The Underinvestment Problem and Corporate Derivative Use: Evidence from South African Listed Firms

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Abstract: Financial innovation, political and economic instability exposed South African firms to different risks which led to a gradual fall in the investment levels compared to other emerging economies. Derivatives were invented to manage risks, among other purposes, more than 90% of the world's largest firms continuously utilise derivatives to manage their risk. The underinvestment theory hypothesises that firms with more significant growth opportunities make greater use of derivatives and companies with amplified investment opportunities together with low cash stock levels use derivatives more. This study carefully examines the underinvestment problem as a determining factor of corporate hedging policy. The study employed Tobit regression models on a sample of 198 non-financial Johannesburg Stock Exchange-listed firms over the period 2009-2018. The study found evidence in support of the hypotheses that firms' make use of corporate derivatives as an attempt to reduce their exposure to possible underinvestment problems. The study determines the role of derivatives in alleviating the underinvestment problem crippling firms in the South African context.

Keywords: Underinvestment; hedging policy; Derivatives; Growth opportunities

JEL Classification: G11; G31; G32

1. Introduction

According to the assumption put forward by Modigliani and Miller (1958), in a world that is perfect, the use of corporate hedging strategies (such as the use of derivatives) is seen to be irrelevant because stakeholders protect themselves well in advance from the exposure of risk by holding well-diversified portfolios. However, this does not hold in today's business environment as companies have to expand and adjust to the increased risks occurring in today's business environment. A derivative could consist of an asset, index or interest rate (Schwegler, 2011). The utilisation of derivatives has numerous purposes such as insuring against price fluctuations, also known as hedging and having a higher exposure to price fluctuation for speculation. In South Africa, the two most used derivatives are divided into two classes of instruments, Options and Futures (Schwegler, 2011).

Contrary to the assumption by Modigliani and Miller (1958) regarding perfect capital markets, hedging philosophers proclaimed that under particular capital market imperfections, such as huge financial distress costs, the underinvestment problem, agency costs and tax convexity, the use of the

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optimal level of derivative instruments could be used to hedge financial risk and this will result in an intensification of the firms' value (Smith and Stulz1985). Many theories of hedging separate the elements of hedging usage into two hypotheses which are; the shareholders' wealth maximisation hypothesis which entails the use of hedging instruments to lessen cash flow volatility by reducing financial distress cost, the underinvestment problem, tax convexity and agency costs of debt (Smith and Stulz 1985;Froot,Scharfstein,Stein 1993). On the other hand, the second hypothesis is managerial risk aversion hypothesis which indicates that, in order to maintain equity value, managers engage in the use of hedging instruments for their own interests and this is also known as the agency theory.

The underinvestment theory, or the over-hang problem, was proposed by Myers (1977), who believed that debt financing could adversely affect the investment policy due to the agency problem between shareholders and creditors. It was argued that debt financing decreases the firm's incentives to invest in projects with a positive NPV because the benefits are received by creditors, whether it is partially or fully (Myers, 1977). The South African market has endured a gradual fall in the investment level compared to other economies mainly due to the issues of corruption and consequent regulatory intervention that have resulted to the situation in which the trade environment stays relatively restricted and government regulations remains inefficient (Larry, Jack, Ryan, Aftab, Erik, 2018).

The agency theory indicates that when both the principal and agent wish to maximise utility, a conflict of interest arises as there will be a misalignment of goals between the two parties (Hennessy and Whited, 2007). The battle of interest is generally resolved in the manager's favour due to the separation of management and control. This is a result of asymmetric information whereby management is advantaged with more details on the operation of the firm than owners and can exercise more freedom with regards to decision making and use of firm's resources (Bartram, Gregory and Fehle, 2009). This process results in underinvestment as shareholders forgo great investments opportunities as the agent benefits. The Modigliani and Miller theory states that the market value of a firm is solely dependent on the earning power and risk of the firm's underlying asset. However, in the modern world, the perfect world of Modigliani and Miller is violated by capital market imperfections which include bankruptcy costs, costly external financing and taxation (Hennessy and Whited, 2007). Bartram et al. (2009) notes South African firms suffer from bankruptcy, costly external funding, and he also concludes that these imperfections create a need for corporate risk management to mitigate their adverse effects. According to Gay and Nam (1998), derivatives are one of the risk management tools that can be used to minimise a firm's underinvestment problem. Their results support the hypothesis that firms' derivatives use is driven, partially, by the need to avoid possible underinvestment problems and a strategy to maximise shareholder value. Modigliani and Miller are a key and fundamental theory in explaining the importance of derivatives when firms are faced with the underinvestment problem.

According to Smith and Stulz (1985); Shapiro and Titman (1986), cash flow risk fluctuation may result in a position whereby a firm's available liquidity is not sufficient to cover all fixed payment obligation. However, financial risk management may decrease the likelihood of encountering such nature and thereby reducing the expected value of cost in relation to financial distress. Myers (1993) and Myers (1984), suggest that reducing the probability of financial distress can, in turn, increase the optimal debt-equity ratio and also the associated tax shield of debt. Additionally, Smith and Stulz (1985) showed that firms which face a convex tax reduce the risk of taxable income, thereby reducing the expected value of tax liabilities. These theories led the preceding researchers to believe that firms that face massive levels of leverage, a short period of debt maturity, low levels of interest coverage

and less liquidity are in favour of using derivatives to hedge financial risk (Bartram et al., 2009).

Gay and Nam (1998) developed a general framework to analyse the underinvestment problem, by employing Tobit estimation procedures they concluded that firm's corporate derivative use might partially be due to firms needs to avoid the possibility of underinvestment problems. Using panel data, Lin, Phillips and Smith (2008) estimated standard models -Probit for hedging decisions and Ordinary Least Squares (OLS) for investment and financing decisions and simultaneous equations framework where each decision was treated as endogenous. Their equilibrium model proposes that as companies become increasingly efficient at high-risk investments compared to low-risk investments, they tend to borrow less whilst investing more in high-risk assets, and as a result, hedge more intensely. A positive relationship between leverage and hedging is also predicted by the model. Froot et al. (1993) developed a general framework for the analysis of risk management policies used by firms. Froot, et al, found that hedging can be viewed as a value-enhancing tool in the presence of costly external financing. During such a time, an underinvestment problem may arise, especially when internally generated cash flows are low. Thus, firms may find it challenging to fund attractive investment opportunities. They, therefore, maintain that because external funds are generally costlier, a steady stream of internal cash flows scales down the underinvestment problem. Judge (2002), found that the costs associated with underinvestment are more significant for firms with more growth opportunities within their investment opportunity set. As firm's financial distress, caused by debt level and cash flow variability increases, so too does their incentive to overlook value increasing projects, as when firms approach bankruptcy, their financial distress levels increase and shareholders lose the incentive to contribute new capital, even in the case of positive NPV projects. Therefore, Judge (2002) found that firms with high levels of debt and where investment growth opportunities make up a significant amount of firm value are more likely to take on hedging programs seeing as these firms experience a more substantial reduction in agency costs.

Firms experiencing diminishing cash flows, usually would not have access to as many growth opportunities that require financing during low cash flow periods, and as a result, the firm would have less incentive to hedge. Conversely, firms experiencing higher cash flows, have access to more growth opportunities and would, therefore, need to protect themselves from exposure increasing the incentive to hedge (Fazzari et al., 1988). Even though various above mentioned empirical studies yield conflicting results about the relationship between derivative use and the underinvestment problem, such as those proposed by Froot et al. (1993) and Mian (1996), the theories explained provides the rewards for engaging in derivatives which are based on the rationale for hedging, this is indicated by management incentive, financial distress cost and taxes, underinvestment problem. The above theories are combined with positive beliefs and values of hedging.

The prime focus of this paper is based on the hypothesis that the use of corporate derivatives assists in alleviating the underinvestment problem. Hedging can alleviate the underinvestment problem by decreasing the volatility of cash flows and accommodate the risk aversion of undiversified managers as well as improve the effectiveness of managerial incentive structures through abolishing unsystematic risk (Gay and Nam, 1998), this paper explores these issues. The analysis used in this paper adds to prevailing studies by making use of advanced methods to capture investment opportunities, and by analysing the interaction between a firm's investment opportunities, cash stock and internally generated funds.

2. Data and the Variables

This analysis makes use of a panel of 198 Johannesburg Stock Exchange (JSE) listed non-financial firms for the past 2008 financial crisis period 2009 to 2018. Non-financial firms were used mainly because they engage less frequently in the use of derivatives for the purpose of trading and in terms of executing the dealer activities. The study focused on the post-financial crisis (2009) to avoid possible bias which may occur due to extreme economic conditions (Gay and Nam, 1998). Data were obtained from the Bloomberg online financial database. The dependent variable (Y*) was measured as the net value of derivatives. Tobin's Q was used to proxy for the firm's growth opportunities in investments, measured as the market value of the firm divided by the firm's replacement value (Lewellen and Badrinath, 1997). A dummy variable was used to different firms that have greater growth opportunities but low cash from those with small growth opportunities to explain which firms are expected to face the underinvestment problem. To formulate the dummy variable, cash stock was measured in terms of the ratio of cash and short-term investments to total assets (Gay and Nam, 1998). Firm's with cash stock level above the sample average was classified as a high cash stock firm. Conversely, firms with cash stock level below the average were classified as a low cash stock firm (Gay and Nam, 1998). The dummy variable (Dt) was given a value of one if the firm has lower than average cash stock together with above-average investment. The hedge decisions by firms are driven by many other aspects, the interest coverage ratio and (ICR) and the firm's debt to market value ratio (DEBT) were used as measures of financial distress. The hypothesis of financial distress suggests that firms with greater leverage and financial exposure are more likely to hedge against the possibility of financial distress. Formalised by Smith and Stulz (1985), the tax argument for risk management, holds that firms may hedge in response to tax function convexity. If the function that graphs income into tax liability displays convexity, then according to Jensen's Inequality, firms can reduce their expected tax liability by using hedging instruments to stabilise taxable income. To manage for hedging alternatives, the use of the ratio of preferred stock to market value (PREF) was used. The firm size (SIZE) was used as another control variable measured as the log of the total sum of the book value of the firm's debt and preferred stock plus the market value of the firm's equity. Nance et al. (1993), predicted that this variable could have either a positive or negative relationship with hedging activities. For example, size is linked to economies of scales which indicates that larger firms are likely to hedge more while on the other hand cost of financial distress are not relatively constant across various firms. Therefore it is known that bankruptcy costs are negatively related to size, which simply means small firms have a higher incentive to hedge. Managerial shareholdings (STOCK), was used to account for the manager's risk aversion. STOCK was measured as the log of the total market value of common shares which are beneficially owned by the directors and officers of an entity (Gay and Nam (1998)).

Model Specification

The study investigated the relationship between a firm's growth opportunities and derivative use by examining whether hedging is affected by Tobin's q. The study adopted a Tobit model used by Gay and Nam (1998) that tested the relationship between the utilisation of hedging and investment opportunities proxied by Tobin's q. *The model is specified as:*

$$Y^* = \alpha + \beta_0 * TQ + \sum_{i=1}^{n} \beta_i X_i \qquad eq\ 1$$

Where Y is the net value of a firm's derivative position; TQ is investment opportunities; X are control variables - tax, debt, interest coverage ratio, preference shares, firm size and stock which affects the*

net value of a firm's derivative position. β_0, β_i, α *are parameters of the model to be estimated.*

To investigate the influence of internally generated cash flow on firm's derivatives use, the study examined whether firms with increased investment opportunities together with low cash stock utilise derivatives more. A dummy variable (D) was added to the model, which splits the sample into two sets, firms with increased investment opportunities together with low cash stock and the secondly, firms with an increased investment opportunity and high cash stock. The dummy variable takes a value of one for firms with lower than average cash stock together with above-average investment opportunities and zero for more significant than average cash stock.

$$Y^* = \alpha + \beta_0 * TQ + \beta_1 D_1 + \beta_2 D_1 TQ + \sum_{i=1}^{n} \beta_i X_i \qquad eq\ 2$$

β_1 is the effect that the dummy variable has on the net value on a firm's derivative position, D_1 is the dummy variable, β_2 is the effect that firms with increased investment opportunity together with low/high cash stock have on the net value of a firm's derivative position, $D_1(TQ)$ is equal to 0 for high cash stock firms and 1 for low cash stock firms.

Model Estimation Techniques

The occurrence of censored or truncated variables takes place when the observable range of values of the dependent variable are somewhat limited (Brooks, 2014). The data on Figure 1 shows that there are many observations on the dependent variable which are on the zero line, therefore using the Ordinary Least Square technique may produce a biased and inconsistent estimation of the parameters (Brooks, 2014). Thus, the study employed the Tobit regression model. The Tobit model allows for the truncated nature of the dependent variable (Brooks, 2014). A similar regression was used by Gay and Nam (1998) to test the relationship between the underinvestment problem and derivative utilisation.

For an N observation data set, with standard normal cumulative distribution function (Φ)*; standard normal probability density function* (φ) *the general log-likelihood function of the Tobit model stated as:*

$$\log \mathcal{L}\,(\beta, \sigma) = \sum_{j=1}^{n} I(y_j)\, log\left(\frac{1}{\sigma}\varphi\left(\frac{y_j - X_j\beta}{\sigma}\right)\right) + (1 - I(y_j))log\left(1 - \Phi\left(\frac{X_j\beta - y_l}{\sigma}\right)\right) \qquad eq\ 3$$

$$Y_i = Y_i^* \qquad \text{for } Y_i^* > 0$$

$$Y_i = 0 \qquad \text{for } Y_i^* \leq 0$$

Y_i^* *refers to the true observable net value of a firm's derivative position (Dependent variable) and this will be observable only for the net worth of a firm's derivative position that is greater than zero.*

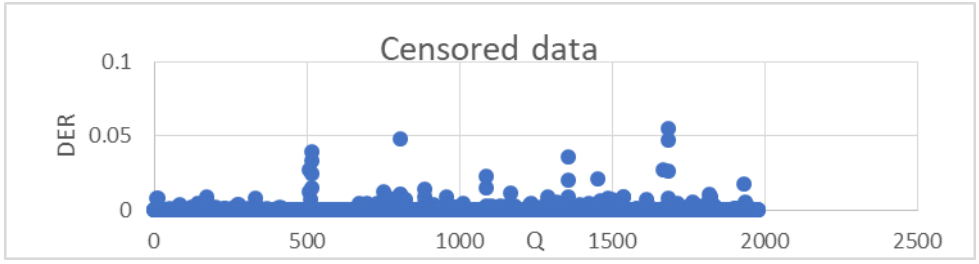

Figure 1. Censored Data
Source: Own Elaboration Based on Sample Data

3. Empirical Results

Table 1 depicts summary statistics concerning users and non-users of the derivatives. The t-statistic test was based on the equality of means among the derivative-users and non-users of derivatives.

Table 1. Financial Characteristics of Derivative-Users and Non-Users of Derivative

Variables	Hedgers Mean	Hedgers Std.dev.	Non-Hedgers Mean	Non-hedgers Std.dev	T-statistic	P-value
Q	18200	31806	14059	35326	-20024	0,0454
Debt	0,3959	10209	0,2535	11003	-23706	0,0179
ICR	573777	2836660	130773	348018	20210	0,0435
Tax	0,5520	66410	0,1598	11379	-1,0276***	0,3043
Pref	48935	590919	0,0810	0,7451	1,5915***	0,1118
Size	46836	12162	37704	10477	115445	0,0000
Stock	0,1287	1.5776	0,2751	11955	-30380	0,0000

Source: Own Elaboration Based on Sample Data

Froot (1993) indicated that firms which have higher growth levels or investment opportunities should have a higher rate of underinvestment problem and therefore should use derivatives more. From the univariate analysis results in Table 1, it can be seen that Tobin's q mean is higher for hedgers (1,8200) than non-hedgers (1, 4059), providing evidence that firms with more top investment opportunities will hedge more since they suffer more from the underinvestment problem. The results are consistent with, Gay and Nam (1998) and Talat and Atia (2011) who had conducted a similar study on 105 non-financial firms in the Karachi stock exchange. The mean value of the tax variable by hedgers 0,5520 is greater non-hedgers 0,1598 indicating that derivative-users should engage in higher tax loss carryforwards (TAX) compared to non-users of derivative (Heitzman and Lester, 2018). In testing for the equality of means between hedgers and non-hedgers, Table 1 indicates that the variable TAX is statistically insignificant, this is in line with the tax argument put forward since this shows that a difference of mean exists between hedgers and non-hedgers. Gay and Nam (1998) found two variables to be statistically significant, namely TAX, PREF looking at the relationship between USA firms engaging in hedging and a set of growth and control variables. Similarly, Talat and Atia had found the difference in the tax variable between hedgers and non-hedgers. Contrary to the findings of Gay and Nam (1998), Talat and Atia (2011) found the t statistic insignificant in testing for the difference of means in the SHARE and DEBT variable.

Tests of Hypothesis 1. The Use of Derivatives and Investment Opportunities

The first hypothesis states that firms with more significant investment opportunities will hedge more.

Table 2 shows that the growth variable Tobin's q is statistically significant, implying that the use of derivatives is affected by the firm's investment opportunities. The sign of Tobin's q is positive, and this adheres to the expectations that the higher the value of Tobin's q, the more firms will utilise derivatives. The results support the underinvestment theories by Bessembinder (1991) and Froot et al. (1993) that argues that firms with higher growth opportunities should hedge more because of capital market imperfections. Provided that these capital market imperfections exist in the market, hedging allows firms to reduce their debt obligations so that they can reap the benefits from potential investment opportunities that shareholders seek without the payoff of these benefits been offset by debt obligations (Pyeman, Zakaria and Idris , 2019). The results are consistent with Gay and Nam (1998). They also found a positive relationship between Tobin's q and utilisation of derivatives for

486 non-financial firms in the United States of America. All the control variables are statistically significant, except TAX and ICR. DEBT, PREF and SIZE, STOCK have the expected signs and adheres to the different theory predictions. The stock sign is counter to the negative projection of Smith and Stulz (1985). However, this is because certain features of stock options granted to corporate managers tend to make the payoff of these options similar to the expected payoff from common stock (Gay and Nam, 1998). The negative relationship between STOCK and extent of derivative usage explains that higher managerial ownership firms like to employ selective hedging in situations where benefits acquired from hedging exceed costs of risk management to enhance their equity.

Table 2. Tobit Model Estimates for Determinants of Corporate derivative use

Variable	Coefficient	Std. Error	Prob
C	0,0241	0,0029	0,0000
Q	0,0013	0,0005	0,0120
DEBT	0,0016	0,0005	0,0033
ICR	-0,0000	0,0000	0,1217
TAX	-0,0017	0,0012	0,1616
PREF	-0,0001	0,0000	0,0002
SIZE	0,0032	0,0006	0,0000
STOCK	-0,0015	0,0005	0,0012

Source: Own Elaboration Based on Sample Data

There is a positive relationship between debt and hedging and a negative correlation between ICR and hedging since the financial distress theory predicts that firms with higher leverage, shorter debt maturity and lower interest coverage will utilise derivatives more. Talat and Atia (2011) and Gay and Nam found debt and stock to be significant in affecting hedging by looking at US firms. As discussed in Nance, Smith, and Smithson (1993), alternative arguments predict either a positive or negative relationship between firm size and hedging. Consistent with Batram et al. (2009), the results presented in Table 2 shows size to be positively related to hedging.

Hypothesis 2. Interaction Between Cash and Investment Opportunities

Table 3. Comparisons of Derivative Use: High-Growth, Low-Cash and High cash firms

Tobin's q (Value>1)	Mean(Y)	Std. dev.(Y)	Number of users
Low cash firms	0.001369	0.0041	120
High cash firms	0.001364	0.0052	95
t-statistic(P-value)	(0,0118) 0,9906		

Source: Own Elaboration Based on Sample Data

Table 3 provides evidence that the number of derivative users is more significant for low cash firms (120) than high cash firms (95). The equality of the mean test was proven to be insignificant at all levels. This suggests that there is a difference in the net value of derivatives between high growth firms coupled with low cash and high growth coupled with high cash. This finding does provide empirical evidence based on south African firms on the predictions put forward by Froot et al. (1993) which states that a relationship exists between hedging, cash flow and firm value. According to Froot et al. (1993), for a firm with significant growth opportunities, the underinvestment problem becomes most important when it has low cash availability. The reason for this is that firms find external financing sufficiently expensive in that they must decrease investment spending during times when internally generated cash flows are not sufficient to finance growth opportunities (Froot, Scharfstein and Stein, 1993).

Hypothesis two states that firms with enhanced investment opportunities concurrently with low cash

stock will utilise derivatives more than firms with high cash stock. In testing this hypothesis, the interaction of the dummy variable D1 and D*Q was used to show the interactive effects of firm value and cash flow. Table 4 provides the Tobit results for equation 2, Tobin's q was found to be statistically significant. Consistent with Gay and Nam (1998), the interactive dummy variable D_1*Q was also found to be statistically significant. This finding implies that firms with high-growth opportunities and low cash stock have a higher level of sensitivity between derivatives use and growth opportunities. This is because firms with low cash stock and high growth opportunities find external financing more expensive due to the limited cash flow available and would underinvest in positive NPV projects. In order to reduce the underinvestment problems, these firms will hedge more. The results of the interactive dummy variables (Di*Q) support the predictions of Froot et al., (1993).

Table 4. The Interactive Influence of Cash and Investment Opportunities on Corporate Derivatives use

Variable	Coefficient	Std. Error	Prob.
C	0,0164	0,0025	0,0000
Q	0,0013	0,0005	0,0046
DEBT	0,0009	0,0005	0,0444
ICR	-0,0000	0,0000	0,3487
TAX	-0,0010	0,0011	0,3403
PREF	-0,0001	0,0000	0,0489
SIZE	0,0010	0,0006	0,0692
Share	-0,0008	0,0004	0,0587
Dummy	0,0130	0,0010	0,0000
Dummy*Q	0.0076	0,0006	0,0000

Source: Own Elaboration Based on Sample Data

The results support the hypothesis that firms with enhanced investment opportunities, together with low cash stock will tend to use derivatives more frequently. This, therefore, provides evidence that firms who suffer from the underinvestment problem are more characterised by tremendous investment opportunities/growth opportunities together with low cash stock will utilise derivatives more.

An essential limitation of the Tobit model is that it is much more affected by non-normality than the standard regression models (Brooks, 2014). The test of the restrictions of the Tobit model assumes normality which is questionable. If the disturbance terms are not normally distributed, this may lead to inconsistent results. One approach to this problem is to use alternative distributions (Greene,2002). The estimated Tobit parameters were found robust to alternative distribution assumptions tested using the different distributions such as the logistic and extreme value distribution.

Conclusion

South Africa, of all the African countries, is known to have the most active and well- operated derivatives market. The percentage of companies using derivatives is increasing as noted in the sample over the ten years, indicating that hedging is a standard risk management tool amongst South African companies. This paper investigates corporate derivatives use by carefully examining the underinvestment hypothesis. The study evaluates explicitly the connection amongst the firm's investment opportunities, internally generated funds, cash stock and hedging behaviour. The study employed a Tobit model for a sample non-financial JSE listed firms and found evidence of a positive association between a firm's investment opportunities and derivative use. The study examined the relationship between firms' cash stock levels and their investment opportunities. The main finding is that firms with enhanced growth opportunities utilise derivatives more during periods of low cash

stock. The results are in support of the hypothesis that the use of corporate derivatives is, to some extent, driven by the need to alleviate possible underinvestment problems in South Africa. The results of this paper demonstrate that firms can and do utilise derivatives as a value-enhancing strategy.

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