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The relationship between earnings volatility and corporate risk disclosures

Authors:
Johannes Rammala[1]
Franz Eduard Toerien[1]

Affiliations:
[1]Department of Financial Management, Faculty of Economic and Management Sciences, University of Pretoria, Pretoria, South Africa

Corresponding author:
Franz Eduard Toerien,
eduard.toerien@up.ac.za

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Background: Corporate risk management theory argues that effective hedging with derivatives should reduce earnings volatility and enhance firm value. However, studies that have examined the relationship between the use of derivatives and earnings volatility, particularly from developed markets have reported mixed results.

Aim: This study investigates the relationship between corporate risk management practices such as the use of derivatives and earnings volatility. More specifically, it examines whether the use of derivatives by non-financial firms listed on the JSE has an effect of smoothing earnings volatility.

Setting: The setting includes 135 JSE listed non-financial companies during the period 2005-2021.

Method: Firm level data were obtained from financial data depositories, IRESS and Thomson Reuters Datastream. This study made use of panel estimated generalised least squares method (period seemingly unrelated regression) regression model in the analysis.

Results: The findings of this study contradict the prediction of corporate risk management theory. The empirical findings showed that derivatives use measured by a dichotomous variable was positively associated with earnings volatility, meaning that derivatives were not effective in smoothing earnings volatility. However, when derivatives use is measured by a continuous variable, the empirical findings showed a weak association.

Conclusion: The present study rejects the null hypothesis based on the results of the regression models. However, the results of this study do not suggest that JSE listed firms are ineffective in managing risks and cannot conclude that these firms used derivatives for speculative purposes, exposing themselves to additional risks and volatility.

Contribution: The findings of this study add to the body of knowledge on corporate risk management practices and their impact on earnings volatility and on firm value.

Keywords: Corporate risk management; derivatives; earnings volatility; firm value; hedging; risk disclosure; and speculation.

Introduction

The purpose of this study is to investigate whether certain risk management practices, particularly hedging with derivatives by listed non-financial firms on the Johannesburg Stock Exchange (JSE), have an effect of smoothing earnings volatility. In the normal course of making business decisions, non-financial firms grapple with numerous risks, particularly financial risks such as fluctuations in foreign exchange rates, interest rates and commodity prices (Phua et al. 2021). Whether a firm is concerned about the impact of currency risk on its global sales, or the impact of interest rates risk on its leverage position, the approach and course taken to mitigate such risks can directly affect the value of a firm (Miloš Sprčić 2007). Exposure to these factors can directly affect the earnings of a firm, induce earnings volatility and thus translate into real losses in firm value (Beneda 2013). Such volatility can have an impact on a firm's value through its relation to the cost of capital (Francis et al. 2004), increasing the costs of financial distress (Smith & Stulz 1985) and possible violation of debt covenants (Dichev & Skinner 2002). In addition, earnings volatility increases the possibility of missing earnings targets which is associated with a stock market sell-off (Kothari 2001).

Therefore, an effective corporate hedging strategy is key to firm sustainability and value creation (Batten & Hettihewa 2007). Non-financial firms that are concerned about the impact of financial risks on their bottom line may hedge those risks with derivatives (Afza & Alam 2011). The

derivatives market is a gateway used to connect investors with different risk appetites; it allows for the transfer of risks from those who are risk adverse to those who have an appetite for risk (Lien & Zhang 2008). However, in emerging markets such as South Africa, the derivatives market is undersized relative to developed markets and many firms may not be fully equipped with adequate knowledge on how to effectively use derivatives for financial risk management (Kozarevic et al. 2012).

Corporate derivatives use has attracted considerable attention in recent years, primarily because derivatives have been linked with several corporate scandals (Chui 2012). As a result, the study on the use of derivatives by firms and its impact on the bottom line (earnings) is of interest to stakeholders. There are also global sceptics that these financial instruments are not time tested sufficiently to conclusively demonstrate their effectiveness in managing risks (McHenry 1995). This concern is timely amid the fact that it has become increasingly complex for risk practitioners to assess the effectiveness of risk management strategies due to the evolution of complex financial products. Phua et al. (2021) states that risk management practices may not always alleviate business risks. If derivatives users hedge ineffectively, it can even increase earnings volatility.

Research on corporate derivatives use and earnings volatility, such as that by Jalilvand (1999), Barton (2001), Pincus and Rajgopal (2002), Beneda (2013), and Paligorova and Staskow (2014), has particularly focused on developed markets and, recently, Phua et al. (2021) have focused on an emerging market. However, these studies have reported mixed results. In emerging markets, such as South Africa, not much research focus has been directed to understanding the effects of corporate derivatives use on earnings volatility. Nonetheless, with increased global volatility and uncertainty in the global economy, it is imperative for firms to implement effective risk management strategies to hedge against various risks in the face of multiple international crises, for example the disruption in the international supply chain caused by the COVID-19 pandemic and the Russian invasion of Ukraine. Therefore, it is arguably important to examine the effectiveness of corporate risk management practices on smoothing earnings volatility, particularly from an emerging market's perspective. This is because the findings from developed markets may not be generalised to countries such as South Africa due to various factors such as structural differences in the capital markets, strict regulatory environment, and limited knowledge on derivatives.

This study adds to the body of knowledge by investigating whether corporate hedging by derivatives is effective in smoothing earnings volatility in an emerging market context. The findings from an emerging market are useful in that they can provide unique insights relative to developed markets. Additionally, the contribution made by this study concerns its methodological approach. Data on derivatives use was directly sourced from firms' annual financial statements whereas previous studies such as ones by Bodnar and Gebhardt (1999), Pramborg (2005), El-Masry (2006), and Martin et al. (2009), relied on a survey method to capture derivatives data. Capturing derivatives data from annual financial statements is a better alternative to survey results, because survey results depend on the participation rate (Bartram, Brown & Conrad 2011). Studies conducted by Barton (2001), Nguyen and Faff (2002), Beneda (2013), and Phua et al. (2021) measured derivatives using either a dichotomous or a continuous variable. In this study, both approaches were adopted. Additional inferences can be drawn from using both approaches because a dichotomous variable only takes two values, zero or one, whereas a continuous variable includes derivatives values collected from companies' annual reports. The practical findings of this study might be useful to businesses, policymakers, researchers, and other stakeholders in understanding how corporate hedging with derivatives affects earnings volatility and ultimately firm value.

The following sections review the literature on earnings volatility and derivative use, present the research methodology and results, and conclude with discussions on the study's limitations and future research recommendations.

Literature review and hypothesis development

Importance of managing earnings volatility

Managing earnings volatility is an important aspect of firm value for several reasons. Earnings volatility reflects an inherent business risk that can arise from the firm's operations as well as the result of market shocks (Ghasemzadeh, Heydari & Mansourfar 2021). Firms manage earnings volatility because earnings volatility can enhance a firm's cost of capital (Minton, Schrand & Walther 2002), increase the possibility of the violation of debt covenants and cost of financial distress (DeFond & Jiambalvo 1994; Dichev & Skinner 2002; Smith & Stulz 1985), create agency problems (Morellec 2004; Stulz 1990), lead to underinvestment problems (Froot, Scharfstein & Stein 1993), lead to information disparity between informed and uninformed investors (Goel & Thakor 2003), and can increase the possibility of missing earnings targets which is associated with negative stock market reaction (Barton 2001; Kothari 2001).

Motives for hedging

The foundation of the modern financial theory is based on three premises: value creation, the risk versus return trade-off, and the no-arbitrage principle (Fatemi & Luft 2002). The firm value creation can be attributed to one of three sources: reducing the cost of financial distress (Smith & Stulz 1985), efficient and optimal tax payment (Graham & Smith 1999; Smith & Stulz 1985), and mitigating the effect of credit rationing by reducing the possibility that the firm may be forced to forego positive net present value projects because of insufficient internal funds (Froot et al. 1993). Alternatively, managerial risk aversion is based on the agency model (Tufano 1998).

Global use of derivatives

Today, across the globe, most non-financial firms use derivatives; however, to determine whether the intent is hedging or timing the market (speculating) is not always obvious (Bartram 2019). Researchers across the globe have examined the use of derivatives by non-financial firms and the use of derivatives varies across countries. For instance, Bodnar and Gebhardt (1999) performed a comparative survey study on derivatives use in risk management by United States (US) and German non-financial firms. The study found that more German firms (78%) used derivatives than US firms (57%). The use of derivatives was for hedging purposes; however, firms in Germany hedged with derivatives to manage accounting earnings volatility, whereas US firms used derivatives to manage cash flow fluctuations. Based on the analysis of a survey conducted in 1996 on the sample data of 77 Canadian non-financial firms, Jalilvand (1999) found that 75% of the firms in the survey used derivatives for risk management. The study also found that companies with global presence engaged in derivatives.

Several studies have been undertaken across the European continent. Fatemi and Glaum (2000) presented a survey study of corporate hedging behaviour of non-financial firms listed on the Frankfurt Stock Exchange. The overall sample size included 71 firms and 89% indicated that they used derivatives for risk management. This rate is higher than the 78% reported by Bodnar and Gebhardt (1999). In Scandinavia, Hagelin (2003) examined 160 Swedish non-financial firms' use of currency derivatives. Unlike Fatemi and Glaum (2000), this study adopted a combination of survey data and financial statements. The study found that Swedish firms hedged currency risk with derivatives. El-Masry (2006) surveyed 173 United Kingdom (UK) non-financial firms in 2001 and found that 67% of UK-based firms in the sample hedged with derivatives. The primary reasons for not using derivatives were cited as inadequate financial risk exposure and costs in setting up derivatives programmes.

Bodnar et al. (2013) conducted a web-based survey on risk management practices and use of derivatives by Italian non-financial firms. The analysis was on a sample of 86 firms during the period September 2007 to January 2008. The study found that Italian firms used derivatives to hedge foreign currency risk. Further, similar to Bodnar and Gebhardt (1999), some studies adopted an international perspective and comparison across countries. Examining 155 firms using a survey approach, Prevost, Rose and Miller (2000) found that derivatives use and trends in small open economies such as New Zealand were comparable and similar to more developed countries such as the UK, the US and Germany. Pramborg (2005) undertook a comparative survey study on the use of derivatives by Swedish and Korean non-financial firms. The sample was constituted of 163 firms, 60 from Korea and 103 from Sweden. The study found that firms in Sweden hedged with derivatives to manage earnings volatility and Korean firms primarily used derivatives to manage cash flow fluctuations. Bartram, Brown and Fehle (2009) conducted the first comprehensive global examination of risk management practices among non-financial firms. Annual reports were used as the source of data in this study. The overall sample included 7292 firms across 48 countries including the US. The results showed that 60% of the firms used derivatives for hedging purposes.

Outside of the US and Europe, similar studies have been undertaken in New Zealand and Australia. Extracting data from the 2007 annual reports of 134 non-financial firms listed on the New Zealand Stock Exchange, Li, Visaltanachoti and Luo (2014) examined corporate benefits of derivatives use. The study found no evidence that corporate hedging with derivatives is associated with an increase in firm value measured by Tobin's Q. Nguyen and Faff (2002) investigated the determinants of derivatives use among Australian listed firms. The study included a sample of 469 firm observations between 1999 and 2000. The study found that liquidity, size, and leverage are the determinants of derivatives use among Australian firms. Firms also used derivatives to reduce expected cost of financial distress and cash flow volatility.

Use of derivatives in emerging markets

Research on corporate derivatives use in emerging markets has gained attraction in recent years. However, research that has examined corporate hedging strategies in emerging markets has documented relatively low use of derivatives. Accordingly, Martin et al. (2009) adopted a survey method to examine corporate derivatives use by Peruvian non-financial firms. The analysis included 65 non-financial firms and was carried out during 2005. The study found that only a small fraction (33%) of the firms in the sample engaged in derivatives. This number is relatively low compared to developed markets studies. During the period 2004–2007, Afza and Alam (2011) examined the determinants of foreign currency derivatives among non-financial firms in Pakistan. The annual reports were used as the source of firm data of 86 non-financial firms listed on the Karachi Stock Exchange. The study found that firms in Pakistan hedged currency risk with derivatives. In South Africa, Correia, Holman and Jahreskog (2012) conducted a survey on derivatives use by 98 non-financial firms listed on the JSE in 2006. The study found that South African firms hedged with derivatives. In addition, as in some emerging markets such as Peru, high costs of setting up derivatives programmes were cited by South African firms as one of the reasons that hinder derivatives use.

Relationship between derivatives use and earnings volatility

Recently, there has been a growing interest in research that focuses on the relationship between corporate derivatives use and earnings volatility. Barton (2001) examined whether the use of derivatives and discretionary accruals can be used as alternatives to manage earnings volatility. The sample included Fortune 500 firms between 1994 and 1996 and the study found that firms that engaged in derivatives had lower

earnings volatility. Similarly to Barton (2001), Pincus and Rajgopal (2002) examined US-based firms focusing on the Oil and Gas sector. The study also used annual reports data on a sample of 236 firms. The results showed that the choice of discretionary accrual and derivatives use is associated with lower earnings volatility. In contrast, Zhang (2009), found no evidence that suggests that derivatives use is associated with changes in earnings volatility. However, even though the time period in the analysis is similar to the Barton (2001) study, the sample size is much smaller. Beneda (2013) used a regression model to examine the use of derivatives by US non-financial firms over the period 2003–2010. Similarly to Barton (2001), and Pincus and Rajgopal (2002), the study found the use of derivatives by US non-financial firms is negatively associated with earnings volatility. Abdel-Khalik and Chen (2015) point out that the earlier mixed results can be attributed to the use of small total derivatives amounts or to insufficient derivatives after the implementation of SFAS No. 133.

Among Canadian firms, the evidence also showed mixed findings. Jalilvand (1999) examined survey data of 77 non-financial listed Canadian firms and found that corporate hedgers had higher earnings volatility compared to non-hedgers. Paligorova and Staskow (2014) found that the derivatives use by Canadian firms is associated with lower earnings volatility between 2005 and 2013. This contradicts the result of Jalilvand (1999). More recently, in an emerging market, Phua et al. (2021) examined the association between derivatives use and earnings volatility. The study found that derivatives use by Malaysian non-financial firms is positively associated with earnings volatility, suggesting that derivatives use did not lower earnings volatility as expected. These results did not concur with similar studies in the US and other developed parts of the world. Possible reasons for this are that the derivatives market in emerging markets remains relatively small compared to that in developed markets.

Synthesis of finding and research question

From the empirical evidence presented above, the theoretical framework states that firms primarily engage in derivatives to manage risks. This suggests that corporate hedging with derivatives can lead to lower earnings volatility (Beneda 2013; Smith & Stulz 1985). Previous research on the effect of derivatives use on earnings volatility has focused primarily on developed markets such as the US and Canada. However, findings from these studies offer mixed results, highlighting the need for further investigation, particularly in emerging markets such as South Africa. Based on the empirical findings and theoretical framework, the following hypothesis is developed:

H1: The use of derivatives is negatively associated with earnings volatility

Research methodology

Sample selection and data collection

The present study examined a sample of 135 firms listed on the JSE. Financial firms, such as insurance firms, banks, investment banks, and asset managers, were excluded because the intent of derivatives use could be profit-making rather than risk management (Batten & Hettihewa 2007). The research period covers the years 2005–2021. All the variables used in this study were collected from this period. In addition, derivatives data were available in the annual reports for the period chosen in this study. The data used in this study are firm-level data obtained from financial data depositories, Iress and Thomson Reuters Datastream, and annual financial statements. Previous studies relied on the survey questionnaire method to capture data on derivatives use. However, the International Financial Reporting Standards (IFRS) prescribes disclosure requirements on both quantitative and qualitative information regarding financial instruments such as derivatives. Hence, in this study, derivatives data were sourced from the annual reports using the Thomson Reuters Datastream. Relying on the annual reports for derivatives data is a better alternative to a survey method that places much reliance on the participatory rate.

Data analysis

The data used in this study can be characterised as panel data. It includes firm observations over a period of 17 years. As there were some missing data points over the sample period and across firms, an unbalanced panel design was adopted. Eviews11, a statistical package which allows for statistical analysis of panel data, was used. The analysis outcomes were descriptive statistics, Pearson correlation coefficients and panel regression analysis.

Model specification and variables

Regression modelling was conducted in Eviews11. In regression modelling, there are numerous assumptions regarding the model, namely autocorrelation, linearity, multicollinearity and homoskedasticity. Before determining the appropriate regression model, tests were performed to determine a statistically valid regression model for this study. The Hausman test was used to determine if a random or fixed effect model applied for this study. To account for the presence of autocorrelation and homoskedasticity, the panel estimated generalised least squares method (period seemingly unrelated regression) was suitable for this study instead of an ordinary least squares (OLS), random or fixed effect model. A white diagonal standard errors and covariance which is a robust standard error estimation was applied and thus ensured that the significant values were not influenced by heteroskedasticity.

Earnings volatility (dependent variable)

The dependent variable in this study is earnings volatility. Earnings volatility can be computed as the standard deviation of earnings divided by total assets, that is, earnings before interest and tax (EBIT) divided by average total assets over different periods. Barton (2001) measured earnings volatility for the most recent five-year period. Beneda (2013) and Phua et al. (2021) measured earnings volatility as the standard deviation of eight quarterly earnings over a two-year period.

The present study used a similar measure of earnings volatility to Barton.

Derivatives use (independent variable)

El-Masry (2006), Beneda (2013) and Phua et al. (2021) measured corporate derivatives use by a dichotomous variable. Barton (2001) measured derivatives use using total notional values in the financial statements. According to Barton, the most accurate way to capture derivatives use is by using the ratio of the derivatives position to the amount of risk exposure the firm is trying to hedge. However, this ratio is not easily obtainable on financial statements as most firms do not disclose sufficient information to capture this ratio (Phua et al. 2021). A dichotomous variable, where a dummy variable takes a value of one for use of derivatives use and a value of zero for non-use, is commonly used (Bartram et al. 2011; Beneda 2013; Phua et al. 2021). This study, similar to Beneda, captured derivatives use by a dichotomous variable and also used aggregate notional values, similar to Barton. A key contribution of this study is that it uses both approaches to examine the effects of corporate derivatives use on earnings volatility.

Control variables

The control variables used in this study are discussed below. These variables were selected over others that could be relevant based on existing empirical research.

Interest-bearing debt level (DEBTCAP) is measured by total interest-bearing liabilities divided by total assets. It is expected that firms with high gearing ratios will show smooth earnings volatility. Firms that finance most of their assets by debt rather than equity have an incentive to use derivatives (Bartram et al. 2009). Past studies have found that the use of derivatives for hedging increases as the debt levels on the balance sheet increases (Dolde 1995; Haushalter 2000).

Market-to-book ratio (MKBK) is measured by market value of the common equity divided by the book value of common equity. A high market-to-book ratio is an indication of growth; therefore, firms with growth opportunities are expected to have high earnings volatility (Huang et al. 2015). It is also expected for growing firms to hedge with derivatives to manage earnings volatility and generate sufficient internal cash flow to fund growth opportunities because external financing may be expensive (Barton 2001).

Research and development expense (RD) is measured by research and development expenses disclosed in the financial statements divided by average total assets. It is expected that firms that invest in research and development will have a higher earnings volatility (Beneda 2013). As with other expenses, research and development expense will affect a firm's earnings. Firms with growth options will spend more on their research and development and thus affect earnings as these developments only generate cash flow at a later stage (Tufano 1996).

Firm size (LNSIZE) is measured by a logarithm of total assets. Large firms tend to have stable earnings profiles, as most of them have a significant portion of the market share in their specific industries. These firms also generate a significant amount of their earnings globally. Therefore, it is expected that large firms will have lower earnings volatility (Barton 2001). It is also expected for large firms to use derivatives to manage the impact of currency risk on the earnings generated by their global operations. In addition, large firms have economies of scale and budget to set up and maintain risk management programmes (Berkman et al. 2002).

The model specification used in this study is stated as follows:

- **EARNVOL** = $\alpha + \sum SECTOR + (\beta_1 * DERDUM) + (\beta_2 * DEBTCAP) + (\beta_3 * MKBK) + (\beta_4 * RD) + (\beta_5 * LNSIZE) + e$;
- **α** = intercept,
- **∑SECTOR** = classification of firm sample sectors,
- **EARNVOL** = standard deviation of the most recent five years earnings before interest and tax (EBIT) divided by total assets,
- **DERDUM** = dichotomous variable, one indicates use of derivatives and zero indicates non-use of derivatives,
- **TOTDER** = total derivatives amount, continuous variable,
- **DEBTCAP** = total interest-bearing liabilities divided by total assets,
- **MKBK** = market value of the common equity divided by the book value of common equity,
- **RD** = research and development expense divided by average total assets,
- **LNSIZE** = logarithm of total assets,
- **e** = error term.

Robustness analysis

It is common to have outliers in the financial data that can influence the results. Therefore, testing for normality is important. Normality test showed a skewness value which is within ±2 and is acceptable. Kurtosis results were also within an acceptable range of ±7. Where applicable, the presence of skewness and kurtosis were addressed by winsorisation. Because autocorrelation in a panel data set biases the standard errors and causes the result to be less efficient, this study used the Durbin Watson test to check for autocorrelation. The Durbin Watson test is between the acceptable thresholds of 1.5 and 2.5 and therefore indicates that autocorrelation was addressed. A Pearson correlation matrix was used to test for multicollinearity and no presence of multicollinearity was depicted.

Results and discussion

Descriptive statistics

In this section, descriptive statistics for the sample of non-financial firms included in this study are summarised and presented. The descriptive statistics of the variables are depicted in Table 1. The mean and standard deviation for earnings volatility (EARNVOL) were 0.050 and 0.036. This suggests that the earnings volatility of the sample firms in

this study was not widely distributed. DEBTCAP as a measure of interest debt level has a mean of 0.498, indicating that on average firms included in the sample finance their assets by 50% of debt. The minimum value of DEBTCAP was 0.144 while the maximum value was 0.930.

Figure 1 depicts the use and non-use of derivatives by firms across sample years 2005–2021. As shown in Figure 1, more firms in the sample years did use derivatives.

Correlation analysis

Table 2 and Table 3 presents the Pearson correlation matrix for variables in this study. Correlation analysis examines the relationship between variables; however, correlation does not imply causation. Table 2 and Table 3 also show no evidence of multicollinearity between variables.

From Table 2, it can be observed that there is a statistically significant weak negative relationship between earnings volatility (EARNVOL) and derivatives use (DERDUM). Table 2 also shows a correlation between earnings volatility (EARNVOL) and the control variables. It can be observed that there is a statistically significant negative weak relationship between earning volatility and three control variables, interest-bearing debt level (DEBTCAP), market-to-book ratio (MKBK) and firm size (LNSIZE), but a positive weak relationship is found between earnings volatility (EARNVOL) and research and development (RD). Correlation analysis was also conducted between derivatives use (DERDUM) and control variables. From Table 2, it can be observed that there is a statistically significant positive weak relationship between derivatives use (DERDUM) and two control variables, interest-bearing debt level (DEBTCAP) and firm size (LNSIZE). Table 2 also shows a positive weak relationship between derivatives use (DERDUM) and research and development expense (RD) and, lastly, a negative weak relationship was observed with market-to-book-ratio (MKBK).

A statistically significant positive relationship between the use of derivatives (DERDUM) and interest-bearing debt level (DEBTCAP) supports the financial distress argument for corporate hedging. The result indicates that the use of derivatives increases as debt levels on the balance sheet increases. Corporate risk management theory argues that hedging with derivatives can lower earnings volatility and generate sufficient internal cash to fund investment opportunities. Therefore, firms that have growth opportunities will use derivatives to manage earnings volatility. However, the results of this study do not support that argument shown by a statistically negative weak relationship between derivatives use (DERDUM) and market-to-book ratio (MKBK). The reason for a negative relationship in this study could be that firms included in this study are matured firms that generate enough internal cash flow to fund growth opportunities. It is also expected for firms with high research and development costs to use derivatives (Froot et al. 1993). The present study found a statistically positive weak relationship between derivatives use (DERDUM) and research development (RD). Lastly, Table 2 shows a statistically significant positive weak relationship between derivatives use (DERDUM) and firm size (LNSIZE). The results indicate that larger firms in terms of their market capitalisation listed on the JSE are more likely to engage in derivatives. Because of economies of scale, large firms can also set up and maintain derivatives programmes (El-Masry 2006).

From Table 3 it can be observed that there is a negative weak relationship between earnings volatility (EARNVOL) and derivatives use (TOTDER). From Table 3, it can also be

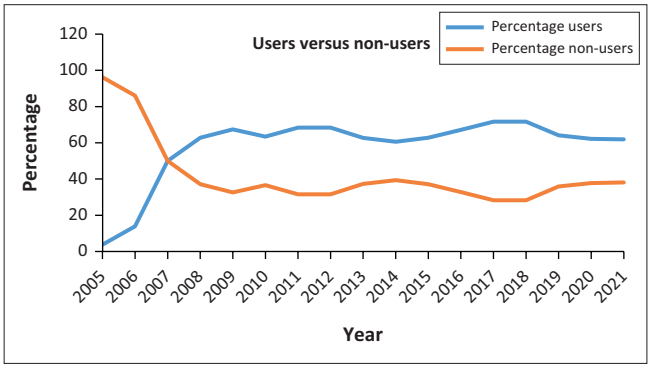

FIGURE 1: Derivatives use of the sample years.

TABLE 1: Descriptive statistics: Independent variables including a continuous variable (TOTDER).

Measure	Observation	EARNVOL	DEBTCAP	MKBK	RD	LNSIZE	TOTDER
N	Valid	1783	1770	1770	384	1770	1783
-	Missing	0	13	13	0	13	0
Mean	-	0.050	0.498	2.143	0.004	15.852	84156.902
Median	-	0.036	0.486	1.455	0.001	15.945	3141.000
SD	-	0.041	0.219	2.007	0.008	1.748	181981.431
Skewness	-	1.263	0.197	1.648	8.890	−0.188	2.670
SE of skewness	-	0.058	0.058	0.058	0.125	0.058	0.058
Kurtosis	-	0.706	−0.839	2.105	102.042	0.086	6.106
SE of kurtosis	-	0.116	0.116	0.116	0.248	0.116	0.116
Minimum	-	0.008	0.144	0.131	0.000	9.507	0.000
Maximum	-	0.156	0.930	8.011	0.101	20.773	723218.400

SD, standard deviation; SE, standard error; EARNVOL, earnings volatility; DEBTCAP, interest-bearing debt level; MKBK, market-to-book ratio; RD, research and development; LNSIZE, firm size; TOTDER, derivatives use.

TABLE 2: Pearson correlation matrix with derivatives (DERDUM).

Variable	Measure	EARNVOL	DERDUM	DEBTCAP	MKBK	RD	LNSIZE
EARNVOL	Pearson correlation	1	-	-	-	-	-
	N	1783	-	-	-	-	-
DERDUM	Pearson correlation	−0.124**	1	-	-	-	-
	N	1783	1783	-	-	-	-
DEBTCAP	Pearson correlation	−0.169**	0.144**	1	-	-	-
	N	1770	1770	1770	-	-	-
MKBK	Pearson correlation	−0.084**	−0.001	0.240**	1	-	-
	N	1770	1770	1770	1770	-	-
RD	Pearson correlation	0.036	0.043	0.004	−0.008	1	-
	N	1783	1783	1770	1770	1783	-
LNSIZE	Pearson correlation	−0.154**	0.283**	0.009	0.068**	0.087**	1
	N	1770	1770	1770	1770	1770	1770

EARNVOL, earnings volatility; DEBTCAP, interest-bearing debt level; MKBK, market-to-book ratio; RD, research and development; LNSIZE, firm size; TOTDER, derivatives use.
**, Correlation is significant at the 0.01 level (two-tailed).

TABLE 3: Pearson correlation matrix with total amount of derivatives (TOTDER).

Variable	Measure	EARNVOL	TOTDER	DEBTCAP	MKBK	RD	LNSIZE
EARNVOL	Pearson correlation	1	-	-	-	-	-
	N	1783	-	-	-	-	-
TOTDER	Pearson correlation	−0.043	1	-	-	-	-
	N	1783	1783	-	-	-	-
DEBTCAP	Pearson correlation	−0.169**	−0.002	1	-	-	-
	N	1770	1770	1770	-	-	-
MKBK	Pearson correlation	−0.084**	0.111**	0.240**	1	-	-
	N	1770	1770	1770	1770	-	-
RD	Pearson correlation	0.036	−0.030	0.004	−0.008	1	-
	N	1783	1783	1770	1770	1783	-
LNSIZE	Pearson correlation	−0.154**	0.274**	0.009	0.068**	0.087**	1
	N	1770	1770	1770	1770	1770	1770

EARNVOL, earnings volatility; DEBTCAP, interest-bearing debt level; MKBK, market-to-book ratio; RD, research and development; LNSIZE, firm size; TOTDER, derivatives use.
**, Correlation is significant at the 0.01 level (two-tailed).

observed that there is a statistically significant positive weak relationship between derivatives use (TOTDER) and two control variables, market-to-book ratio (MKBK) and firm size (LNSIZE). Table 3 also shows a negative weak relationship between derivatives use (TOTDER) and interest-bearing debt level (DEBTCAP) and, lastly, a negative weak relationship was observed with research and development expense (RD).

The more leveraged a firm is, the more likely the firm is to engage in derivatives. This is because highly leveraged are more sensitive to changes in interest rates and high earnings volatility may make it difficult to service debt obligations. The results of this study using derivatives as a continuous variable do not support this rationale shown by a negative weak relationship between total amount of derivatives (TOTDER) and interest-bearing debt level (DEBTCAP). Firms with high growth prospects are more likely to use derivatives to lower the probability of underinvestment and ensure availability of funds for growth opportunities (Géczy, Minton & Schrand 1997). The result of this study confirms this expectation shown by a statistically significant positive weak relationship between total amount of derivatives (TOTDER) and market-to-book-ratio (MKBK). The expected relationship between derivatives use and research and development as a proxy for growth is positive. The results from Table 3 do not confirm that expected relationship shown by a negative weak relationship between total amount of derivatives (TOTDER) and research and development (RD). Lastly, a statistically significant positive weak relationship was found between total amount of derivatives (TOTDER) and firm size (LNSIZE).

Regression analysis

The results from the regression analysis models are presented in Table 4 and Table 5. The findings from Table 4 revealed a positive association between derivatives use measured by a binary value and earnings volatility. However, the association is not significant. The findings from Table 5 revealed a weak association between derivatives use measured as a continuous variable and earnings volatility as indicated by coefficient of 0.000.

Discussion of results

The formulated hypothesis of this study is that effective hedging with derivatives should lower earnings volatility. Corporate risk management theory argues that non-financial firms engage in derivatives to manage earnings volatility since earnings volatility affects firm value. Earnings volatility affects firm value as it leads to costs of financial distress and bankruptcy (Smith & Stulz 1985), reliance on costly external financing (Froot et al. 1993), underinvestment problems and

TABLE 4: Panel period seemingly unrelated estimates (DERDUM).

Dependent Variable: EARNVOL				
Method: Panel EGLS (Period seemingly unrelated)				
Date: 07/04/22 Time: 23:31				
Sample: 2005 2021				
Periods included: 17				
Cross-sections included: 135				
Total panel (unbalanced) observations: 1770				
Linear estimation after one-step weighting matrix				
Period seemingly unrelated (PCSE) standard errors & covariance (*d.f.* corrected)				
Variable	**Coefficient**	**SE**	***t*-statistic**	**Probability**
C	0.170818	0.015678	10.89514	0.0000
DERDUM	0.002025	0.001322	1.532251	0.1256
RD	1.39E-05	0.002225	0.006247	0.9950
DEBTCAP	0.002119	0.004588	0.461772	0.6443
LNSIZE	−0.003791	0.000926	−4.091499	0.0000
MKBK	−0.000696	0.000479	−1.452527	0.1465
BM	−0.042288	0.010109	−4.183351	0.0000
CD	−0.074729	0.010083	−7.411313	0.0000
CS	−0.074491	0.010632	−7.006058	0.0000
HC	−0.054445	0.012392	−4.393647	0.0000
IND	−0.070681	0.009745	−7.252923	0.0000
TECH	−0.057796	0.011229	−5.147175	0.0000
RE	−0.077421	0.009815	−7.887709	0.0000
TEL	−0.068444	0.012317	−5.556915	0.0000
Weighted statistics				
Root MSE	0.937113	R-squared		0.061566
Mean dependent variant	0.648086	Adjusted R-squared		0.054618
SD dependent variant	1.008174	SE of regression		0.940842
Sum squared residual	1554.381	F-statistic		8.861671
Durbin-Watson statistic	1.737629	Prob (F-statistic)		0.000000
Unweighted statistics				
R-squared	0.158186	Mean dependent variant		0.049567
Sum squared residual	2.437519	Durbin-Watson stat		0.349486

Insert extension for Stat SD, standard deviation; SE, standard error; EARNVOL, earnings volatility; DEBTCAP, interest-bearing debt level; MKBK, market-to-book ratio; RD, research and development; LNSIZE, firm size; DERDUM, derivatives use; BM, basic materials; CD, consumer discretionary; CS, consumer staples; HC, healthcare; IND, industrials; TECH, technology; RE, real estate; TEL, telecommunications; MSE, mean square error.

TABLE 5: Panel period seemingly unrelated estimates (TOTDER).

Dependent Variable: EARNVOL				
Method: Panel EGLS (Period seemingly unrelated)				
Date: 07/17/22 Time: 20:24				
Sample: 2005 2021				
Periods included: 17				
Cross-sections included: 135				
Total panel (unbalanced) observations: 1770				
Linear estimation after one-step weighting matrix				
White diagonal standard errors & covariance (*d.f.* corrected)				
Variable	**Coefficient**	**SE**	***t*-statistic**	**Probability**
C	0.170988	0.019822	8.626369	0.0000
TOTDER	1.51E-09	4.48E-09	0.337322	0.7359
RD	9.05E-05	0.002197	0.041224	0.9671
MKBK	−0.000736	0.000692	−1.063525	0.2877
DEBTCAP	0.002934	0.006264	0.468349	0.6396
LNSIZE	−0.003773	0.001094	−3.449320	0.0006
BM	−0.042231	0.015213	−2.776015	0.0056
CS	−0.074136	0.014834	−4.997607	0.0000
CD	−0.074705	0.014171	−5.271692	0.0000
HC	−0.054280	0.019918	−2.725174	0.0065
IND	−0.070443	0.014226	−4.951704	0.0000
TECH	−0.057926	0.015104	−3.835254	0.0001
TEL	−0.068447	0.015744	−4.347472	0.0000
RE	−0.077019	0.014407	−5.346102	0.0000
Weighted statistics				
Root MSE	0.937961	R-squared		0.061256
Mean dependent variant	0.647088	Adjusted R-squared		0.054306
SD dependent variant	1.009223	SE of regression		0.941692
Sum squared residual	1557.193	F-statistic		8.814181
Durbin-Watson statistic	1.745168	Prob (F-statistic)		0.000000
Unweighted statistics				
R-squared	0.159300	Mean dependent variant		0.049567
Sum squared residual	2.434295	Durbin-Watson stat		0.350916

Insert extension for Stat SD, standard deviation; SE, standard error; EARNVOL, earnings volatility; DEBTCAP, interest-bearing debt level; MKBK, market-to-book ratio; RD, research and development; LNSIZE, firm size; DERDUM, derivatives use; BM, basis materials; CD, consumer discretionary; CS, consumer staples; HC, healthcare; IND, industrials; TECH, technology; RE, real estate; TEL, telecommunications; MSE, mean square error.

agency costs of debt (Myers 1977), and costs of managerial risk aversion (Fatemi & Luft 2002). Prior research, for example by Bodnar and Gebhardt (1999), Pramborg (2005), El-Masry (2006), Bartram et al. (2009), and Bodnar et al. (2013), cites that one of the primary reasons for corporate derivatives use is to manage earnings volatility.

The main findings of this study suggest that derivatives use (measured by a binary value) is positively but not significantly associated with earnings volatility. The findings of this study contradict the findings of Beneda (2013), Paligorova and Staskow (2014), and Abdel-Khalik and Chen (2015) who found that the use of derivatives is negatively associated with earnings volatility. However, the findings of this study confirm the findings of Jalilvand (1999) and Phua et al. (2021) who found a positive association between the use of derivatives and earnings volatility. When compared to studies that measured derivatives use by total notional amount, the main findings of this study suggest that derivatives use is positively, yet not significantly, associated with earnings volatility. The results of the current study contradict the findings of Barton (2001), and Pincus and Rajgopal (2002) who found a negative association between the use of derivatives and earnings volatility. However, the results of this study are similar to the findings by Choi, Mao and Upadhyay (2015) who found a positive association between derivatives use and earnings volatility.

The reasons why the present study's results might be different to studies such as those by Beneda (2013), and Paligorova and Staskow (2014) is because this study examined the relationship from an emerging market's perspective. Correia et al. (2012) found that high costs of setting up derivatives programmes were cited by South African firms as one of the reasons that hinder the use of derivatives. Other reasons cited were negative perceptions on derivatives by investors, strict regulatory environment as well as perceived credit risk (Correia et al. 2012). Therefore, this means that JSE-listed firms, as indicated by Barton (2001), might be using other alternatives such as discretionary accruals to manage earnings volatility. Adding to this, the present study examined the use of derivatives measured by a continuous variable, whereas previous studies examined corporate derivatives use by a dichotomous variable. Therefore, different types of

derivatives instruments could have a different effect on earnings volatility. Future studies might pursue this avenue of research.

The present study rejects the null hypothesis based on the findings from the regression models. The findings suggest that derivatives use by JSE-listed firms had no impact on smoothing earnings volatility. However, these findings do not indicate that JSE-listed firms are ineffective in managing risks. Based on previous research, corporate derivatives use in risk management is effective in hedging currency risk and interest rate risk.

Conclusion and recommendations

This study investigated a sample of 135 non-financial firms listed on the JSE from 2005 to 2021 to examine the effect of corporate derivatives use on earnings volatility. The study adopted a panel estimated generalised least squares method (period seemingly unrelated regression) and accounted for the presence of autocorrelation and homoskedasticity. The results of this study show that derivative use is positively associated with earnings volatility. The evidence derived from the regression model when derivatives use is measured by a dichotomous variable shows that derivatives use marginally affects earnings volatility. This appears to be contradictory to the theoretical prediction that derivatives use in risk management should lower earnings volatility. On the other hand, when derivatives use is measured by a continuous variable, the regression model showed a weak and non-linear relationship. This suggests that changes in derivatives use do not correspond to changes in earnings volatility. However, based on the results of both regressions, the null hypothesis is rejected, and derivatives use by JSE-listed firms do not decrease earnings volatility.

The results of this study contradict those of Barton (2001), Beneda (2013) and Paligorova and Staskow (2014), who found that the use of derivatives is associated with low earnings volatility from developed markets. However, the findings of this study corroborate those of Phua et al. (2021) who also examined firms from an emerging market. It is possible that there are systematic differences between developed markets and emerging markets, which could explain divergence in results. A further possible explanation for divergence in results could be linked to evidence presented by Correia et al. (2012) who cite that high cost of setting up derivatives programmes was one of the reasons that hinder the use of derivatives by JSE-listed firms.

This research contributes to the body of knowledge in a number of ways. First, previous research captured the use of derivatives by using a dichotomous variable, whereas this study used both a dichotomous and a continuous variable to capture the use of derivatives. Incorporating both approaches yields additional insights on the effects of corporate derivatives use on earnings volatility. Second, this study provides empirical evidence on the effects of corporate derivatives use on earnings volatility from an emerging market perspective, an area that has not received great attention. From a practical perspective, the findings of this study may aid management, investors, regulators, shareholders, boards of directors, professional bodies, and other related stakeholders in assessing how the use of derivatives by non-financial firms influences earnings volatility and ultimately firm value.

Limitations and suggestions for future research

The limitations encountered in this study are associated with the availability of data and the sample period. For instance, to capture the use of derivatives, this study relied only on the information that was available in the financial statements. The period covered in this study included the global financial crisis. The global financial crisis was a period of extreme stress in global financial markets and could have created volatility in variables used in this study.

Further research may examine the impact structural breaks or changes in accounting standards on derivatives and earnings volatility. Future research could also examine how periods of heightened volatility like the global financial crisis impact the use of derivatives. This study measured earnings volatility over a five-year period; therefore, future research could investigate measuring earnings volatility over a two-year period. This time span might provide a better match for derivatives use. Finally, other variables that could influence earnings volatility can be included in future regression models.

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Competing interests

The authors declare that they have no financial or personal relationships that may have inappropriately influenced them in writing this article.

Authors' contributions

J.R. and F.E.T. contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript. Both J.R. and F.E.T. contributed to developing the topic idea, the theory underlying the study, the computations of the data and the interpretations of the results.

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of Pretoria Faculty of Economic and Management Sciences (NO. EMS152/22).

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Data availability

The data supporting the findings of this study are available from the corresponding author, F.E.T., on request.

Disclaimer

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