model accounted for only 17.28% of the total variance in equity share prices. Despite the lack of practically significant association, Suadiye (2012) asserted that equity book values and earnings variables were value relevant for companies listed on the Istanbul Stock Exchange. In the case of Chebaane and Othman (2014), the authors did concede that the observed negative coefficients for the earnings variable in the industry results they presented were odd and inconsistent with previous studies. However, they did not explore the question further.

Similarly, the initial parameter estimates of Boonlert-U-Thai *et al.'s* (2000) econometric model indicated that all the variables yielded positive coefficients across all the countries and also across all the models. However, an exception was when the dividend variable was entered as an additional explanatory variable along with the equity book value and earnings variables for Indonesia. Following this step, it was evident that specifying the dividend as the "other information" variable led to significant model misspecification, as indicated by the collinearity statistics between both the dividend and the share price variables, and between the earnings and the equity book value variables. Nevertheless, the authors did not explore the challenge of the misspecification of the model.

In the case of Almujamed and Alfraih (2019), while the regression coefficient of the equity book value variable was reported as significant in explaining share price variations when the pooled cross-sectional regression model was utilised, oddly, the same did not hold for any of the years when the results were examined using annual cross-sectional regressions. Although the researchers did not examine the possibility of model misspecification as an explanation for this

phenomenon, it was probable that it was indeed the cause for this observation. In Mostafa's (2016) study, a negative coefficient for the equity book value variable was reported, which was also shown to be non-significant. These results were both surprising and counterintuitive. The researcher should have interpreted this observation as signs of the presence of either data or model specification issues, or that the specified relationship of linear regression of the earnings and equity book value variables did not fit the data well. However, Mostafa (2016) explored none of these possibilities.

In a similar manner, in their country-level parameter estimates, the sign of the response coefficient Boonlert-U-Thai *et al.* (2020) reported for the earnings variable for Indonesia was, paradoxically, negative, while that of the dividend variable was non-significant. Furthermore, for Hong Kong, both the equity book value and the dividend variables were surprisingly non-significant in explaining share price variations. However, the researchers did not provide a reasonable explanation of why these cases might have been observed.

With respect to the Aleksanyan and Karim (2013) study, while the researchers sought to specify dividends as an additional variable to earnings and the equity book values, the coefficient of the dividend variable was indicated as non-significant. Yet the researchers did not explore the matter further.

A similar predicament, encountered in the results of the Makrani and Abdi (2014) study, was that a negative coefficient was obtained for the earnings variable throughout the annual cross-sectional regressions they reported, except for one year. This finding is puzzling because it is inconsistent with the vast majority of related prior evidence regarding the positive effect of an increase in the earnings variable on equity share prices. While these results should have been considered red flags for either earnings management or model misspecification (*cf.* Murwaningsari *et al.*, 2015; Ratnaningrum & Widagdo, 2019), the researchers explored neither possibility.

While Ratnaningrum and Widagdo's (2019) overall results revealed a significant relationship between the explanatory variables and the log-transformed share prices, the coefficient of the earnings variable was found to be non-significant at the 5% level. However, the researchers did not seem to explore the reasons for this finding. Paradoxically, Ahmadi and Bouri (2018) reported that the response coefficients of the univariate regressions of the earnings variable on the equity share price variable were statistically significant, but their coefficients were revealed to be non-significant when specified together in the Collins *et al.* (1997) model. Despite this contradiction being unexpected and patently suggesting model misspecification issues, the researchers ignored this red flag.

f) Time-series and cross-sectional dependence challenges were often ignored when it came to inferential statistics and conclusions. In the current review, no researcher explicitly reported having controlled for both issues. A typical response of some of the researchers (see, e.g., Qi *et al.,* 2000; Durán-Vázquez *et al*., 2014), was to control for time-series dependence. However, the issue of cross-sectional dependence appeared widely neglected.

g) In instances in which the sample observations included the global economic crisis period (see, e.g., Beisland & Knivsfla˚, 2015; Suadiye, 2012; Eng *et al.*, 2013), the researchers typically neglected to measure or control for its potential effect on their inferential statistics and

conclusions. Thus, it was probable that the potential effects of the GFC significantly influenced their results.

Summation

Notwithstanding the methodological and econometric challenges described above, the overall evidence reveals that modelling specifications based on the Collins *et al.* (1997) variant appear to provide robust evidence of the interconnection between fundamental accounting information variables and equity share prices. Moreover, the ease with which its variables can be reformulated (*cf.* Klimczak, 2018) is a clear advantage of the model because it enables researchers to use it to answer a wide range of research questions relating to the association of accounting and other information to share prices or returns.

Evidence relating to EBITDA-based variants

In recent years, some scholars of capital markets have mooted the specification of alternative financial performance measures as a possible solution to the puzzle of the interconnection between intrinsic equity share valuations and their market values or returns. Cases in point are the recent attempts by researchers such as Stenheim *et al.* (2018), Nhleko and Schutte and Ellis (2020), and Nhleko *et al.* (2020b). A common thread among these scholars is that the econometric models they utilised centred on observing associations of the equity share price variations or returns based on EBITDA-based intrinsic valuation models.

Stenheim *et al.* (2018) examined the value relevance of EBITDA measures using 100 of the largest companies listed on the Oslo Stock Exchange during the 2012 to 2016 period. However, as the authors conceded, their endeavours were ultimately thwarted by several severe methodological and econometric hindrances. The most significant of these was attrition bias, which limited the generalisability of their findings.

Nhleko *et al.* (2020a) posited a variant that related equity share prices to a linear regression of EBITDA and the sum of interest, tax, depreciation and amortisation (ITDA). The researchers further specified additional control measures to account for the impact of growth and negative earnings on share price variations. They used empirical data observations comprising 100 of the largest companies listed on the JSE for the 1995 to 2017 period. Their results demonstrated that when regressing the dependent explanatory variables of EBITDA, equity book values, growth and negative earnings in the presence of ITDA, the model became misspecified due to a high variance inflation factor between the ITDA and EBITDA variables, which the researchers attributed to the simultaneity of the data-generating procedures for each of these variables. However, when the ITDA variable was removed from the model, the model became correctly specified. Thus, to study the effects of each of the EBITDA and ITDA variables, they specified separate econometric models that mutually excluded the effect of each of these variables on the other. Ultimately, when Nhleko *et al.* (2020a) examined the results of their annual cross-sectional regressions, they observed that the explanatory EBITDA, equity book value, growth and negative earnings variables they specified consistently accounted for statistically significant variations in equity share prices over the 23-year study period. Moreover, similar patterns were observed when the EBITDA variable was substituted with the ITDA variable.

In a related study, Nhleko *et al.* (2020b) adopted a conceptual-empirical approach to examining the

effects of EBITDA and equity book values on equity share prices. Their econometric analysis model was based on a fixed-effects panel data model formulation that regressed the first-order differences of EBITDA, equity book values, growth, risk and negative earnings as explanatory variables for the response variable of the logarithmic-transformed share prices. They validated this relationship based on complete time-series data observations from the Johannesburg Stock Exchange for the 1994–2017 period.

Their results demonstrated that, whether companies or industries were applied as cross-sections, the EBITDA model they posited accounted for substantially all the variations (over 87% as measured in R-squared) in the dependent logarithmic-transformed share price variable. Their results further revealed that each of the coefficients of the explanatory variables was statistically significant.

Challenges and Weaknesses

Although EBITDA-based models variants appear to provide some evidence of the interconnection between accounting variables and equity valuation that might be of interest to several stakeholders, there is a paucity of evidence in this regard. In this regard, the inconclusive nature of the evidence of studies such as Stenheim *et al.* (2018) is unhelpful. Ultimately, the limited evidence of this sub-stream of research means comparative evaluations of this formulation to the more developed Ohlson and the Collins *et al*. (1997) formulations should be drawn with caution.

Summation

The empirical approaches and evidence of the recent studies by Stenheim *et al.* (2018), Nhleko *et al.* (2020a), and Nhleko *et al.* (2020b) seems to indicate a methodological breakthrough regarding the question of the association between accounting information variables and equity share price variations when EBITDA is specified as an explanatory variable in lieu of bottom-line earnings in a Collins *et al*. (1997) model formulation. However, given the minimal literature regarding these approaches, further evidence of the efficacy of these approaches in accounting for variations in equity share prices in other settings would shed more light on their practical ability to account for variations in equity share prices or returns consistently. However, given the interest in such variables, stakeholders such as valuation professionals (e.g., Bancel & Mittoo 2014; Pinto *et al*. 2019) are increasingly utilising EBITDA-based financial performance measures when making their equity investment decisions.

6 Conclusion

The primary research questions that guided this study were 1. Which econometric model results in the best explanation of the association between accounting information and share prices? 2. On the basis of the answer to question 1, “which variable, when combined with equity book values, seems to provide the most persuasive evidence of association with equity share prices: EBITDA, earnings or residual income?”

The answer is premised on the basis that, whichever model one chooses, the variables determine the model specification. The literature yielded inconsistent findings regarding which earnings variable yielded the most correlation to equity share prices when specified together with equity book values. This phenomenon was especially evident when comparing the highest correlations reported for each of the models reviewed that specified EBITDA, earnings or residual income earnings as a complement to the equity book value variable when accounting for variations in share prices. For example, Lee *et al.* (2013) reported more than 87% model correlations based on a fractional

cointegration approach of a residual earnings model. Similar values for the coefficients of determination, namely 87%, were reported in both the Nhleko *et al.* (2020b) study, which was based on an EBITDA approach, and in the Murwaningsari *et al*. (2015) study, which was based on a traditional earnings approach.

In the end, it appears that all three earnings variables have equally robust associations with equity share prices when specified with complementary variables within an intrinsic equity valuation framework. This observation might be interpreted to imply that the choice of model should thus be guided by its suitability to address the research requirements at hand. However, this consideration might have to be balanced against the methodological and econometric challenges associated with the adopted analysis approaches. As previously mentioned, neglect with regard to the latter aspect appears to have been a common methodological blind spot of several researchers in this field. Thus, the short answer to the two research questions is that the Ohlson (1995) model, the Collins *et al.* (1997) variation and the recent EBIDTA model yield equally valid demonstrations of the association of accounting information to share price variations. Consequently, depending on the choice of model, all three variables, EBITDA, earnings and residual income, appear to possess an equal amount of explanatory power to account for variations in equity share prices. Thus, the primary contribution of this study is that it clarifies the explanatory power of Ohlson-based models and the specification of variables, as well as the methodological and analysis issues of this line of research that could inform future research in the field. It is recommended that future researchers pay closer attention to the methodological and analysis issued highlighted in this study.

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