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Unraveling the existence of the necessity and sufficiency of accounting information

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Abstract

Purpose – The authors illustrate accounting information's effects in terms of necessity and sufficiency, using a set-theoretic approach, and highlight how the approach complements conventional correlational analyses.

Design/methodology/approach – The authors examine the relationship between accounting numbers (accounting information) and stock prices (effect) under both correlational and set-theoretic perspectives using a value relevance methodology.

Findings – The claim that accounting information is significantly correlated to an outcome does not inform the accounting information's necessity or sufficiency. In addition, findings suggest that not all control variables that are significantly correlated to a supposed accounting effect are necessary to explain that effect. Moreover, variables reflecting accounting information are not individually sufficient to explain the effect under investigation.

Research limitations/implications – The study contributes to set-theoretic approach to accounting research and echoes the call for a diversity of research approaches in accounting.

Practical implications – The study may have practical implications for various accounting information users, including investors, financial analysts and financial market and accounting disclosure regulators as well. Indeed, accounting information users should consider the importance of the combined effect of multiple pieces of accounting information in the users' positions on firms' stocks. Understanding what might be the relevant combinations of accounting information associated with a given organizational context is a key in making compelling accounting-informed decisions. Such knowledge can inform reflections of accounting disclosures and regulations on the combined effects of several accounting information.

Originality/value – First, the study adds to the newly introduced set-theoretic approach to empirical accounting. The study also resonates with the call for a diversity of research approaches in accounting. The authors empirically demonstrate that significant correlation between accounting information and its effects does not connote "necessity" or "sufficiency," which is rather revealed by qualitative comparative analysis (QCA). Such complementarity can help accounting researchers to carry out (1) new investigations of accounting's earlier hypotheses or propositions and (2) investigations of new accounting hypotheses/propositions deriving from existing accounting theories and (3) to explore new relationships between accounting phenomena. Second, the study incidentally contributes to value relevance literature in terms of

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contextualization of the relevance of accounting information. Specific to the African capital markets, the study complements the few recent studies on the *Bourse Régionale des Valeurs Mobilières d'Abidjan (*BRVM).

Keywords Accounting numbers, Correlational analysis, Set-theoretic approach, Value relevance, Necessity, Sufficiency

Paper type Research paper

1. Introduction

We illustrate additional insights that a set-theoretic approach provides on the empirical link between accounting information and its consequences (e.g. Du, 2018). We argue that besides conventional well-established correlational associations, set/subset relations based upon a set-theoretic approach can provide complementary insights in accounting knowledge development. A set-theoretic approach applies Boolean algebraic to examine which causes or combination of causes are necessary (i.e. a superset of an outcome) and/or sufficient (i.e. a subset of outcome) for the occurrence of an outcome (Ragin, 1987, 2000, 2008). Mertens *et al.* (2020) refer to necessary conditions as *must-have factors*, i.e. conditions allowing an outcome and sufficient conditions as *should-have factors*, i.e. conditions producing an outcome. A necessary relation implies that the presence of a deemed necessary condition, in a particular state of affairs, guarantees that an outcome can be achieved and also in certain state of affairs while a sufficiency relation denotes that an outcome is always achieved when a condition deemed sufficient is present (Fiss, 2007).

Nevertheless, the almost exclusive focus on correlational-based empirical techniques (i.e. regressions) in accounting research runs the risk of overlooking relationships such as necessity and/or sufficiency which can lead to high-quality accounting-informed decisions (e.g. Mertens *et al.*, 2020). The set-theoretic approach, while being novel to accounting researchers (e.g. Mertens *et al.*, 2020), is now widespread in business-related research (Seny Kan *et al.*, 2016), with QCA as its "most developed form" (Schneider and Wagemann, 2012, p. 1). This paper contributes to this novel line of research in accounting by proposing a research design that facilitates accounting knowledge based on the complementarities of set-theoretic and correlational approaches.

We use value relevance rationale to lay down the foundation of our contribution to accounting literature. Pioneered by Ball and Brown (1968), value relevance is at the forefront of correlational techniques in accounting research. It posits accounting information as causes (conditions) and share price (or stock return) as its effect (outcome) (Barth *et al.*, 2021). It implies that changes in stock price cannot be achieved unless there are changes in accounting numbers reflecting the accounting information (Barth, 2001). Yet, empirical studies indicate that various accounting numbers are individually associated to changes in the stock price. Therefore, accounting numbers are, possibly, individually necessary for the stock price but they would not individually suffice to trigger change in the stock price. This raises the question, addressed in this paper, as to whether the statistical correlation between accounting numbers and they presumed effects implies that accounting numbers allow (necessity) and/or produce (sufficiency) their presumed effects.

We address this question using a unique setting of a regional stock exchange in West Africa–the BRVM. BRVM's location in Abidjan (Ivory Coast) provides unusual institutional characteristics and relevant research interests. Ivory Coast experienced a long period of political instability while remaining attractive to investors (Afrik, 2014; World Bank, 2019; Zori, 2015). Also, studies on the BRVM have focused mainly on the stock market development (e.g. Ndong, 2011).

We show that the claim that accounting information is significantly correlated to an outcome does not inform its necessity or its sufficiency. Moreover, variables reflecting accounting information are not individually sufficient to explain the effect under investigation. This study contributes to the newly introduced set-theoretic approach to empirical accounting (e.g. Bedford *et al.*, 2016). It helps unravel the existence of news forms of relationships between accounting information and its presumed effects (e.g. Mertens *et al.*, 2020). It also resonates with the call for a diversity of research approaches in accounting (Lamprecht and Guetterman, 2019).

The paper proceeds as follows: Section 2 reviews the literature and develops research hypotheses; Section 3 discusses our method; Section 4 reports the findings and Section 5 concludes.

2. Relevant literature and hypothesis development

2.1 Value relevance of accounting information

From the pioneering research (Ball and Brown, 1968; Beaver, 1968), value relevance has become an important accounting research stream examining the relationship between the market value of a firm and different accounting measures (e.g. Barth *et al.*, 2008; Keener, 2011). In most cases, the relevance of accounting information is evaluated through an examination of the explanatory power of the model (captured by R^2, a goodness-of-fit parameter) with regards to the correlational relation between accounting information and stock prices.

Lev (1989) pointed out the relatively low R^2 in value relevance empirical studies. Dhaliwal *et al.* (1999) show that *net income* (NI) is not more relevant than *comprehensive income,* in the USA. Similarly, Collins *et al.* (1997) show that NI and the equity book values (BV) are value relevant. A study of American firms by Keener (2011) highlights the stability of the relevance of the BV and NI over two decades. Kane *et al.* (2015) confirm the value relevance of these two accounting numbers.

Findings also depend on markets examined. Lopes (2002) indicates that the correlational link between accounting information and the stock price is higher in emerging markets than in developed markets. In effect, the imperfection and relative reliability of the available information on emerging markets compared with developed markets increase investor interest in accounting information (Al-Hares *et al.*, 2012). This is confirmed on Egyptian and Iranian financial markets (Ragab and Omran, 2006; Pourheydari *et al.*, 2008). In Kuwait, Al-Hares *et al.* (2012) find that BV, NI and dividends (DIV) are value relevant; the DIV is particularly used to boost investors' confidence; Lopes (2002) in Brazil points the relevance of the NI and BV. However, BV remains more relevant than NI, suggesting that within a concentrated capital market situation, NI is less informative than BV.

In Sub-Saharan Africa, Ernest and Oscar (2014) show that NI is more relevant for oil firms in comparison with companies in the banking sector. Uthman and Abdul-Baki (2014) confirm improvement in the relevance of accounting information in Nigeria under International Financial Reporting Standards (IFRS). In South Africa, Prather-Kinsey (2006) finds an improvement in the value relevance of the NI and BV, which is similar to that of the Mexican financial market.

For our empirical illustration, we mainly focus on BV, NI and DIV as accounting information in the explanation of companies' stock prices listed on the BRVM. We predict that accounting information is value relevant despite the non-use of IFRS. We make no claim to the superiority in value relevance of local accounting standards over IFRS or vice versa, as the market we study currently only applies local accounting standards. We, therefore, formulate the hypothesis as follows:

H1. Accounting information measured by BV, NI and DIV are value relevant in the context of firms listed on the BRVM.

The above literature indicates that value relevance empirical evidence could be contingent on some macro-level idiosyncrasies. Therefore, our substantive knowledge of the study context prompts us to take into account the 2011 civil war in Ivory Coast (the BRVM country base). We infer, in line with Bilson *et al.* (2002), that investing in such a market has become risky for external investors; therefore, accounting information relevance might be unstable. This leads us to hypothesize as follow:

H2. The relevance of accounting information (BV, NI and DIV) in explaining stock price varies between the pre- and post-crisis period.

We develop a set-theoretical causation perspective to value relevance as a complement for correlational models testing (H1 and H2).

2.2 Set theoretic approach to value relevance

A set-theoretic approach (Ragin, 1987, 2000, 2008), in its QCA form, has recently been introduced to the accounting research community (Bedford *et al.*, 2016). QCA allows the examination of the "conditions" contributing to an "outcome" in terms of necessity (i.e. conditions allowing an outcome) and/or sufficiency (i.e. conditions producing an outcome) (Fiss, 2011). The distinctiveness of QCA is its rejection of the assumed independent and net effect of potential conditions on an outcome.

We renew the analysis of the value relevance models by referring to the share price as the outcome. We also reorganize the "independent" variables in five categories of conditions as follows: accounting indicators, performance, economic situation, level of liquidity and size. We recall that value relevance reasoning assumes that change in the accounting numbers guarantees change in the stock prices (Barth *et al.*, 2001). This reflects a logical statement that accounting numbers are necessary conditions (i.e. *must-have factors*) for the stock price. We hypothesize as follows:

H3. High-accounting income numbers (BV, NI and DIV) are individually necessary for high-stock prices.

Yet, extant value relevant empirical studies show that change in a single accounting number does not always associate with change in the stock price. This reflects a logical statement that a single accounting number is rarely sufficient (i.e. *should-have factor*) for the stock price. We rather contend that it is plausible that only combined accounting information can trigger changes in the stock price. We then hypothesize as follows:

H4. Sufficiently high-accounting income numbers (BV, NI and DIV) for high-stock prices varies between the pre- and post-crisis period.

The calibration of variables is essential in QCA empirical process (Ragin, 2008). It allows researchers to assign a score to the observations within the interval [0;1] with "1" indicating a total inclusion in a set (*full inclusion*) and "0" a total exclusion from a set (*full exclusion*). Within this interval, there might be several intermediate scores with the value "0.5" constituting a *crossover point* (Ragin, 2008, pp. 104–105). Researchers must determine the thresholds corresponding to these three qualitative attributes: Total inclusion, total exclusion and the crossover point. Following prior research (Ford *et al.*, 2013), we use the 25th percentile as the threshold of total exclusion, the 50th percentile for the crossover point and the 75th percentile for total inclusion. Appendix 1 shows the result of this calibration process.

3. Research method

3.1 Correlational modeling of value relevance

We run the correlational analysis based on companies listed on the BRVM from 2009 to 2017, following the literature (Collins *et al.*, 1997). We measure stock price (P) six months after the fiscal year-end (Barth *et al.*, 2008). The first correlational modeling expresses simple regressions and is given by Equation (1) as follows:

$$P_t = \beta_0 + \beta_1 X_t + \varepsilon_{it} \qquad (1)$$

where P_t: is the stock price six months after fiscal year-end t, X_t: accounting numbers for the period t (BV = Equity book value per share; NI = Earnings per share and DIV = Dividend per share); β: regression coefficients and ε: error term.

Equation (2) expresses multiple regressions predicting a relationship between stock market price and accounting numbers (BV, NI and DIV).

$$P_t = \beta_0 + \beta_1 \mathrm{BV}_t + \beta_2 \mathrm{NI}_t + \beta_3 \mathrm{DIV}_t + \varepsilon_{it} \tag{2}$$

Following prior research (Barth *et al.*, 2019), Equation (2) includes control variables such as (LEV = financial leverage), performance (ROA = return on assets; ROE = return on equity and ROIC = return on invested capital), size (ASSET = total assets) and level of liquidity (CF = cash flow per share) of companies.

We propose two other metrics for robustness tests according to Barth *et al.* (2008). We estimate the earnings returns relation separately for positive (good news) and negative (bad news) return subsamples. We regress the residuals from this regression, (*NI/P*) on annual stock return, (*RETURN*). Our second (good news) and third (bad news) value relevance metrics are the adjusted R^2 values from the regression given by Equation (3). Table 1 summarizes the variables definitions for our models.

$$(\mathrm{NI}/P)_{it} = \beta_0 + \beta_1 1\mathrm{RETURNit} + \varepsilon_{it}, \tag{3}$$

where NI/*P*: Earnings per stock divided by the beginning of year price (NI/*P*); RETURN is the annual stock return from nine months prior to three months after the firm's fiscal year-end and *P* is the stock price as of six months after fiscal year-end.

3.2 Set-theoretic modeling of value relevance

Schneider and Wagemann (2010) recommend to proceed first with the necessity analysis and then with the sufficiency analysis. We did so using the two-step QCA protocol by Oana and Schneider's (2018). This protocol implies that the necessity analysis is aimed at identifying remote conditions and the sufficiency analysis includes only revealed necessary conditions

Variables	Definition
P	Stock price six months after fiscal year-end in US$
RETURN	Stock return = Ln (Stock price three months after fiscal year-end/Stock price nine months before fiscal year-end)
NI	Earnings per share after fiscal year-end in US$
NI/*P*	Earnings per share after fiscal year-end/beginning of year stock price
DIV	Dividends per share declared during the fiscal year-end in US$. It includes extra dividends declared during the year
BV	Book value per share: proportioned common equity divided by outstanding stocks at the company's fiscal year-end in US$
LEV	Leverage: (Long-term debt + short-term debt & current portion of long-term debt)/common equity * 100
ROA	Return on asset: {Net income – bottom line + [(Interest expense on debt-interest capitalized) * (1-Tax rate)]}/Average of last year's and current year's total assets * 100
ROE	Return on equity: (Net income – bottom line–preferred dividend requirement)/Average of last year's and current year's common equity * 100
ROIC	Return on invested capital: {Net income – bottom line + [(Interest expense on debt–interest capitalized) * (1-Tax rate)]}/Average of last year's and current year's (Total capital + short-term debt & current portion of long-term debt) * 100
CF	Cash flow per share: the cash earnings per share of the company at fiscal year-end in US$
ASSET	Total assets in thousands US$

Table 1.
Definition of variables

with the proximate conditions. Remote conditions are referred to as a depiction of the context within which proximate conditions combine to cause the outcome. We classify the three accounting numbers – BV, NI and DIV – as proximate conditions, whereas we classify identified control variables of the correlational models as remote conditions, expressing idiosyncrasies within which proximate conditions are in play. We run our analyses using *R* packages QCA 3.3 (Dusa, 2019) and SetMethods 2.4 (Oana and Schneider, 2018).

3.3 Data collection

We collected our data from Thomson Reuters Datastream covering 2009–2017 [1]. We built our sample with all 49 firms listed on the BRVM in July 2018. After removing financial firms (14), delisted firms (4) and firms with unavailable data (1), our final sample comprises 30 firms (270 firm/year observations) (Table 2). The study period covers the Ivoirian post-election political crisis of 2010–2011. The BRVM momentarily ceased trading in 2011. Consequently, we defined three main periods for our empirical tests: 2009–2010 (pre-crisis), 2011 (crisis) and 2012–2017 (post-crisis).

4. Results

4.1 Correlational analysis

4.1.1 Descriptive statistics. Table 3 shows a strong dispersion of variables. Small companies have a capitalization of less than 0.82 million US$, and very large corporations have a market capitalization greater than 4,000m US$. Listed firms on the BRVM have on average: NI = 3.865, DIV = 1.771 and BV = 10.376. We also notice a positive stock market performance of BRVM companies (RETURN = 0.024).

Table 2. Classification of companies

ICB code	Industry	Number of firm	Percentage
3,000	Consumer goods	12	40%
2000	Industries	9	30%
1,000	Base materials	1	3%
0001	Oil and gas	2	7%
7,000	Services to communities	2	7%
5,000	Consumer services	2	7%
6,000	Telecommunication	2	7%
Total		30	100%

Note(s): The classification of companies is based on that proposed by the Industry Classification Benchmark (ICB)

Table 3. Descriptive statistics

Variable	Obs	Mean	Std. Dev	Min	Max
P	270	34.466	87.930	0.08	871.08
RETURN	270	0.02483	0.497	−2.663	1.87748
NI	270	3.865	7.466	0	83.48
DIV	270	1.771	4.479	0	26.469
BV	270	10.376	22.383	−18.892	119.519
LEV	270	122.483	361.848	−2647.62	2716.58
ROA	270	7.618	8.656	−18.78	63.64
ROE	270	7.657	86.030	−1257.93	191.11
ROIC	270	15.130	28.259	−59.2	389.75
CF	270	4.155	9.821	−11.789	62.346
ASSET	270	250512.2	423389.1	324	2534573

4.1.2 Simple and multivariate regressions. Our correlation analysis (not tabulated for brevity) shows that correlations between the independent variables are lower than 70%, suggesting that there is no multicollinearity problem. To test H1 and H2, we run both simple regressions (Equation 1) and multiple regressions (Equation 2). As shown by the Chow test (Table 4), there is a difference between the different periods compared with the overall period. All of the accounting numbers (NI, BV and DIV) are individually relevant but period dependent. During the crisis, DIV is the most relevant number with 87.7% R^2 compared with the pre-crisis (83.4%), post-crisis (71.1%) or overall (61.4%) periods. In all periods, except the pre-crisis and overall period, the DIV has a significantly larger R^2 than each of the other two accounting numbers. The BV has a significantly larger adjusted R^2 than NI does, except in the post-crisis period. These R^2 are substantively high than Dumontier and Raffournier's (2002).

The results suggest that accounting numbers (NI, BV and DIV) in the context of BRVM are relevant, but DIV significantly outperforms BV and NI in the crisis and post-crisis periods. This findings contrast with the stability of BV and NI reported by Keener (2011). Contrary the literature our results show that DIV has superior relevance (Kane *et al.*, 2015). In the pre-crisis period, BV outperforms NI and DIV. Overall, our results allow us to validate H1 and H2.

The multiple regression models seek to explain the stock price by all three accounting numbers (NI, BV and DIV) (Table 5). The variable inflation factor (VIF) ranges below an acceptable level of (average VIF <4). The results show that, for most of the periods, all of our accounting numbers are relevant. Especially, in the pre-crisis (Table 5 - Model 1), only BV and NI are significant; but in the post-crisis, DIV and NI are significant. Our three main variables are significant over the entire period (Table 5 - Model 7). Finally, in the crisis year DIV is significant and, to a lesser extent, the NI at 10%. Our results show that the DIV remains significantly stable over time. This confirms the results of single regressions and contrast with on the Keener's (2011) stability of DV and NI.

In the overall period, the BV and DIV explain more the stock price of companies listed on the BRVM (Table 5 - Model 7). These results are consistent with previous studies on emerging markets (e.g. Qu and Zang, 2015). However, the significance of the DIV is contrary to the

		NI	BV	DIV	Chow_test
Pre-Crisis		2.433*** (0.452)	2.092*** (0.106)	9.085*** (0.533)	$F(3, 258) = 10.59$
	Observations	60	60	60	Prob > F = 0.0000
	R^2	0.333	0.870	0.834	
	F	29.01***	387.1***	290.6***	
Crisis		8.907*** (1.148)	2.062*** (0.160)	9.135*** (0.647)	
	Observations	30	30	30	
	R^2	0.682	0.856	0.877	
	F	60.18***	166.1***	199.6***	
Post-Crisis		15.892*** (0.757)	3.690*** (0.190)	20.488*** (0.979)	
	Observations	180	180	180	
	R^2	0.710	0.679	0.711	
	F	440.7***	376.1***	438.3***	
Overall		7.157*** (0.571)	3.178*** (0.141)	15.387*** (0.744)	
	Observations	270	270	270	
	R^2	0.369	0.654	0.614	
	F	156.9***	507.4***	427.2***	

Note(s): ***p < 0.01. Chow test: it determines if data can be pooled together. Put it differently, it gages if the coefficients estimated over on the three groups (pre-crisis, crisis and post-crisis) of data are equal to coefficients estimated over another

Table 4.
Simple regression Equation (1)

Table 5. Multiple regression Equation (2)

Variables	Pre-crisis (1)	(2)	Crisis (3)	(4)	Post-crisis (5)	(6)	Overall (7)	(8)
BV	1.119** (0.447)	0.546** (0.223)	0.330 (0.466)	−0.548* (0.283)	0.300 (0.509)	1.216 (1.055)	1.741*** (0.474)	0.340 (0.624)
NI	0.871*** (0.177)	0.799*** 0.120)	2.960** (1.305)	1.896** (0.854)	8.618*** (1.582)	8.352*** (1.681)	1.978 (1.191)	1.956 (1.193)
DIV	3.526 (2.156)	0.740 (1.668)	5.760** (2.257)	5.561** (2.121)	10.809** (4.613)	13.690*** (6.324)	5.830** (3.147)	3.949 (3.094)
LEV		0.035*** (0.006)		0.026*** (0.008)		0.004 (0.005)		0.013** (0.006)
ROA		0.219 (0.220)		−0.097 (0.169)		−0.006 (0.462)		−0.299 (0.188)
ROE		−0.141 (0.095)		0.253** (0.102)		0.026 (0.031)		−0.06*** (0.020)
ROIC		−0.012 (0.017)		−0.291* (0.140)		−0.156 (0.178)		−0.072 (0.054)
CF		4.025*** (1.304)		3.147** (1.264)		−2.914 (3.062)		4.330** (1.763)
ASSET		−2.147 (1.336)		−2.302 (1.417)		1.345 (1.494)		−0.239 (1.372)
Constant	−2.780 (2.225)	16.743 (14.14)	0.314 (2.38)	24.682 (16.53)	−6.568** (3.322)	−21.005 (18.23)	−1.573 (3.040)	3.435 (15.49)
Observations	60	60	30	30	180	180	270	270
R^2	0.908	0.955	0.917	0.961	0.817	0.824	0.693	0.722
F	83.76***	182.4***	204.6***	919.6***	24.11***	10.13***	18.48***	12.22***
VIF	3.75	3.71	3.75	3.71	3.75	3.71	3.75	3.71

Note(s): Dependent variable: Stock price of firm i six months after year-end t; $^{***}p < 0.01$, $^{**}p < 0.05$ and $^{*}p < 0.1$ and robust standard errors in parentheses. White's (1980) test was used to detect heteroscedasticity errors which were corrected by robust regression results of Al-Hares *et al.* (2012). Thus, DIV is a relevant piece of information on the West African market in contrast to the Kuwaiti market. When controlling for the year of the Ivoirian political crisis (2011), the results are more nuanced: while BV and NI are relevant before the political crisis, DIV provides substantial informational relevance in the post-crisis period. In addition, BV is not significant post-crisis unlike the NI, which remains significant (Table 5 - Models 3, 5 and 6). Thus, some accounting numbers (BV and NI) have informational content when the political environment of the country becomes unstable. If we consider that the economic and political environments of this market generate transitory earnings unlike permanent earnings (Brief and Zarowin, 1999), a low relevance of accounting indicators might be plausible. This implies that DIV become, therefore, relevant in investors' decision-making process as compared with earnings and equity BV. This result is in line with Brief and Zarowin (1999). This suggests that investors make short-term investment decisions when the political context becomes unpredictable. We implement a series of control variables in Equation 2 (Table 5). Results suggest that if the ROE is relevant in the overall and crisis period, cash flow per share (CF) remains significant over all periods (except post-crisis). Taken together, results confirm our H1 and H2. Thus, we highlight how the accounting numbers are statistically linked to the stock price depending on the sub-periods of analysis.

We test the robustness Equation (3) of our first results by estimating the earnings–returns relation separately for positive and negative return sub-samples based on Barth *et al.* (2008) (Table 6). We note an increase in the significance of the model (Table 6 - Model 2) in the crisis (adj $R^2 = 79\%$) and post-crisis periods (adj $R^2 = 71\%$) compared with the pre-crisis period (adj $R^2 = 61.7\%$). The results show a significant improvement in the value relevance of the DIV during and after the crisis, with a coefficient that was 1.634 in the pre-crisis and, respectively, 6.647 and 12.337 during and after the crisis. The BV is no longer significant after the crisis and the NI becomes significant but in lower proportions than the DIV.

We predict that accounting quality differences have been most pronounced for "bad news" because when firms have "good news" they have less incentive to manage earnings (Barth *et al.*, 2008). The adjusted R^2 value for good news in the post-crisis period (adj $R^2 = 2\%$) is greater than that for good news in the pre-crisis period (adj $R^2 = 1.4\%$). This result implies

Price regression (P^*)	Pre-crisis (1)	Crisis (2)	Post-crisis (3)	Overall (4)
BV	1.334*** (0.485)	−0.24 (0.640)	0.060 (0.394)	1.393*** (0.330)
NI	0.486 (0.293)	3.321** (1.293)	6.519*** (1.277)	1.343** (0.560)
DIV	1.634 (2.084)	6.647** (2.692)	12.337*** (1.84)	6.443*** (1.580)
Adjusted R^2	0.617	0.79	0.71	0.588
Good and Bad News regressions (Adjusted R^2)				
Good News	0.014	−0.009	0.02	−0.006
Bad News	0.0006	−0.01	−0.007	0.0003

Note(s): According to Barth *et al.* (2008), the price regression is based on a two-stage regression. In the first stage, P is regressed on an industry fixed-effect indicator variable. P is the stock price as of six months after the fiscal year-end. The second stage regression is $P^* = \beta_0 + \beta_1 BV + \beta_2 NI + \beta_3 DIV + \varepsilon$, where P^* is the residual from the first-stage regression, BV is book value of equity per share, NI is earnings per share and DIV is dividend per share. We present the coefficients of the price regression based on a two-stage regression with robust standard errors in parentheses. The good/bad news' regressions are based on a two-stage regression. In the first stage, NI/P is regressed on an industry fixed-effect indicator variable. The second stage regression is $[NI/P]^* = \beta_1 RETURN + \varepsilon$, where $[NI/P]^*$ is the residual from the first-stage regression and $RETURN$ is stock return computed over the 12 months ending three months after year-end. Good (bad) news observations are those for which $RETURN$ is positive (negative). We present adjusted R^2 for the second-stage regression of good/bad news
***$p < 0.01$, **$p < 0.05$

Table 6.
Robustness check Equation (3)

that accounting numbers are more relevant post-crisis than pre-crisis. The adjusted R^2 for bad news in the post-crisis period is not significant compare with the pre-crisis period (adj $R^2 = 0.06\%$). In post-crisis, accounting numbers are more relevant due to a better recognition of the DIV by investors. This is particularly the case for the good news of return. On the contrary, for bad news, the accounting numbers are no longer relevant in a period of crisis or post-crisis unlike the post-crisis period when investors integrated the accounting numbers.

These last results combined with the previous results militate for the re-examination of the accounting figures in order to highlight possible combinations of information used by the investors for their decision-making by introducing a set-theoretic approach to value relevance.

We re-examine the multiple regression models (i.e. Equation 2) using QCA, a set-theoretic approach.

4.2 QCA analysis

4.2.1 Necessity analysis. We test if whenever a company has a high-stock price, it also has high financial leverage (LEV), performance, cash flow (CF) and big size (ASSET) (i.e. necessity test). This analysis reveals two disjunctions, LEV + ASSET and LEV + CF (Table 7). This finding suggests that either high LEV or ASSET and high LEV or a high CF jointly are two empirically consistent supersets for the high-stock price. We conclude this analysis with the identification of two disjunctions (LEV + ASSET and LEV + CF) as empirically necessary for a high-stock price. This confirms that the relevance of accounting information is contingent on economic situation (LEV), size (ASSET) and level of liquidity (CF) as companies' internal factors (e.g. Barth *et al.*, 2019).

4.2.2 Sufficiency analysis. Key to the sufficiency analysis in QCA is the construction of a truth table that informs the different logical combinations of conditions that are sufficient for the outcome (high-stock price). BV, NI, DIV, LEV, ASSET and CF are the conditions included in our sufficiency analysis. These six conditions create 64 logical combinations of remote and proximate conditions (i.e. 2^6, with 6 as the number of conditions). Some of these possible logical combinations of conditions have no empirical instances. They correspond to logical cases (Appendix 2, rows 2–63). Taking into account the logical cases, the sufficiency analysis generates a complex solution (without logical cases), a parsimonious solution (with logical cases) and an intermediate solution (with plausible logical cases) (Rihoux and Ragin, 2009) as the result of a Boolean minimization (Ragin *et al.*, 2006). In this paper, we opt for the intermediate solution.

The minimization of the truth table reveals seven sufficient Causal Paths (Table 8) for high stock price. Findings show that no single condition is sufficient for high-stock price. These seven paths and the overall solution have a consistency value higher that 0.75 [2] and each of the solution terms has at least one case (firm/year) having a membership score higher than 0.5.

Findings highlight seven contextual configurations that lead to high-stock price in conjunction with specific combinations of accounting numbers (i.e. proximate conditions). In

	inclN	RoN	covN
LEV + ASSET	0.851	0.559	0.609
LEV + CF	0.853	0.591	0.628

Note(s): inclN: consistency for necessity; RoN: relevance of necessity and Cov.N: coverage for necessity. A single condition or combination of conditions (SUIN) passes the necessity test with a minimum of inclN ≥0.85, RoN ≥0.55 and covN ≥0.60. (+) refers to logically "OR"

Table 7.
Necessity analysis

Table 8. Sufficiency analysis

	Solution expression	Remote conditions	Proximate conditions	inclS	PRI	covS	covU	Cases
1	BV*NI*LEV*~ASSET	Leveraged small companies	High-equity book value and net income	0.955	0.934	0.208	0.122	PEYRISSAC_11
2	BV*DIV*~LEV*CF	Less-leveraged liquid companies	High-equity book value and dividend	0.943	0.91	0.277	0.154	UNILEVER_13; SMB_12, SAPH_16; SOLIBRA_10
3	~BV*NI*~DIV*~ASSET*CF	Small liquid companies	Low-equity book value, high net income and low dividend	0.922	0.7	0.096	0.021	CIE_09, SMB_13, NESTLE_CI_14, NESTLE_CI_15; SODECI_13; SIVOM_14
4	~BV*DIV*LEV*ASSET*CF	Liquid and leveraged big companies	Low-equity book value and high dividend	0.911	0.769	0.127	0.015	SIVOM_13, SHELL_CI_13, NEI_CI_16; SOGB_10, SOGB_12, CROWN_SIEM_15, SOGB_17, SODECI_17
5	BV*~NI*DIV*~LEV*~ASSET	Less-leveraged small companies	High-equity book value, with low net income and high dividend	0.925	0.711	0.117	0.023	SAPH_13, SICOR_14, SUCRIVOIRE_14, TRITURAF_14, ONATEL_BF_14; UNILEVER_13, CROWN_SIEM_15
6	BV*DIV*LEV*ASSET*~CF	Less-liquid, leveraged big companies	High-equity book value and dividend	0.941	0.829	0.113	0.011	SOGB_09, SMB_09
7	~BV*NI*DIV*LEV*ASSET	Leveraged big companies	Low-equity book value, high net income and high dividend	0.925	0.828	0.115	0.001	SIVOM_11, SIVOM_12, BERNABE_13, SOGB_15, SOGB_16; SOGB_10, SOGB_12, CROWN_SIEM_15, SOGB_17, SODECI_17
Overall solution				0.93	0.896	0.548		

Note(s): In the first column "Solution expression," remote conditions are in italic fonts and proximate conditions are in normal fonts. Condition name in upper case indicates the presence of a condition, tilde sign "~" indicates their negation and an asterisk "*" refers to logical "AND." For fuzzy set conditions, the presence (absence) implies that their scores are higher (lower) than "0.5", the crossover point. Thus, for fuzzy sets, presence (absence) reflects a high (low) value in a given set. Conditions that are not displayed indicate, "do not care" or redundant (i.e. the presence or the absence of the condition does not affect the solution). inclS: consistency for sufficiency; PRI: proportional reduction in inconsistency; CovS: coverage for sufficiency; CovU: unique coverage for sufficiency and cases: typical empirical instances (company/year) associated to each of seven solution term (in italic, the most typical case). Number in front of each company name represents the observation year. While this table reports one model, it important to mention that the sufficiency analysis reveals two meaningful models (see M1 and M2 below) which differs only in one term (term in the parentheses in M1 and M2) and are logically equivalent though. We report M1 which, interestingly, is a superset of M2 and whose last term which differs from M1 has high parameters of fit

M1: BV*NI*LEV*~ASSET + BV*DIV*~LEV*CF + ~BV*NI*~DIV*~ASSET*CF + ~BV*DIV*LEV*ASSET*CF + BV*~NI*DIV*~LEV*~ASSET + BV*DIV*LEV*ASSET*~CF + (~BV*NI*DIV*LEV*ASSET) => STOCK PRICE

M2: BV*NI*LEV*~ASSET + BV*DIV*~LEV*CF + ~BV*NI*~DIV*~ASSET*CF + ~BV*DIV*LEV*ASSET*CF + BV*~NI*DIV*~LEV*~ASSET + BV*DIV*LEV*ASSET*~CF + (NI*DIV*LEV*ASSET*~CF) => STOCK PRICE the first configuration, LEV*~ASSET indicates a context of leveraged small companies. In the second configuration, ~LEV*CF depicts less-leveraged liquid companies. In the third configuration, ~ASSET*CF reflects small liquid companies. In the fourth configuration, LEV*ASSET*CF illustrates a context of liquid and leveraged big companies. In the fifth configuration, ~LEV*~ASSET indicates less-leveraged small companies. In the sixth configuration, LEV*ASSET*~CF suggests less-liquid, leveraged big companies. In the last configuration, LEV*ASSET refers to leveraged big companies.

Then, considering the accounting numbers (i.e. proximate conditions), we provide the following interpretations of each of the seven Causal Paths. The first Causal Path indicates that the conjunction of high equity BV with high NI (BV*NI) leads to high-stock price in the context of leveraged small companies (LEV*~ASSET). Second, the conjunction of high equity BV with high DIV (BV*DIV) leads to high-stock price within a context of less-leveraged liquid companies (~LEV*CF). Third, the conjunction of low-equity ~BV with high NI and low ~DIV (~BV*NI*~DIV) leads to high-stock price in the context of small liquid companies (~ASSET*CF). Fourth, the conjunction of low-equity ~BV with high DIV (~BV*DIV) leads to high-stock price within the context of big liquid and leveraged companies (LEV*ASSET*CF). Fifth, the conjunction of high-equity BV with low ~NI and high DIV (BV*~NI*DIV) leads to high-stock price in the context of less-leveraged small companies (~LEV*~ASSET). Sixth, the conjunction of high-equity BV with high DIV (BV*DIV) leads to high-stock price in the context of less-liquid, leveraged big companies (LEV*ASSET*~CF). Finally, the conjunction of low-equity BV with high NI and high DIV (~BV*NI*DIV) leads to high-stock price in the context of leveraged big companies (LEV*ASSET).

As to the three periods of analysis, Table 8 indicates that Causal Path 6 corresponds to two typical cases belonging to the pre-crisis period. The only typical case of Causal Path 1 is relative to the period of crisis, while all typical cases of Causal Path 5 are related to the post-crisis period. However, the pattern in Causal Paths 2, 3, 4 and 7 include cases of several periods, yet the majority of them are from the post-crisis period. We remain cautious about the interpretation of this pattern because the post-crisis period has more cases. Overall findings do not support H3, yet partly support H4. Furthermore, they provide a fine-tune appreciation of accounting informativeness' complementarities (e.g. Masschelein and Moers, 2020) and contingencies (e.g. Lee and Lee, 2013; Uthman and Abdul-Baki, 2014; Qu and Zang, 2015; Manganaris *et al.*, 2016; Kouki, 2018; Abdollahi *et al.*, 2020; Benkraiem *et al.*, 2021).

5. Conclusion

The pervasive focus of the current accounting literature on correlational associations between accounting information (condition) and its supposed effect (outcome) neglects the existence of other forms of links and their potential contributions to accounting knowledge development. It is, therefore, opportune to be aware of their existence, examine alternative explanations they allow and how this in turn reinforces extant understanding of accounting role in decision-making.

Consequently, this study argues that necessity and sufficiency are other forms of relationships linking accounting information and its effects. We show that these two forms of relations can be unraveled within an original research design using conventional correlational models (regressions) in complement to a set-theoretic approach (QCA). We achieve this using value relevance rationale and data collected from a unique setting of a West African regional stock exchange – the BRVM as foundation of our illustration. We find that only specific combinations of firms' size and liquidity are empirically necessary to explain the stock prices. Findings also indicate that seven combinations made of these necessary conditions and accounting information are sufficient (i.e. produce) for the stock prices. This means that no single accounting information (i.e. number) is individually sufficient to explain stock prices.

Our findings suggest above all that in addition to the statistical correlations between accounting information and their effects, it is the existence of the combination of accounting information that produces effects. Better still, there is a multiplicity of combinations of accounting information producing the same effect. Overall, this study may have practical implications for various accounting information users, including investors, financial analysts and financial market and accounting disclosure regulators as well. Indeed, accounting information users should consider the importance of the combined effect of multiple pieces of accounting information in their positions on firms' stocks. Understanding what might be the relevant combinations of accounting information associated with a given organizational context is key in making compelling accounting-informed decisions. Such knowledge can inform reflections of accounting disclosures and regulations on the combined effects of several accounting information.

This study makes several important contributions and suggest novel research avenues. First, it adds to the newly introduced set-theoretic approach to empirical accounting (e.g. Bedford and Sandelin, 2015; Bedford *et al.*, 2016). It also resonates with the call for a diversity of research approaches in accounting (Lamprecht and Guetterman, 2019). We empirically demonstrate that significant correlation between accounting information and stock prices does not connote "necessity" or "sufficiency," which is rather revealed by QCA. Such complementarity can help accounting researchers to carry out (1) new investigations of accounting's earlier hypotheses or propositions and (2) investigations of new accounting hypotheses/propositions deriving from existing accounting theories and (3) to explore new relationships between accounting phenomena (e.g. Seny Kan *et al.*, 2016).

Second, this study incidentally contributes to value relevance literature in terms of contextualization of the relevance of accounting information (Abdollahi *et al.*, 2020; Benkraiem *et al.*, 2021; Kouki, 2018; Lee and Lee, 2013; Manganaris *et al.*, 2016; Qu and Zang, 2015; Uthman and Abdul-Baki, 2014). Specific to the African capital markets, this study complements the few recent studies on the BRVM (N'Zué, 2006; Ndong, 2011).

Besides the abovementioned contributions, it is important to emphasize the limits of this study: the limited number of companies listed on the BRVM and the non-exhaustiveness of accounting information. Beyond these limitations, the relationship between accounting and organizational outcomes can be envisaged in terms of set/subset relations. Overall, we believe that future studies can contribute to this research stream by digging further complementarity and configural nature of accounting information.

Notes

1. Not only this was the most recent data at the time of the analysis, but that period has coincidentally the most comprehensive data available (1). There was an erratic downtrend on BRVM from 2017 onward. The index experienced a decrease of 7.5% in 2019, 29.4% in 2018 and 16.8% in 2017 (2). Also, during the last two years politically tensions preceding the contested presidential pool of 2020, there was an importance uncertainty (3). For the three above reasons, we consider the period 2009–2017 as relevant for this study especially while considering the political crisis of 2010–2011.
2. According to Ragin (2008), a good consistency or coverage must have a value between 0.75 and 1.

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Appendix 1

Conditions Accounting indicators BV	DIV	NI	ROCE	Performance ROA	ROE	ROIC	Economic situation LEV	Liquidity CF	Size ASSET	Outcome *P*
1	0.05	0.95	0.18	0.96	0.91	0	0.53	1	0.14	0.59
1	0.05	0.95	1	0.83	0.83	0.04	0.14	1	0.97	0.98
0	0.05	0.95	0	0.01	0	0	0.01	0.04	0	0.79
0.39	0.05	0.95	0.99	1	1	0.99	0.08	0.32	0.12	0.8
0.16	0.05	0.95	1	0.04	0.96	0	0.89	1	1	0.57
0.38	0.05	0.95	0.77	0.97	0.97	0.97	0.94	0.01	0.05	0.79
0.55	0.05	0.95	0	0	0	0.01	0.61	0	0.97	0.04
0	0.05	0.03	1	0.83	0.83	0.04	0.67	0	0.21	0.04
0.97	0.05	0.95	1	0.83	0.83	0.04	1	1	0.82	0.01
0.66	0.05	0.95	1	0.83	0.83	0.04	0.67	0.71	0.21	0.79
0.03	0.05	0.95	0.52	1	1	0.92	1	0.26	0.97	0.22
0.66	0.05	0.95	1	0.83	0.83	0.04	0.67	0.71	0.21	0.12
0.66	0.05	0.95	1	0.83	0.83	0.04	0.67	0.71	0.21	0.99
1	0.05	0.26	1	0.83	0.83	0.04	0.02	1	0.93	1
0.66	0.05	0.95	0.03	0.26	0.9	0.84	0.03	0.71	0	0.04
0.33	0.05	0.95	1	0.83	0.83	0.04	0.67	0.82	0.21	0.61
1	0.05	0.95	0.85	0.94	0.97	1	0.91	0.99	0.01	0.99
1	0.05	0.95	0.18	0.96	0.91	0	0.53	1	0.14	0.59

Table A1. Calibrated conditions and outcome (an excerpt)

Appendix 2

#	BV	NI	DIV	LEV	ASSET	CF	OUT	*n*	incl	PRI	Cases ID
62	1	1	1	1	0	1	1	17	0.967	0.952	4,12,19,34,42,49,64,72,79, 94,109,124,139,154,184,214,229
60	1	1	1	0	1	1	1	19	0.961	0.935	9,39,58,69,88,99,118,123,128, 148,153,178,189,208,219,238, 243,245,268
47	1	0	1	1	1	0	1	1	0.959	0.849	24
44	1	0	1	0	1	1	1	7	0.956	0.883	28,35,65,68,93,95,158
61	1	1	1	1	0	0	1	1	0.953	0.856	102
53	1	1	0	1	0	0	1	1	0.951	0.813	132
22	0	1	0	1	0	1	1	1	0.944	0.783	234
32	0	1	1	1	1	1	1	6	0.942	0.855	90,120,180,210,240,200
42	1	0	1	0	0	1	1	4	0.941	0.74	38,98,199,248
58	1	1	1	0	0	1	1	1	0.928	0.766	8
41	1	0	1	0	0	0	1	5	0.923	0.63	83,113,136,188,218
54	1	1	0	1	0	1	1	1	0.915	0.718	264
18	0	1	0	0	0	1	1	2	0.915	0.575	173,204
31	0	1	1	1	1	0	1	1	0.913	0.757	150
16	0	0	1	1	1	1	1	2	0.906	0.659	30,60
57	1	1	1	0	0	0	0	2	0.9	0.644	5,169
35	1	0	0	0	1	0	0	2	0.885	0.283	155,213
55	1	1	0	1	1	0	0	2	0.883	0.706	114,215
45	1	0	1	1	0	0	0	2	0.877	0.661	166,259
46	1	0	1	1	0	1	0	2	0.875	0.611	23,53
8	0	0	0	1	1	1	0	2	0.869	0.576	59,89
26	0	1	1	0	0	1	0	5	0.86	0.46	7,37,67,187,192
64	1	1	1	1	1	1	0	15	0.858	0.757	3,6,10,11,27,36,40,41,84, 129,159,233,244,249,252
19	0	1	0	0	1	0	0	2	0.856	0.497	17,174
39	1	0	0	1	1	0	0	2	0.853	0.506	185,202
52	1	1	0	0	1	1	0	5	0.825	0.458	125,156,160,161,177
11	0	0	1	0	1	0	0	3	0.823	0.374	107,137,167
15	0	0	1	1	1	0	0	4	0.818	0.458	149,179,209,239
23	0	1	0	1	1	0	0	4	0.814	0.587	29,144,152,182
21	0	1	0	1	0	0	0	3	0.79	0.427	143,145,225
40	1	0	0	1	1	1	0	2	0.775	0.447	183,212
48	1	0	1	1	1	1	0	17	0.766	0.495	18,33,50,54,63,80,110,119,140, 170,197,200,227,230,257, 260,263
3	0	0	0	0	1	0	0	7	0.701	0.296	47,77,176,205,206,236,266
25	0	1	1	0	0	0	0	13	0.686	0.302	14,16,21,51,81,97,111,127,157, 203,217,222,255
56	1	1	0	1	1	1	0	27	0.678	0.465	20,57,66,70,71,87,96,100,101,117, 122,126,130,131,147,186,190,191, 207,216,220, 221,237,246,250,251,267
7	0	0	0	1	1	0	0	5	0.656	0.233	32,62,92,242,269
13	0	0	1	1	0	0	0	10	0.646	0.231	2,46,76,196,211,226,241,256,258,262
9	0	0	1	0	0	0	0	10	0.644	0.185	13,15,52,106,112,142,223,253,254,261
17	0	1	0	0	0	0	0	14	0.512	0.104	22,25,26,44,74,104,133,135,141, 162,171,201,231,247
5	0	0	0	1	0	0	0	7	0.462	0.089	121,151,181,195,198,000,000

(*continued*)

Table A2.
Truth table for the sufficiency analysis

#	BV	NI	DIV	LEV	ASSET	CF	OUT	*n*	incl	PRI	Cases ID
1	0	0	0	0	0	0	0	34	0.39	0.097	1,31,43,45,48,55,56,61,73,75,78,82, 85,86,91,103,105,108,115,116,134, 138,146,163,164,165,168,172,175, 193, 194,224,235,265
2	0	0	0	0	0	1	0	0	–	–	
4	0	0	0	0	1	1	0	0	–	–	
6	0	0	0	1	0	1	0	0	–	–	
10	0	0	1	0	0	1	0	0	–	–	
12	0	0	1	0	1	1	?	0	–	–	
14	0	0	1	1	0	1	?	0	–	–	
20	0	1	0	0	1	1	?	0	–	–	
24	0	1	0	1	1	1	?	0	–	–	
27	0	1	1	0	1	0	0	0	–	–	
28	0	1	1	0	1	1	?	0	–	–	
29	0	1	1	1	0	0	?	0	–	–	
30	0	1	1	1	0	1	?	0	–	–	
33	1	0	0	0	0	0	0	0	–	–	
34	1	0	0	0	0	1	0	0	–	–	
36	1	0	0	0	1	1	?	0	–	–	
37	1	0	0	1	0	0	?	0	–	–	
38	1	0	0	1	0	1	?	0	–	–	
43	1	0	1	0	1	0	0	0	–	–	
49	1	1	0	0	0	0	0	0	–	–	
50	1	1	0	0	0	1	0	0	–	–	
51	1	1	0	0	1	0	0	0	–	–	
59	1	1	1	0	1	0	0	0	–	–	
63	1	1	1	1	1	0	?	0	–	–	

Note(s): The first column indicates number of row in the truth table. “OUT”: outcome under analysis (stock price); “*n*”: number of empirical instances (i.e. company/year) associated to logical combination of causal conditions forming each row (those cases have a membership score >0.5 in the corresponding rows) and “incl”: sufficient consistency. In this analysis, we set up the threshold of sufficient consistency at 0.90. We choose to sort the truth rows by “OUT” and “incl,” which explains why the first column that represents the rank of the rows is disordered. “PRI” stands for proportional reduction in inconsistency; “?” refers to the logical remainders (combination of remote and proximate conditions without empirical instances, yet essential for counterfactual analysis) and “Case ID”: company/year identification in the raw data. For convenient reason, we do not insert the company name. The purpose here is to show truth table rows with empirical instances

Table A2.

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