INTERNATIONAL REAL ESTATE REVIEW

2024 Vol. 27 No. 1: pp. 139 – 167

Bankruptcy Prediction in REITs

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Bankruptcy in many industries is a well-documented norm; however, in the real estate investment trust (REIT) industry, the related literature is very thin. This study uses the vector autoregressive (VAR), logistic, and multilinear models to detect bankruptcy in the REIT industry. The macroeconomic variables used as part of showing bankruptcy are adopted from Altman (1968), with an addition of funds from operations (FFOs). The results confirm interconnectedness among the Altman (1968) variables, including their causal nature on bankruptcy. The commonly used ratios (i.e. profitability, solvency and liquidity) confirm the declining financial health and financial positions of REIT firms during tough market conditions.

Keywords

Bankruptcy, REIT

1. Introduction

Manda (2021) has modelled different cash flows in the South African REIT industry. The cash flows are specifically equity cash flows (ECFs), capital cash flows (CCFs), free cash flows (FCF) and debt cash flows (CFd). These cash flows have been modelled before, but in different industries without focus on the real estate sector (see Altman 1968; Mensah 1984; Fernández 2007). Based on previous studies such as Fernández (2007), these cash flows have a common pattern, i.e. CCFs are another form of FCFs, and vice versa. Among the common features of cash flows is their sensitivity to numerous macroeconomic variables.

Manda (2021) shows that these cash flows can be negative in the REIT industry, which is a novel finding. Furthermore, these cash flows are sensitive to the capital structure of REIT firms, which is consistent with Fernández (2007). Interestingly, CCFs actually mirror the market capitalisation of REITs, which is a novel finding. Cash flows react differently to selected quantitative and qualitative "macroeconomic" variables (see Manda 2021). Fundamentally, negative cash flows, which are partly due to the presence of debt funds, can be highly negative, and could lead to financial distress and/or bankruptcy. Additionally, there is the highly levered nature of REITs. Also, consider the fact that South Africa is an emerging country with a robust macroeconomic environment that could result in financial distress. Most recently in South Africa, Rebosis filed for voluntary business rescue in 2022, which suggests the possibility of bankruptcy, depending on the steps of the business rescue plan. This is the first of its nature since the enactment of REITs in South Africa in 2013. According to Gibilaro and Mattarocci (2018), one potential reason why such things happen in REITs is because of the low transparency and REITs suffer from reputation and financial guarantees. Note that Rebossis largely invested in government owned buildings and the reputation of the government in running businesses tends to be low in South Africa. The question is whether there is something that other African countries and emerging markets can learn, or are there mitigative steps to take to avoid bankruptcy in a highly-debt intensive market, or perhaps identify the key financial metrics that could potentially signal that a standalone REIT company in an emerging market could be vulnerable to bankruptcy in the near future.

Now, the question that remains is how managers can mitigate the risk of bankruptcy as bankruptcy is undesirable in any industry. There is no straight answer, but this study builds on previous studies. For example, Mensah (1984) shows that bankruptcy can be detected by using (non)stationarity methods while Altman (1968) creates specific ratios which he deems central to determining the bankruptcy of firms. Some REIT studies such as Giacomini et al. (2017) and Giambona et al. (2018) caution against high debt levels, in particular when the debt level is significantly high. Note that they never provide a specific measure and/or number that would constitute as a high debt level. This, among other factors, raises the question on how bankruptcy can be detected in the REIT industry.

This study is unique in that first, the work is the first of its kind on financial bankruptcy in the emerging REIT markets (Mensah 1984, Shumway 2001 and Charalambakis and Garrett (2019). Secondly, earlier studies (Altman 1968, Waqas and Md-Rus 2018), when selecting data, pretty much select companies that filed for bankruptcy and/or financial distress. In this study, no REIT in South Africa has officially filed for bankruptcy; however, it is important to note that Rebosis Property Fund, which is part of the sample in this study, entered into voluntary business rescue in August 2022. Moreover, the sample of previous studies is made up of pairs, while in this study, each REIT is analysed as a standalone firm. Finally, earlier studies extract bankruptcy periods that are known while in this study, the bankruptcy period is unknown, thus making the financial distress and/or bankruptcy calculations in this study more computationally challenging and interesting.

This study contributes to the current body of knowledge by showing how bankruptcy can be detected in emerging REIT markets. In order to detect bankruptcy, first, this study uses the variables in Altman (1968) which are modelled in the VAR model to illustrate the interrelationship between the Altman (1968) variables. Then, funds from operations (FFOs) are added to the Altman (1968) variables in the logistic model because FFOs are a widely accepted measure of performance in the REIT industry. The usage of a logistic model helps to test bankruptcy in both non-stationarity and stationarity environments, which is similar to the work in Mensah (1984). Finally, a multilinear regression, similar to that in Marcato et al. (2019), is used to test the robustness of the model. Moreover, the rolling over process is undertaken in a similar manner to that in Marcato et al. (2019).

The results of this study illustrate the following. The VAR results confirm that the Altman (1968) variables are interconnected, which is partly due to the fact that the Altman (1968) variables are (in)directly related to the financial health and financial positions of REIT firms. Altman (1968) is probably the premier study that has laid the foundations for predicting corporate bankruptcy by using specific ratios, which have been retested by numerous studies to date Overall, all of the Altman (1968) variables have causal effects irrespective of their statistical significance. The main causal bankruptcy variables are (i) $\frac{retained\ earnings}{total\ assets}$ (has negative effect) and (ii) FFOs (has positive effect). Interestingly, profitability, solvency and liquidity ratios show declining financial health and financial positions during tough market conditions. Notably, based on yearly data for a 5-year period from 2013 to 2018, the results accurately predict the collapse of the Rebosis Property Fund in 2022, which is a rare forecasting capability.

The remainder of the paper is as follows. Section 2 is a literature review. The modelling process is presented in Section 3. The data are discussed in Section 4 and the empirical analysis is elaborated in Section 5. The last section concludes the study.

2. Literature Review

Wong and Reddy (2018) explore the exposure of REITs that had overseas investments and operations to several key foreign markets. Only exposure to the U.S. market is statistically significant. Before the global financial crisis (GFC) took place, Wong and Reddy (2018) state that "the coefficient for the S&P500 was negative…(which) suggests that U.S. operations serve a defensive purpose and is an important source of diversification benefits. However, the events of the crisis reversed this trend and added to financial risk. In the post-GFC phase, exposure to the S&P500 was no longer a significant driver of REIT returns in Australia". Wang and Reddy (2018) further posit that the Australian REIT (A-REIT) sector outperformed the equity markets prior to the GFC. Although the A-REITs did not perform as well post-GFC, the sector still managed to outperform general equities in terms of risk-adjusted returns. Recovery efforts focused on capital raising which was aided by the general recovery of the equities market, debt reduction and balance sheet restructuring. Evidence in Wong and Reddy (2018) suggests that "A-REITs represented defensive options for investors during the early period".

Acknowledging the importance of credit and access to funding, Kanno (2020) analyze credit risk assessment in REITs from the perspective of blockholders and lending networks. "The study assesses the credit risk of Japan's real estate investment trusts (J-REITs) in two related markets during the fiscal years 2008-2017…J-REITs are… close-ended funds listed on the stock exchange and thus, has corporate credit risk" Kanno (2020). Credit risk factors are "more secure than any other debt, such as subordinated debt due to an entity"[1]. Prior to analyzing the credit risk of J-REITs, Kanno (2020) states that REITs are a popular alternative investment. The J-REIT market is the second-largest REIT market globally, after the U.S. post the U.S. subprime mortgage crisis. The J-REIT market started to show strain, in that some firms started to file for bankruptcy in 2008. This was caused by failure of entities to manage the cash flow - the effects of the subprime mortgage crisis left real estate firms in a position where many of them were unable to raise funds to acquire assets and fund the operations of the firm.

Kanno (2020) focuses on calculating the credit risk parameters. First, by looking into external funding, J-REITs rely on external financing, namely,

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[1] *Duties of Credit Risk Officers at IOB*. Retrieved from https://namibiahub.com/duties-of-credit-risk-officers-at-iob

issuing investment corporation bonds and investment securities and borrowing from financing institutions. With a high degree of dependence on external financing sources, credit risk management is essentially the failure to refinance which leads to default. Kanno (2020) analyzes the credit risk of an investment corporation and the association with sponsors in the blockholding and lending network. The approach is based on discounted cash flow valuation. A lending asset is valued based on its discounted expected cash flow by using a discount rate adjusted for credit risk. Kanno (2020) calculates the credit risk exposure of a lending contract, discounting its cash flow at a discount rate adjusted for credit risk. In order to correct for the rate difference issues among the credit rating agencies, the study adopts the lowest credit rating when two or more different ratings are assigned to a firm.

The first liquidity risk measure used is market liquidity (LIQ) in DiBartolomeo et al. (2021). The LIQ measure captures liquidity related to temporary price fluctuations induced by the order flow. The illiquidity (ILLIQ) measure (used to measure non-REIT common stocks on the New York Stock Exchange (NYSE)/American Stock Exchange (AMEX)) captures the synchronous price impact of trades. Given the two adopted measures, DiBartolomeo et al. (2021) average the measure in Amihud (2002) across all identified stocks, thus enhancing their measure by using the residual from the ARIMA (3,1,3) model to measure innovations in marketplace illiquidity.

In examining the liquidity risk of a security, DiBartolomeo et al. (2021) use a regression model, where the dependent variable of the model is return on security. For time, DiBartolomeo et al. (2021) use market-wide liquidity innovations. Additional time-varying factors that can be deemed relevant for asset prices are considered as explanatory variables. This model is added to minimize model misspecification and ensure that the results are attributable directly to liquidity risk. DiBartolomeo et al. (2021) expand on the model, by drawing from the five-factor model. Notable findings from the research emphasize that REIT liquidity betas are significantly negative in the time periods the robustness test was performed within.

A fundamental underlying premise is that REITs are unique because investors possess ex-ante information that they are due to receive dividends from the firm. DiBartolomeo et al. (2021) unveil that equity REITs as a group show negative sensitivity toward market-wide liquidity shocks.

In addition, when market-wide liquidity declines, REIT values increase relative to those of other industries. These findings show that REIT prices provide a liquidity benefit to investors contrary to non-REIT firms, which show no such relationship, seeing as their prices do not increase when market-wide liquidity declines. Furthermore, the findings in DiBartolomeo et al. (2021) suggest that diversified REITs commonly suffer from lower valuation and reduced liquidity because these REITs exhibit higher market-wide liquidity risk than firms with more property investment holdings. Lastly, DiBartolomeo et al. (2021) examine the liquidity beta of firms that operate within REIT status at a specific time while having operated as a non-REIT firm, which is fully taxable. The stock liquidity risk of these firms is lower when the firms operate as REITs than when they do not. Conclusively, DiBartolomeo et al. (2021) show that REITs as a security class exhibit a lower return sensitivity to market-wide liquidity shocks and thus expose investors less to liquidity risk.

Gibilaro and Mattarocci (2018) examine US REIT financing decisions and the switching effect. They focus on initial public offering (IPO) settings. Their sample is for a 10-year horizon, from 2004 to 2013, and data are obtained from S&P US REIT index. Amounts raised ranged from US$35 to US$60 billion. They use a probabilistic model to show switching opportunities; moreover, the model is similar to the logistic model. The key parameters of their model are: (i) equity (E), (ii) bonds (B), (iii) loans (L) or multiple securities (M) and (iv) choice of not raising new money (NC). The issue of leverage is distinctly presented in their empirical work. The preliminary findings show that financing type is as follows. Equity financing solutions are used in 447 cases, bonds in 171 cases, loans in 249 cases and issuing multiple securities in 379. An in depth analysis with the logistic regression shows that market performance, interest rate, and growth opportunities are negative and statistically significant, irrespective of financing type while REIT performance and size have statistically significant positive coefficients irrespective of financing solution. The switching effect confirms a similar finding. As expected in the real estate sector (see Kola and Sebehela (2021)), leverage has a positive and statistically significant outcome. Interestingly, Gibilaro and Mattarocci (2018) argue that financing decisions are structure insensitive, which contradicts Kola and Sebehela (2021).

Prombutr et al. (2023) study the return anomalies of US REITs based on the q-theory. They state that the main focus of the q-theory is maximization of the yields of the firm. Their data are obtained from selected American stock exchanges (i.e., NYSE, AMEX, and NASDAQ), where the analyzed variables are investment-to-assets (I/A0, prior-year return (PRYR), firm size (SZ), book-to-market (BM) and return to equity (ROE). Preliminary empirical work shows that the analyzed variables have positive coefficients, and are statistically significant. Furthermore, premiums in relation to the analyzed variables confirm earlier findings. To increase the strength of the analysis, Prombutr et al. (2023) carry out a cross-sectional analysis and univariate (bivariate) modelling. The earlier findings are confirmed including outcome of friction. The momentum in Prombutr et al. (2023) has a positive effect on I/A, PRYR, SZ, BM and ROE. Fundamentally, Prombutr et al. (2023) confirm that the q-theory holds in their case.

3. Modelling

3.1 Preface

Before running different models to test for potential bankruptcy, this study first tests the relationship between different independent variables as taken from Altman (1968). The key findings suggest that there is a multi-relationship that should be noted. Therefore, the study proposes using the vector autoregressive (VAR) model in a panel setting as follows:

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + e_t \qquad (1)$$

where the l-periods that support observation y_{t-1} are called the l-th lag of y, c is a $k * 1$ vector of constants (intercepts), A_j is a time-invariant $k * k$ matrix and e_t is a $k * 1$ vector of the error terms that satisfies $\mathrm{E}(e_t) = 0$. Every error term has a mean of zero. $\mathrm{E}(e_t e_t') = \Omega$, where the contemporaneous covariance matrix of the error terms is Ω (a $k * k$ positive-semidefinite matrix). $\mathrm{E}(e_t e_{t-k}') = 0$, and for any non-zero k, there is no correlation across time; in particular, no serial correlation in the individual error terms.

3.2 Financial Modelling

Mensah (1984) is one of the few notable studies that has investigated both stationarity and non-stationarity when there is bankruptcy. However, Mensah (1984) does not use both in his analysis. Therefore, the method in this study differs from Mensah (1984) as stationarity and non-stationarity are combined in the analysis. The log-linear model is suitable for the latter scenario (see Marcato et al. 2019). For the main analysis, this study proposes logistic and log-linear models. Second, it can be inferred from Mansur et al. (2020) that returns and volatilities of REITs do not tend to have a normally distributed curve. Therefore, this study proposes to use models that take into account the non-normality of the distribution of curves. The model suitable for the latter scenario from previous studies (Mensah 1984, Wiggins and Metrick 2019, Fan et al. 2020) is a probabilistic model which is suitable for describing bankruptcy, in particular the logistic model as it does not take into account linearity. Therefore, this study adopts a logistic-panel model:

$$f(x) = \frac{L}{1 + e^{-k(x - x_0)}} \qquad (2)$$

where x_0 is the x value of the midpoint of the sigmoid, L is the maximum value of the curve, and k is the logistic growth rate or steepness of the curve. Like an empirical study, it is in the interest of the analysis that the results are validated and/or supported by testing their robustness for practical applications. Therefore, this study uses another model to carry out the robustness test.

3.3 Robustness Test

Another model that is similar to a probabilistic model but multilinear in approach is the log-linear model. According to Marcato et al. (2019), the log-linear model allows each variable to take its appropriate distribution in terms of (non-)linearity. Therefore, this study uses a log-linear panel as a second choice model for testing bankruptcy:

$$ln(Z) = c + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \varepsilon_t \qquad (3)$$

where Z is the market capitalization (market cap) of each REIT firm, x_1 is the working capital over total assets, x_2 is retained earnings over total assets, x_3 is earnings before interest and taxes over total assets, x_4 is the market value equity over the book value of the total debt, x_5 is sales over total assets, x_6 is the FFO and ε_t is an error term. The first five intendent variables are adopted from Altman (1968) including their sequence, and FFOs are included as they are main yard stick of the performance measurement of REITs.

4. Data

This study makes use of the annual financial statements (AFS) of FTSE/JSE listed REIT firms from Bloomberg for the financial years of 2014-2018. The REITs mentioned above were all listed on the JSE in 2014, which include GRT as the ticker symbol for Growthpoint Properties, VKE for Vukile Property Fund Limited, SAC for SA Corporate Real Estate Limited, EMI for Emira Property Fund, RES for Resilient Properties Income Fund Limited, TEX for Texton Property Fund, RDF for Redefine Properties, DIA for Dipula Properties, FFA/FFB for Fortress REIT Limited, TWR for Tower Property Fund, REB for Rebosis Property Fund, ATT for Attacq, OAS for Oasis Crescent Property Fund, HYP for Hyprop Investments, DLT for Delta Property Fund, HPB/HPA for Hospitality Property Fund, FVT for Fairvest, IPF for Investec Property Fund, APF for Accelerate Property Fund, AHD for Arrowhead Properties Ltd and EQU is Equites Property Fund. The study makes use of the available-for-sale (AFS), namely the income statement, balance sheet and cash flow statement to obtain the key ratios analyzed in Altman (1968). Further to this, this study extracts additional data, such as the market cap and FFOs of REITs for the financial years of 2014-2018 from the Thomson Reuters dataset.

5. Empirical Analysis

The panel data on South African REITs from 2014 to 2018 based on the variables in Altman (1968) are plotted in Figure 1. The variables are: (i) working capital/total assets, (ii) retained earnings/total assets, (iii) earnings before interest and taxes/total assets, (iv) market value equity/book value of total debt, sales/total assets and (v) market cap. Altman (1968) uses the overall index for the sixth variable while this study uses market cap because this study focuses on firm specific bankruptcy as opposed to market bankruptcy. The data is from the Bloomberg Terminal. Note that the Cholesky decomposition graphs in Figure 1 need to be interpreted in conjunction with the VAR results in Table 1. Kola and Sebehela (2021) also follow the same procedure when interpreting their VAR findings.

In order to determine the appropriate lag, the following diagnostic tests are carried out. Given that the results of the vector autoregression are sensitive to the order of the variables, this study follows the exact order of the variables as per Altman (1968) because Altman (1968) has pioneered the bankruptcy of firms with the use of a ratio analysis among other factors. To determine the appropriate lag, diagnostic tests are conducted in the following order. A residuals test is carried out, where the correlation of the LM test of 2 lags is tested for both the first- and second-order correlations. The results show that both the first- and second-order correlations are significant. This implies that any lag up to 2 lags is appropriate for the vector autoregression. Subsequently, the lag structure is tested for 1 lag length and the results indicate that 1 lag is acceptable based on the Akaike information criterion and Schwarz criterion. Finally, the lag structure is tested using the autoregressive root test. The modulus values in Table 1 with the autoregressive root results are used, and all of the absolute values are less than one. As such, all of the roots that lie inside the unit are stationary. The results, therefore, support the use of VAR (1,1).

In order to predict bankruptcy in the South Africa REIT market, a multiple discriminant statistical technique is adopted with the use of economic ratios. In this section, the results from the VAR model are provided, and the results are presented in conjunction with the Cholesky decomposition. According to Kola and Sebehela (2021), the Cholesky decomposition provides more insight and interpretative power of the results.

The six key economic ratios that are outlined by Altman (1968) are used to assess the cause and effect relationship between the ratios that will be discussed below. However, before reporting on the findings, it is imperative to define the respective ratios by using Altman (1968) as a benchmark. The ratios are explained in sequential order according to their level of importance and significance as this is important for the multivariate analysis model that is performed in this study. The definitions below are adopted from Altman (1968). As such, these will be the definitions of the ratios in this study. WC_TA measures the net liquid assets of the firm relative to the total capitalization. RE_TA measures the cumulative profitability over time. EBIT_TA measures the true productivity of the firm assets abstracting from any tax or leverage factors. MVE_BVTD shows how much the assets of a firm can decline in value before the liabilities exceed the assets and the firm becomes insolvent. Sales_TA measures the capability of management in handling a competitive condition. Lastly, MARKET_CAP measures business value based on the number of outstanding shares and share price.

Figure 1 VAR (1,1) Results: Cholesky Decomposition

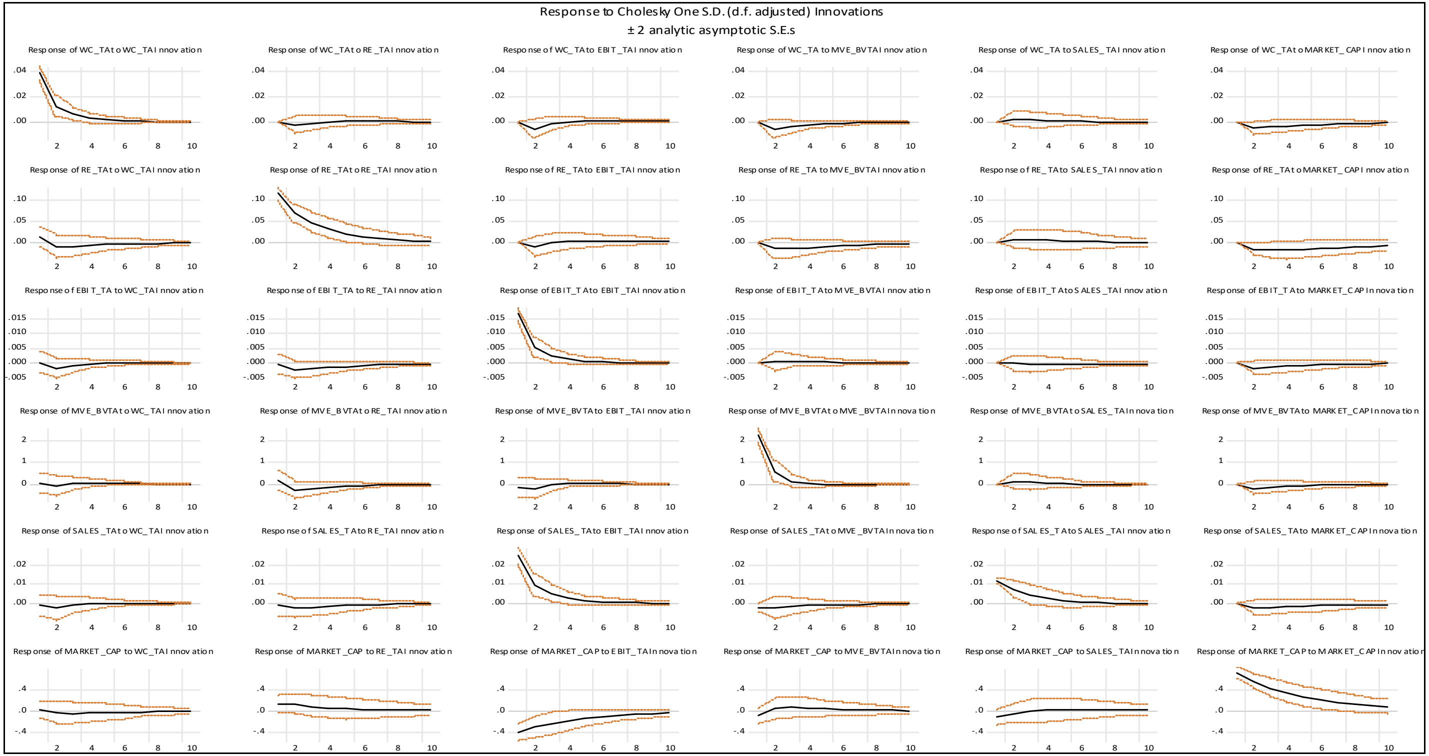

Table 1 VAR (1,1) Results

Parameter	WC_TA	RE_TA	EBIT_TA	MVE_TA	SALES_TA	MARKET_CAP
WC_TA(-1)	0.3472	-0.4314	-0.0459	-0.9294	-0.0380	-1.2499
	(0.0969)	(0.2918)	(0.0415)	(5.7595)	(0.0689)	(2.04718)
	[3.5868]#	[-1.4782]	[-1.1043]	[-0.1614]	[-0.5517]	[-0.6106]
RE_TA(-1)	-0.0139	0.6378	-0.0148	-2.3068	-0.0153	0.03969
	(0.0259)	(0.0780)	(0.0111)	(1.5394)	(0.0184)	(0.5472)
	[-0.5359]	[8.1766]#	[-1.3301]	[-1.4985]	[-0.8284]	[0.0726]
EBIT_TA(-1)	-0.7032	-1.8077	0.3279	-3.0086	-0.4058	-4.5835
	(0.4484)	(1.3505)	(0.1922)	(2.6653)	(0.3188)	(9.4739)
	[-1.5683]	[-1.3385]	[1.7067]	[-1.1288]	[-1.2729]	[-0.4838]
MVE_TA(-1)	-0.0026	-0.0064	0.0001	0.2586	-0.000	0.0522
	(0.0017)	(0.0051)	(0.0007)	(0.1011)	4(0.0012)	(0.0359)
	[-1.5057]	[-1.2427]	[0.1887]	[2.5575]#	[-0.3402]	[1.45834]
SALES_TA(-1)	0.1208	0.4574	-0.0314	7.8961	0.6103	3.4520
	(0.2636)	(0.7938)	(0.1129)	(1.5667)	(0.1874)	(5.5688)
	[0.4585]	[0.5762]	[-0.2779]	[0.5040]	[3.2569]#	[0.6199]
MARKET_CAP(-1)	-0.0072	-0.0227	-0.0023	-0.2876	-0.0030	0.7888
	(0.0035)	(0.0106)	(0.0015)	(0.2095)	(0.0025)	(0.0745)
	[-2.0476]#	[-2.1366]#	[-1.5329]	[-1.3724]	[-1.2083]	[10.5907]#

(Continued…)

(Table 1 Continued)

Parameter	WC_TA	RE_TA	EBIT_TA	MVE_TA	SALES_TA	MARKET_CAP
Adjusted R^2	0.1505	0.4459	0.1259	0.0595	0.2004	0.6049
F-Statistic	3.8649	14.0113	3.3291	2.0231	5.0523	25.7603
Akaike IC	-3.5998	-1.3947	-5.2943	4.5702	-4.2819	2.5014
Schwarz SC	-3.4152	-1.2100	-5.1097	4.7548	-4.0973	2.6861

Notes: WC_TA denotes $\frac{working\ capital}{total\ assets}$, RE_TA denotes $\frac{retained\ earnings}{total\ assets}$, EBIT_TA is $\frac{earnings\ before\ interest\ and\ taxes}{total\ assets}$, MVE_BVTD is $\frac{market\ value\ equity}{book\ value\ of\ total\ debt}$ and SALES_TA represents $\frac{sales}{total\ assets}$. In each cell, the first decimal number is the coefficient. The decimal number in rounded brackets is the standard error and that in squared brackets is the t-test value. All of the decimal numbers in the squared brackets with # symbol next to them, are statistically significant for the VAR values as they are at least 2 irrespective of being negative or positive.

The ratios proposed by Altman (1968) are analyzed by using a multivariate analysis, namely the VAR[1,1] model. The following observable findings are noted in the model. It is interesting that a 1 unit lag in five of the six ratios, with the exception of EBIT_TA, has a direct impact on their own ratios. The EBIT_TA ratio is a true measure of the productivity of the assets of the REIT firms. Productivity is defined as the potential earning power of an asset (Altman 1968). The results of the model show that EBIT_TA has no statistically significant results. This suggests that the productivity of assets in REIT firms will not be affected by a 1 unit lag in the analyzed economic ratios. This is particularly interesting as it is the only ratio that has no statistically significant result. These results could do with the fact that the productivity of the assets that enable earning power to the respective REITs are dependent on macroeconomic factors such as but not limited to consumer spending, consumer price index (CPI), disposable income supply and demand of rental properties (Azmin and Shariff 2016). The firm has limited control over these factors.

As reported above, the lag (-1) in WC_TA, RE_TA, MVE_BVTD, SALES_TA and MARKET_ CAP is significant to their own ratios, which suggests that if there is a 1-unit lag in the respective ratio, they would have a direct impact on themselves. Therefore, a shock in any of the components that make up the items of the respective line would create a positive shift in itself, in which the shift ranges from a shift of 0.347530 - 0.788772. Interestingly, a 1-unit shock or lag in MARKET_CAP results in a shift in the other variables which is the only variable that does so. The shift happens in WC_TA and RE_TA. As such, the results alongside the Cholesky decomposition reveal that a 1-unit lag in MARKET_CAP would result in a negative shift in both the WC_TA and RE_TA ratios. The lag in both of these variables result in -0.022684 in RE_TA, -0.007218 in WC_TA and -0.022684 in RE_TA in the South African listed REITs. The rate of shock in RE_TA caused by the lag above is the smallest shift that occurred in the period of 2014-2018. Before one understands the effects of these ratios based on the (-1) shock of MARKET_CAP, one needs to understand what could potentially affect the market cap of a firm. Pavone (2019) opines that the macroeconomic environment plays a significant role in the market capitalization of firms. Furthermore, Pavone (2019) emphasizes that the price that a stock is trading on the stock market reflects the exogenous and endogenous factors that are related to the performance of the economy.

As such, this reveals that the market cap is not solely dependent on the performance of a firm. This does not suggest that firm performance will not affect the market cap. The market is affected by both the performance of a firm and macroeconomic environment. Retained earnings are leftover profit from net income after dividends are issued to shareholders. Given the nature of the REIT industry and its mandate to distribute 75% of net income as dividends, this results in the high dividend payout of REITS, which limits the retained earnings of REIT firms. Subsequently, there is high dependence on equity and debt financing of REIT firms to keep operations and increase earning power through acquisitions. Therefore, the relationship between retained earnings and market cap substantiates the negative shift in the RE_TA ratio given a 1-unit lag in MARKET_CAP. The shift of -0.022684 of RE_TA is not as significant as the shift of all the other variables.

WC_TA is a measure of the net-liquid assets of firms relative to the total capitalization, according to Altman (1968). Working capital is the lifeline of any corporation and the immediate liquidity available to the entity. As such, positive working capital will show that a company is operationally efficient in the short-term period. Therefore, working capital is pivotal to the daily running of any entity. It is interesting to observe the shift and behavior of working capital in the REIT market, primarily because REITs are highly levered firms (Giacomini et al. 2017). The fact that REITs are highly levered means that there must be efficient management of REIT's working capital to avoid any form of bankruptcy. The studied dataset shows that although some REIT firms during the financial years of 2014-2018 had healthy financial positions, bankruptcy was not out of reach for these REITs.

5.1 Logistic Results

Given that data used for running the logistic model are panel data, the model is used in different scenarios to increase the robustness of the logistic results. First, when the independent variables are rolled over, after step-wise regression, the rolling over procedure follows the order of importance based on that of the Altman (1968) variables. According to Altman (1968), the order of the independent variables is as follows: $\frac{working\ capital}{total\ assets}$, $\frac{retained\ earnings}{total\ assets}$, $\frac{earnings\ before\ interest\ and\ taxes}{total\ assets}$, $\frac{market\ value\ equity}{book\ value\ of\ total\ debt}$ and $\frac{sales}{total\ assets}$. Then, the second rolling in the logistic model hinges on the ascending causality effect based on the step-wise regression results. The reason that this logic is used in the second logistic model is because an ascending order of causality minimizes econometrics challenges including multicollinearity (Ghysels and Motegi 2020). In both logistic models, this study adds FFOs because they are a widely used and accepted measure for measuring performance in the REIT industry (Beracha et al. 2019, Seok et al. 2020). For the first logistic model based on the Altman (1968) variables, the FFO is the last variable that will be rolled over in the model. Note that Resilient Property Fund (RES) in 2018 and Fortress Property Fund in 2016 and 2018 had negative FFOs. However, for modelling reasons, they are changed into positive numbers to obtain neutral logarithms for the negative FFOs.

The results of Panel A in Table 2 show that only 4 of the 6 explanatory variables used in the step-wise regression model are statistically significant, which are WC_TA, EBIT_TA, SALES_TA and FFO. FFO is the only variable that reacts positively towards MARKET_CAP in SWR6. As such, this result reveals that

FFO is a predictor in the change that occurs in the market cap of REITs, and supported by the fact that FFOs are the most acceptable performance measure in the REIT industry. Further to this, the results for WC_TA, SALES_TA AND EBIT_TA are negatively and statistically significant to MARKET_CAP. The negative statistical significance of the Altman (1968) variables in the context of their relationship to market cap in the REIT industry offers diversification benefits. Diversification benefits were first presented in Marcato et al (2019). The diversification benefits of the Altman (1968) variables in REITs are a novel finding according to the best of the knowledge of the author. Panels B and C both show the same conclusion: EBIT_TA, MVE_BVTD and FFO are causal variables and thus have additional explanatory power. The causality of MVE_BVTD is influenced by the relationship that exists between MARKET_CAP and MVE_BVTD, where the former represents the capital structure of a company. On the other hand, EBIT_TA provides additional relevant information about REITs as real estate companies in support of growing interest among generalist investors. The relationship between the order of importance of the Altman (1968) variables and the step-wise ascending order of the rolling over model confirms the robustness of the results because they arrive at the same conclusion.

5.2 Robustness Test

For the robustness test, this study uses the following ratios: (i) profitability-return on ROE and return on assets (ROA), (ii) liquidity-current and cash ratios and (iii) solvency-debt to equity and equity multiplier. The reason for using these as part of the robustness testing is because it can be inferred from Islamoglu et al. (2015) that these ratios are central in determining the financial health and financial position of REITs. Table 3 lists the selected ratios of the REIT firms.

From 2014-2018, the profitability ratios show a negative trend; a decline in both the ROA and ROE over this period of time. The results show that some companies reported a negative ROA in 2018 which include AHA, REB and FFA. The negative result is attributed to a decline in total assets in all three entities. Further to this, the same entities that reported a negative ROA also reported a negative ROE in 2018. The negative ROE can also be attributed to a decline in total equity. The decline in total equity is associated with the dividend policy that REIT firms have put in place. Currently, South Africa REITs are required to declare 75% of their profits as dividends to their unit holders annually. The profitability in this period was fairly stable.

Table 2 Logistic Results

[Panel A] Step-Wise Regression

Eq.	SWR1	SWR2	SWR3	SWR4	SWR5	SWR6
Constant	0.0888	0.0885	1.0649	0.08868	0.1068	0.0557
	(0.000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.000)***
WC_TA	-0.0617					
	(0.0480)**					
RE_TA		-0.1778				
		(0.8369)				
EBIT_TA			-2.7338			
			(0.0002)***			
MVE_BVTD				-0.0141		
				(0.8012)		
SALES_TA					-0.1894	
					(0.0000)***	
FFO						0.8127
						(0.0000)***
Adjusted R^2	0.0281	-0.0093	0.1196	-0.00091	0.1699	0.6362
F-Stat	4.0005	0.0426	15.129	0.0637	22.2995	182.9051
	(0.0000)***	(0.8369)	(0.0001)***	(0.8012)	(0.0000)***	(0.0000)***
Durbin-Watson Stat	0.5475	0.4668	0.5042	0.4596	0.5204	0.9898
Akaike IC	3.4209	3.4587	3.3221	3.4585	3.2631	2.4382
Schwartz C	3.4572	3.5092	3.3727	3.5090	3.3138	2.4887
Hannan-Quinnn C	3.4414	3.4792	3.3426	3.4789	3.2836	2.4587

[Panel B] Altman (1968) Variables in Ascending Order

Eq.	Altman (1968) 1	Altman (1968) 2	Altman (1968) 3	Altman (1968) 4	Altman (1968) 5
Constant	0.08893	0.1083	0.1085	0.1089	0.0710
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
WC_TA	-0.0616	-0.0689	-0.0689	-0.0669	0.4226
	(0.0502)*	(0.0193)**	(0.0197)**	(0.0240)**	(0.8019)
RE_TA	-0.00483	-0.2563	-0.2509	0.0221	-0.2233
	(0.9549)	(0.7474)	(0.7538)	(0.9776)	(0.6117)
EBIT_TA		-0.2858	-0.2854	-0.7288	-0.1896
		(0.0001)***	(0.0001)***	(0.9558)	(0.0135)***
MVE_BVTD			-0.0095	-0.0325	0.0548
			(0.8540)	(0.5258)	(0.0667)*
SALES_TA				-0.1908	-0.0377
				(0.0148)**	(0.4030)
FFO					0.8046
					(0.0000)***
Adjusted R^2	0.0186	0.1517	0.1435	0.1855	0.7381
F-Stat	1.9848	7.1997	5.3566	5.7363	49.8442
	(0.1427)	(0.0002)***	(0.0006)***	(0.0001)***	(0.0000)***
Durbin-Watson Stat	0.5491	0.6805	0.6798	0.6645	1.0741
Akaike IC	3.4399	3.3034	3.3221	3.2809	2.1552
Schwartz C	3.5158	3.4045	3.4485	3.4325	2.3321
Hannan-Quinnn C	3.4707	3.3444	3.3733	3.3423	2.2269

[Panel C] Step-Wise Ascending Order

Eq.	SWAO 1	SWAO 2	SWAO 3	SWAO 4	SWAO 5
Constant	0.0711	0.0731	0.0730	0.0733	0.0710
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
WC_TA			0.1619	0.2075	0.4236
			(0.9238)	(0.9031)	(0.8019)
RE_TA				-0.1677	-0.2232
				(0.7104)	(0.6117)
EBIT_TA		-0.1581	-0.1579	-0.1620	-0.1898
		(0.0333)**	(0.0345)**	(0.0327)**	(0.0135)**
MVE_BVTD					0.0548
					(0.0667)*
SALES_TA	-0.1383	-0.0584	-0.0583	-0.0561	-0.0377
	(0.0000)***	(0.1827)	(0.1855)	(0.2086)	(0.4030)
FFO	0.7653	0.7816	0.7831	0.7836	0.8046
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Adjusted R^2	0.7271	0.7365	0.7339	0.7316	0.7381
F-Stat	139.5506	97.9199	72.7219	57.7041	49.8442
	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***	(0.0000)***
Durbin-Watson Stat	0.9726	1.0112	1.0137	1.0119	1.0741
Akaike IC	2.1601	2.1340	2.1529	2.1706	2.1552

(Continued…)

(Panel C Continued)

Eq.	SWAO 1	SWAO 2	SWAO 3	SWAO 4	SWAO 5
Schwartz C	2.2359	2.2351	2.2794	2.3223	2.3321
Hannan-Quinnn C	2.1908	2.1750	2.2042	2.2321	2.2269

Note: SWR stands for step-wise regression for stand-alone equation (i.e. Eq.), where each number means a specific equation, i.e. SWR is step-wise regression 1. For Panel B, the variables are rolled over until the full model [i.e. Altman (1968) Model 6] based on ascending order as in Altman (1968) on page 594. For the step-wise ascending order as illustrated in Panel C, rolling over starts from the coefficient that has the lowest causal effect provided that it is statistically significant until the variable with the highest casual effect, provided that it is statistically significant. The non-statistically significant variables are rolled over in the same manner as statistically significant variables in terms of ascending order of casual effect; however, the non-statistically significant variables are rolled in last. The ascending rolling over to the full model is inferred from Ghysels and Motegi (2020). In terms of rolling over the independent variables, the model starts rolling over statistically significant variables, starting from the smallest to the largest absolute coefficient. The latter phenomenon minimizes the occurrence of multicollinearity among potential econometrics challenges according to Ghysels and Motegi (2020).The same rule applies to the statistically insignificant independent variables. The FFOs are added last as they are not part of Altman (1968) but are a widely used and accepted performance measure in the REIT industry. WC_TA stands for $\frac{working\ capital}{total\ assets}$, RE_TA stands for $\frac{retained\ earnings}{total\ assets}$, EBIT_TA is $\frac{earnings\ before\ interest\ and\ taxes}{total\ assets}$, MVE_BVTD is $\frac{market\ value\ equity}{book\ value\ of\ total\ debt}$ and SALES_TA represents $\frac{sales}{total\ assets}$. In both Panels B and C, the funds from operations are rolled over in the last step because they are part of the Altman (1968) variables but FFOs are one of the most important measure of performance of REITs.

Table 3 Ratio Analysis

REIT	Date	Panel D: Profitability		Panel E: Solvency		Panel F:Liquidity	
		D1: ROA	**D2: ROE**	**E1: Debt:Equity**	**E2: Equity Multiplier**	**F1: Current Ratio**	**F2:Cash Ratio**
GRT	2014	0.0803	0.1367	0.4327	1.6684	0.8733	0.2329
	2015	0.0707	0.1247	0.4415	1.6791	1.3259	0.2501
	2016	0.0503	0.0874	0.5500	1.7355	1.4738	0.3909
	2017	0.0653	0.1172	0.6677	1.7608	1.4629	0.2343
	2018	0.0596	0.1050	0.7200	1.8248	2.5095	0.9760
VKE	2014	0.0317	0.0001	2.1509	3.7566	0.3269	0.1569
	2015	0.0657	0.0001	0.2879	1.4782	0.4626	0.3499
	2016	0.0778	0.1192	0.3448	1.5382	0.4749	0.3325
	2017	0.0885	0.1172	0.2134	1.3360	1.1627	0.9727
	2018	0.0928	0.1536	0.3478	1.4792	0.6469	0.5495
SAC	2014	0.0909	0.0938	0.0779	1.0997	0.8800	0.4776
	2015	0.1210	0.1416	0.3493	1.4164	0.9862	0.4634
	2016	0.1363	0.2055	0.2850	1.4076	0.6571	0.1294
	2017	0.0731	0.1173	0.3707	1.4906	0.7437	0.1765
	2018	0.0441	0.0645	0.4088	1.5858	0.4873	0.0907
EMI	2014	0.1009	0.1710	0.3738	1.6618	0.1168	0.0265
	2015	0.1311	0.2245	0.4675	1.6303	0.1726	0.0371
	2016	0.0447	0.0723	0.3911	1.6138	0.8236	0.0379
	2017	0.0474	0.0806	0.3988	1.6666	0.6655	0.0712
	2018	0.0579	0.0946	0.3594	1.6915	0.7768	0.0367

(Continued…)

(Table 3 Continued)

REIT	Date	Panel D: Profitability		Panel E: Solvency		Panel F:Liquidity	
		D1: ROA	**D2: ROE**	**E1: Debt:Equity**	**E2: Equity Multiplier**	**F1: Current Ratio**	**F2:Cash Ratio**
RES	2014	0.1330	0.2005	0.4207	1.4782	0.4258	0.0679
	2015	0.1527	0.2114	0.2734	1.3182	0.8849	0.0512
	2016	0.0920	0.1309	0.2728	1.4211	0.5401	0.0231
	2017	0.0598	0.1040	0.6366	1.7049	0.6553	0.4360
	2018	0.0841	0.1443	0.6443	1.7771	0.3129	0.1678
TEX	2014	0.0818	0.1222	0.2393	1.4655	0.2978	0.1691
	2015	0.0713	0.1221	0.5969	1.6315	3.6311	2.2150
	2016	0.0555	0.0901	0.5377	1.6201	0.3565	0.1362
	2017	0.0243	0.0413	0.4263	1.6703	0.2170	0.1080
	2018	0.0227	0.0508	0.1676	2.3175	0.1737	0.0355
RDF	2014	0.0601	0.1075	0.4583	1.7570	0.1469	0.2205
	2015	0.0826	0.1243	0.4862	1.5616	0.4211	0.0635
	2016	0.0578	0.0928	0.4322	1.6170	0.1890	0.1103
	2017	0.0363	0.0632	0.5402	1.7122	0.1707	0.0209
	2018	0.0743	0.1138	0.6107	1.7111	0.4574	0.0839
DIA	2014	0.0199	0.1046	3.3295	5.1579	0.1413	0.0441
	2015	0.0703	0.1085	0.4862	1.6019	0.3870	0.1513
	2016	0.0936	0.1581	0.6084	1.6917	0.5736	0.1630
	2017	0.0536	0.0920	0.5212	1.6741	0.5534	0.1925
	2018	0.0577	0.0910	0.4901	1.7468	0.2474	0.0738

(Continued…)

(Table 3 Continued)

REIT	Date	Panel D: Profitability		Panel E: Solvency		Panel F:Liquidity	
		D1: ROA	**D2: ROE**	**E1: Debt:Equity**	**E2: Equity Multiplier**	**F1: Current Ratio**	**F2:Cash Ratio**
FFA/ FFB	2014	0.0848	0.1874	1.0318	2.2342	0.2034	0.0042
	2015	0.1730	0.2245	0.3289	1.4567	0.3151	0.0033
	2016	0.0972	0.1236	0.3095	1.3599	0.6391	0.0057
	2017	0.0699	0.0910	0.3065	1.3477	0.9539	0.0076
	2018	-0.0890	-0.1318	0.4037	1.5286	0.4390	0.1465
TWR	2014	0.0395	0.0680	0.4327	1.6684	0.5978	0.3040
	2015	0.0665	0.1293	0.4327	1.6684	0.1175	0.0215
	2016	0.0426	0.0756	0.4327	1.6684	0.3335	0.0843
	2017	0.0811	0.1341	0.4327	1.6684	0.5320	0.1662
	2018	0.0524	0.0863	0.4327	1.6684	0.3266	0.1302
REB	2014	0.0384	0.1673	2.7915	4.2849	0.1525	0.1933
	2015	0.0278	0.0525	0.6908	1.9295	0.1611	0.0233
	2016	0.0869	0.1751	0.8635	2.0187	1.1487	0.1531
	2017	0.1169	0.2288	0.4468	1.9097	0.1869	0.0190
	2018	-0.0473	-0.0883	0.4709	2.0825	0.1193	0.0281
ATT	2014	0.0537	0.1021	0.7304	1.8628	1.2162	1.2162
	2015	0.0402	0.0823	0.8635	1.9475	2.6046	0.7431
	2016	0.0500	0.1326	1.1935	2.6452	3.3163	0.4629
	2017	0.0215	0.0432	0.7306	2.0914	9.3235	0.7141
	2018	0.1008	0.1589	0.6403	1.6016	26.5178	2.4661

(Continued…)

(Table 3 Continued)

REIT	Date	Panel D: Profitability		Panel E: Solvency		Panel F:Liquidity	
		D1: ROA	D2: ROE	E1: Debt:Equity	E2: Equity Multiplier	F1: Current Ratio	F2:Cash Ratio
OAS	2014	0.1121	0.1202	0.0000	1.0397	2.2295	0.4370
	2015	0.0709	0.0778	0.0000	1.0405	2.4420	0.5108
	2016	0.0771	0.0796	0.0000	1.0373	2.5553	0.0545
	2017	0.0657	0.0677	0.0000	1.0389	3.5360	0.1322
	2018	0.0828	0.0961	0.0000	1.0366	3.5754	0.0661
HYP	2014	0.0717	0.1523	0.8518	2.0858	0.0208	0.0070
	2015	0.1249	0.1748	0.2776	1.3323	0.0374	0.0139
	2016	0.0816	0.1203	0.3863	1.4724	0.2075	0.1092
	2017	0.0770	0.1093	0.2182	1.3924	0.3160	0.2604
	2018	0.0747	0.0964	0.3119	1.3368	1.8169	1.2807
DLT	2014	0.1002	0.2335	0.9139	2.3109	0.3098	0.1103
	2015	0.0780	0.2012	0.7949	2.3543	0.3605	0.0633
	2016	0.0632	0.1140	0.6383	1.9473	0.2970	0.1072
	2017	0.0542	0.0964	0.5883	1.7552	0.4982	0.1668
	2018	0.0621	0.1115	0.3800	1.7371	0.2125	0.0392
HPA/ HPB	2014	0.0203	0.1322	5.0709	6.3779	2.3466	0.7604
	2015	0.0235	0.1383	4.1677	5.6100	1.4583	0.4525
	2016	0.0897	0.1343	0.3018	1.4947	0.5614	0.2699
	2017	0.0650	0.0825	0.2260	1.2816	0.3653	0.5730
	2018	0.0077	0.0102	0.1748	1.1819	1.4664	4.9573

(Continued…)

(Table 3 Continued)

REIT	Date	Panel D: Profitability		Panel E: Solvency		Panel F:Liquidity	
		D1: ROA	**D2: ROE**	**E1: Debt:Equity**	**E2: Equity Multiplier**	**F1: Current Ratio**	**F2:Cash Ratio**
FVT	2014	0.0000	0.0000	0.2009	0.2146	0.2858	0.0551
	2015	0.0832	0.1096	0.1837	1.2542	0.2905	0.0477
	2016	0.1133	0.1682	0.4304	1.4823	0.6905	0.2192
	2017	0.1280	0.1756	0.1795	1.3451	0.1926	0.0450
	2018	0.0915	0.1301	0.2079	1.4729	0.1683	0.0202
IPF	2014	0.7500	0.9910	0.3396	1.6730	0.8795	0.7227
	2015	0.0950	0.1337	0.1428	1.3354	0.2652	0.1264
	2016	0.0648	0.1003	0.4631	1.5541	0.2105	0.0530
	2017	0.7710	0.1199	0.4696	1.5684	0.2633	0.1325
	2018	0.5584	0.0987	0.4771	1.5781	0.5913	0.4002
APF	2014	0.0803	0.1422	0.4696	0.5319	0.3840	0.1253
	2015	0.0986	0.1527	0.4865	1.5492	0.7014	0.1798
	2016	0.0908	0.1400	0.4781	1.9343	0.3688	0.1331
	2017	0.0735	0.1239	0.4500	2.1455	0.4229	0.1168
	2018	0.0735	0.1238	0.5287	1.6834	0.3896	0.0461
AHA	2014	0.2815	2.1249	0.4684	0.9875	0.3758	0.2729
	2015	0.3831	1.6572	5.1361	0.0120	1.1074	0.6511
	2016	0.3979	1.7698	1.4992	1.6916	0.4644	0.2287
	2017	0.2281	0.8402	0.3537	1.9684	0.1806	0.0612
	2018	-0.0038	-0.0163	0.3946	2.0396	0.2573	0.0273

(Continued…)

(Table 3 Continued)

REIT	Date	Panel D: Profitability		Panel E: Solvency		Panel F:Liquidity	
		D1: ROA	D2: ROE	E1: Debt:Equity	E2: Equity Multiplier	F1: Current Ratio	F2:Cash Ratio
EQU	2014	0.0120	0.0132	0.0890	1.1066	0.6937	0.1225
	2015	0.1162	0.1291	0.0979	1.1117	0.7031	0.1992
	2016	0.0980	0.1143	0.1198	1.1672	0.6599	0.0231
	2017	0.0957	0.1261	0.2218	1.3176	0.3920	0.0290
	2018	1.0450	0.1062	0.3026	1.3470	1.2501	0.0135

Notes: GRT is the ticker symbol for Growthpoint Properties, VKE for Vukile Property Fund Limited, SAC for SA Corporate Real Estate Limited, EMI for Emira Property Fund, RES for Resilient Properties Income Fund Limited, TEX for Texton Property Fund, RDF for Redefine Properties, DIA for Dipula Properties, FFA/FFB for Fortress REIT Limited, TWR for Tower Property Fund, REB for Rebosis Property Fund, ATT for Attacq, OAS for Oasis Crescent Property Fund, HYP for Hyprop Investments, DLT for Delta Property Fund, HPB/HPA for Hospitality Property Fund, FVT for Fairvest, IPF for Investec Property Fund, APF for Accelerate Property Fund, AHD for Arrowhead Properties Ltd and EQU is Equites Property Fund.

During the same period of time, the Panel D:E ratio increased steadily for the entities, with the exception of DIA, REB, HPA and OAS. Interestingly, OAS is the only REIT with a zero Panel D:E ratio because the company is Islamic owned and believe in the principle of Haram, which means forbidden in Arabic. Haram dictates that individuals who practice Islam should not have debt, and if they do have debt, it should be limited. This is the case with OAS, which has no non-current liabilities and limited current liabilities. In the case of DIA, REB and HPA, they had a low debt level. As such, these companies are more dependent on equity financing. This is particularly engrossing for REIT firms, which are traditionally known to be highly levered firms (Giacomini et al. 2017, Ooi et al. 2010). The equity multiplier (EM) shows an upward trend and that over the period of 2014-2018, the majority of the assets of the companies was financed by debt and not through stockholder equity. The year 2014 is the year that most of the REITs started to operate, and as such, they could not depend much on debt due to the lack of collateral. Once the firms started to acquire more assets, their dependence on debt financing increased.

The liquidity ratio shows the same pattern as that of the solvency ratio. In Panel F, there is an increase over time for both the current ratio and the cash ratio. As such, Panel F shows that there is a positive relationship between solvency and liquidity and a negative relationship between profitability and liquidity. Addae et al. (2013) support this finding for highly levered firms, and report that there is a significantly negative relationship between profitability and total debt. Qui and La (2010) find that although there are generally more levered firms than unlevered firms, there is a profitability decline in the debt ratio of levered firms. Notably, the cash ratios contradict the q-theory of investment (see Prombutr et al. 2023) as when cash ratios increase so does the debt:equity ratio; see Table 5.3. This is probably due to the same reason in Prombutr et al. (2023), that is, there are market inefficiencies among investors in understanding investments and momentum.

6. Conclusion

The findings of this study are as follows. First, the Altman (1968) variables and FFOs are interrelated in numerous ways. During certain points, the relationship is positive and other times, negative. The inter-relationship seems to be based on their connection to the financial health and financial positions of REIT firms (i.e. Altman (1968) variables and FFOs). Second, the probabilistic results show that the main contributor to bankruptcy in the REIT industry are $\frac{retained\ earnings}{total\ assets}$ and FFOs. Third, the ratios (i.e. profitability, solvency and liquidity) show deterioration of the financial health and financial positions of REIT firms. Finally, irrespective of the method used to detect bankruptcy, they show a gloomy picture of investment opportunities during bankruptcy periods.

The implications from this study are as follows. First, FFOs are a widely used and accepted measure, and also explain for bankruptcy in the REIT industry. Thus, FFOs have more importance than just being a performance measure. Retained earnings are related to the financial health and financial position of any firm; therefore, the importance of retained earnings in explaining bankruptcy is not surprising. Second, probabilistic measures are valuable techniques in detecting bankruptcy because probabilistic measures can be customised to different situations. Third, traditional measures such as ratios are still valuable in showing bankruptcy. Finally, it is advisable that more than one bankruptcy technique should be used to detect bankruptcy as that would provide deeper insights into the given financial health and/or financial position of any firm.

Acknowledgement

I am grateful for Tumellano Sebehela's valuable contribution and comments from anonymous reviews, including the editor (Sing Tien Foo), which have improved the final version of the paper. The remaining errors are solely those of the author. The author has nothing to declare, including any conflicts of interest.

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