A Review of the Rationales for Corporate Risk Management: Fashion or the Need?

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Abstract

This paper presents the extensive literature survey based both on theoretical rationales for hedging as well as the empirical evidence that support the implications of the theory regarding the arguments for the corporate risk management relevance and its influence on the company's value. The survey of literature presented in this paper has revealed that there are two chief classes of rationales for corporate decision to hedge - maximisation of shareholder value or maximisation of managers' private utility. The paper concludes that, the total benefit of hedging is the combination of all these motives and, if the costs of using corporate risk management instruments are less than the benefits provided via the avenues mentioned in this paper, or any other benefit perceived by the market, then risk management is a shareholder-value enhancing activity.

1. Introduction

Financial or corporate risks - the risks to a corporation stemming from price fluctuations - are pervasive, and directly or indirectly influence the value of a company. A combination of greater deregulation, international competition, interest rates and foreign exchange rate volatility, together with commodity price discontinuities starting in the late 1960s, heightened corporate concerns, which have resulted in the increased importance of financial risk management in the decades that followed (Allen and Santomero, 1998). It should be noted that, before derivatives markets were truly developed, the means for dealing with corporate risks were few, and thus financial risks were largely outside managerial control. Firms resorted to operational alternatives like establishing plants abroad to minimise exchange-rate risks, or to natural hedging by trying to match the currency structure of their assets and liabilities (Santomero, 1995). During the 1980s and 1990s, markets for derivative instruments have developed and grown at a breathtaking pace, and many corporations have become active participants in derivatives markets. Since then, the range and quality of both exchange-traded and OTC derivatives, together with the depth of the market for such instruments, have expanded intensively (Allen and Santomero, 1998). With the development of the derivatives market, active risk management has become an important part of modern corporate strategy, as can be seen from the fact that financial executives in companies all around the world have ranked risk management as one of their most important objectives (Bartram, 2000).

However, for a long time it was believed that corporate risk management is irrelevant to the value of the firm and the arguments in favour of the irrelevance were based on the Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965; Mossin, 1966) and the Modigliani-Miller theorem (Modigliani and Miller, 1958). One of the most important implications of CAPM is that diversified shareholders should care only about the systematic component of total risk. On the surface it would appear that this implies that managers of firms who are acting in the best interests of shareholders should be indifferent about hedging of risks that are unsystematic. Miller and Modigliani's proposition supports CAPM findings. The conditions underlying MM propositions also imply that decisions to hedge corporate exposures to interest rates, exchange rates and commodity prices are

completely irrelevant because stockholders already protect themselves against such risks by holding well-diversified portfolios.

However, it is apparent that managers are constantly engaged in hedging activities that are directed at the reduction of unsystematic risk. In the real world, financial managers and treasurers give a great deal of thought to matters of capital structure and securities design. Additionally, the corporate use of derivatives in hedging interest rate, currency, and commodity price risks is widespread and growing. As an explanation for this clash between theory and practice, imperfections in the capital market are used to argue for the relevance of corporate risk management function. Scholars have constructed two classes of explanations or determinants for management concern with hedging of non-systematic risk. The first class of explanations focuses on risk management as a mean to maximise shareholder value, and the second focuses on risk management as a mean to maximise managers' private utility. This paper presents and discusses the theories related to these arguments and their empirical implications.

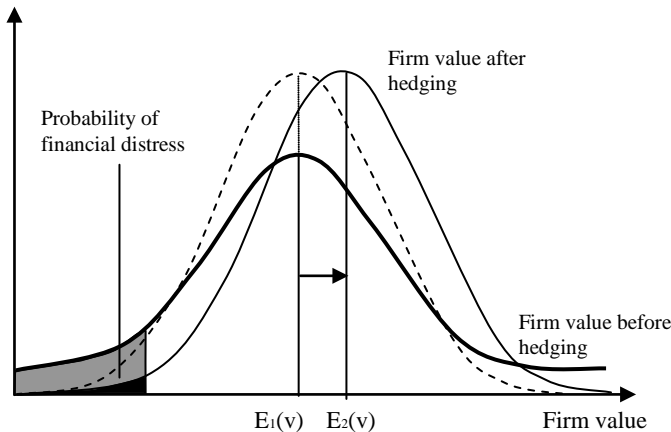## 2. Shareholder Maximisation Hypothesis

2.1 Cost of Financial Distress

One of the possible explanations for managers' choices of risk management activities on behalf of their firms is based on the fact that non-systematic risk does affect the probability that a firm will go bankrupt or experience financial distress. If financial distress generates real costs for the firm as a whole, then shareholders will be interested in hedging this risk (Campbell and Kracaw, 1987). Additionally, the cost of financial distress is one of the reasons why firm performance and market value might be directly associated with volatility (Mayers and Smith, 1982; Stulz, 1984; Smith and Stulz, 1985; Shapiro and Titman, 1998; Haushalter 2000). In the MM world, financial distress is assumed to be costless. Hence, altering the probability of financial distress does not affect firm value. If financial distress is costly, firms have incentives to reduce its probability, and hedging is one method by which a firm can reduce the volatility of its earnings. Costs of financial distress include the legal and administrative costs of bankruptcy, as well as the agency, moral hazard, monitoring and

contracting costs which can erode firm value even if formal default is avoided (Myers, 1984). By reducing the variance of a firm's cash flows or accounting profits, hedging decreases the probability, and thus the expected costs, of financial distress.

The literature is filled with such stories. The classic paper by Warner (1977) was the first to present empirical evidence of the bankruptcy cost, but some other studies, such as Weiss (1990), have continued to reinforce its importance. Smith and Stulz (1985) used the same argument to justify a desire for reduced volatility. The authors were on the firm ground, as there is ample evidence that financial distress leads to substantially increased costs associated with bankruptcy proceedings, legal costs, and perhaps most importantly, the diversion of management attention from creating real economic value.

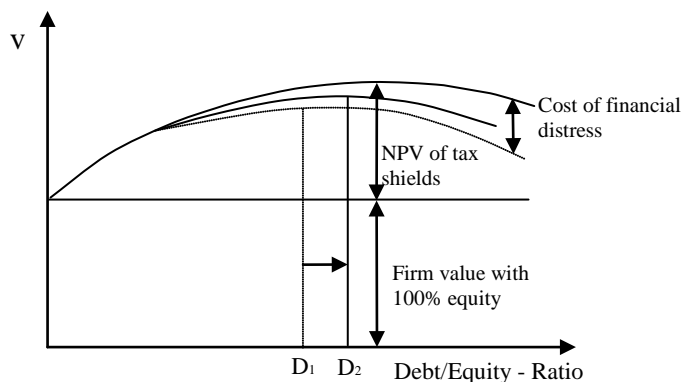*Graph 1.* **Hedging and the cost of financial distress**

Source: Bartram, 2000

While the reduction of financial distress costs increases firm value, it augments shareholder value even further by simultaneously raising the firm's potential to carry debt. It is known that corporate debt creates a fixed cost that can be used as a competitive weapon (e.g. see Brander and Lewis, 1986; Maksimovic, 1988). This follows from the fact that interest payments of debt are made out of pre-tax income creating a tax shield of debt financing. As shown in graph 2, corporate risk management lowers the cost of financial distress, which leads to a higher

optimal debt ratio (or lower financing costs), and the tax shields of the additional debt capital further increases the value of the firm. However, shareholders must account for hedging costs when they decide among alternative hedging strategies (Smith and Stulz, 1985).

Graph 2. Hedging and the cost of financial distress

Source: Bartram, 2000

Dobson and Soenen (1993) have argued that foreign exchange hedging will lower the probability of corporate bankruptcy. By extending the longevity of corporations, hedging will tend to ameliorate the moral-hazard-agency-problem. Moral hazard arises from conflicts of interest among corporate stakeholders, for example management and debtholders. By reducing the probability of bankruptcy and thereby increasing the perceived duration of contractual relations between stakeholders, foreign exchange hedging increases the power of reputation to enforce contracts. They have also proven that when a firm undertakes international capital projects, uncertainty exists concerning the domestic currency value of the future cash flows from these projects. Foreign exchange hedging reduces this uncertainty by smoothing the future cash flow stream. Although this uncertainty is largely unsystematic, it does not just impact firm risk. It also impacts directly firm value. If projects are financed by debt, then the smoothing of the cash flow stream tends to lower the firm's cost of debt.

Bessembinder's (1991) model focuses on simple debt contracts and the senior claim, but the analysis can be extended to any obligation with higher legal

priority than equity. He has shown that hedging increases value by improving contracting terms. The hedging instrument specifically evaluated in his study is a forward contract, but the analysis also applies to other financial contracts, such as options and swaps, which alter the cash flow distribution such that there is a reduced likelihood of small cash flow realisations. Hedges provide net cash inflows in those states where the firm's cash flows are low, bonding its ability to meet commitments in additional states. Bessembinder's (1991) has proven that hedging can secure value-increasing changes in contracting terms with creditors, customers, employees, and suppliers if the contracts with these parties have initially positive Net Present Value (NPV).

When exploring corporate hedging behaviour, scholars are particularly interested in the relationship between hedging and leverage, since theoretical considerations suggest that both affect expected costs of financial distress and agency costs. Greater leverage exacerbates those costs, but greater hedging ameliorates them, suggesting a positive linkage. Dolde (1995) has controlled for financial risks differences by conducting a survey of Fortune 500 firms in 1992 and presents statistically significant evidence that leverage and hedging are positively related. He also constructed a direct measure of expected costs of financial distress and found some evidence that hedging measures interact with and mitigate the effects of leverage.

Haushalter (2000) has found that the use of commodity derivatives is to be related to the reduction of expected bankruptcy costs, which should increase firm value. He examined the hedging activities of oil and gas producers and has documented a wide variation in hedging policies among analysed companies. The tests conducted have found that this variation is associated with several differences in the firms' characteristics. Among oil and gas producers that hedge, the extent of hedging is related to proxies for financing costs. Conditional on a company hedging, the fraction of production hedged is increasing in the debt ratio, is greater for companies that pay out a smaller fraction of income in dividends, and is less for those that do have a debt rating. This finding is consistent with theories of the transaction cost of financial distress.

Mian (1996) has investigated all three types (commodity, interest rate, or currency) of hedging activities for a sample of 3,022 firms. He has found no

significant difference in leverage between hedgers and nonhedgers. Examination of type of a risk hedged yields results that are different to the two-way classification (hedgers vs. nonhedgers). The evidence indicates that interest-rate hedgers have higher leverage and longer term debt as compared to nonhedgers of interest-rate risk. In contrast, currency-price hedgers have lower leverage and shorter term debt as compared to nonhedgers of currency-price risk. Leverage is positively correlated with interest-rate hedging and negatively correlated with currency-price hedging. Mian's (1996) evidence has shown that lumping interest-rate hedging and currency-price hedging into one broad category essentially "averages out" the negative correlation between leverage and currency-price hedging, and the positive correlation between leverage and interest-rate hedging.

It could be concluded that the link between hedging and financial leverage supports the notion that hedging can reduce financing costs and it is also consistent with the predictions of Stulz (1996) who has argued that corporate hedging can be viewed as a technique that allows managers to substitute debt for equity. If financial distress is costly and if there is an advantage to having debt in the capital structure, hedging may be used as a means to increase debt capacity. As a result, a company's risk management policy should be made jointly with its financing policy. If hedging and financing policies are made jointly, evidence on literature survey presented in this paper indicates that studies of corporate financing decisions need to consider corporate hedging policies as well. In particular, a company facing relatively high costs of financing that hedges, may choose the same capital structure as a firm with lower costs of financing that does not hedge. Without controlling for hedging, the relation between capital structure and the determinants of the costs of financing will be missed.

2.2 The Agency Cost of Debt

Besides being in a position to know more about the firm's prospects than investors, management also sometimes has the power to take actions that transfer value from bondholders to shareholders. The first agency conflict considered is usually referred to as the underinvestment problem. Jensen and Smith (1985)

have argued that when a substantial portion of the value of the firm is composed of future investment opportunities, a firm with outstanding risky bonds can have incentives to reject positive net present value projects if the benefit from accepting the project accrues to the bondholders. In this example, the manager of a levered firm has an incentive to limit the scale of investment because the additional returns from further investment accrue primarily to bondholders.

The second agency conflict considered is usually referred to as the asset substitution problem, also known as the risk shifting problem, which encountered by the corporation in selecting among mutually exclusive investment projects. Jensen and Smith (1985) have observed that the value of the stockholders' equity rises and the value of the bondholders' claim is reduced when the firm substitutes high risk for low risk projects. Once a corporation has obtained debt financing, it is well known that by switching from a relatively safe investment project to a riskier one, the corporation can increase the value of its equity at the expense of its bondholders. This phenomenon can be explained by the fact that the residual claims of shareholders can be interpreted as a call option on the assets of the firm (e.g., see Black and Scholes, 1973). The value of the option will increase as the underlying assets' volatility increases. Thus management – acting in the interests of shareholders – will tend to prefer capital projects with volatile cash flow streams.

Jensen and Meckling (1976), Myers (1977) and Smith and Warner (1979) have indicated that actions available to the firm after bonds are sold can reduce the value of the bonds. Unless protected against these forms of managerial opportunism, creditors can be expected to reduce the price they are willing to pay for the bonds. This reduction in price (or increase in required yield), necessary to compensate creditors for managerial opportunism and combined with the costs of writing and enforcing covenants, are collectively described by economists as the "agency costs of debt". Some of these actions are prevented by provisions in debt covenants (Mayers and Smith, 1982; 1987). But it should be noted that debt covenants could be welfare reducing as they limit the degrees of freedom of management and possibly obstruct the realisation of profitable, yet risky investment alternatives.

According to Dobson and Soenen (1993), there are three sound reasons based on agency costs why management should hedge corporate risk. First, hedging reduces uncertainty by smoothing the cash flow stream thereby lowering the firm's cost of debt. Since the agency cost is borne by management, assuming informational asymmetry between management and bondholders, hedging will increase the value of the firm. Therefore, management will rationally choose to hedge. Second, given the existence of debt financing, cash flow smoothing through exchange risk hedging will tend to reduce the risk-shifting agency problem. Finally, hedging reduces the probability of financial distress and thereby increases duration of contractual relations between shareholders. By fostering corporate reputation acquisition, hedging contributes directly to the amelioration of the moral-hazard agency problem.

MacMinn and Han (1990) have argued that, by smoothing cash flows, hedging will tend to ameliorate the risk-shifting agency problem. Thus, the existing claimholders of the firm are motivated to include provisions in the debt contract limiting the opportunities to transfer wealth from the bondholders. Debt indentures frequently contain covenants requiring the firm to maintain certain types of hedging activity. Mayers and Smith (1982) analysis suggests that these provisions reduce the incentive of the firm's other claimholders to accept certain risk-increasing negative net present value projects after the sale of the bond issue. Since potential wealth transfers from bondholders to the firm's other claimholders are increased the larger the fixed claims in the capital structure, they have argued that the probability of inclusion of hedging covenants will increase with the firm's debt/equity ratio.

The nature of the firm's investment opportunity set affects the conflict between the firm's fixed and residual claimholders. Myers (1977) has shown that issuance of claims with higher priority than equity (senior claims) creates incentives for the firm's equity holders to ''underinvest''. A profitable project may be rejected by management if the expected payoff is sufficient to cover the cost of debt only, thus leaving no residual cash flow for shareholders. Hedging mitigates this problem by decreasing the number of states in which the firm would default on bond payments. Corporate risk management represents a means to eliminate or alleviate conflict of interests between debt holders and

stockholders, and the associated welfare loss resulting from non-realised value-increasing investments by reducing the volatility of firm value.

Bessembinder (1991) has shown that corporate hedging reduces incentives to underinvest, effectively bonding the firm's equity holders to undertake additional positive NPV investment. He has argued that the hedge shifts individual future states from default to nondefault outcomes, increasing the number of future states in which equity holders are the residual claimants. As a result, the sensitivity of senior claim value to incremental investment is reduced. Bessembinder (1991) also noted that the hedge results in equity holders receiving a larger proportion of the incremental benefits from new projects, which increases their willingness to provide funds for additional capital investment, as well as it increases their value due to avoided agency costs.

Minton and Schrand (1999) have also documented that companies with more cash flow variation have lower levels of investment and higher costs associated with external capital. They conclude that cash flow volatility can lead companies to underinvest. Haushalter, Randall and Lie (2002) have argued that equity values reflect this potential underinvestment. Their empirical tests have shown that the sensitivity of an oil producer's value to changes in oil price uncertainty is related to proxies for the likelihood that the producer will encounter costly market imperfections, such as financial distress and underinvestment. They conclude that by reducing the expected costs from these market imperfections, corporate risk management can increase shareholder value. MacMinn (1987) has shown that an appropriately selected insurance portfolio will increase the safety of debt and allow stockholders to capture all the additional returns from further investment. The model has shown that the corporation has an incentive to purchase insurance because it may eliminate or reduce the bankruptcy and/or agency costs.

2.3 Capital Market Imperfections and Costly External Financing

Smith and Stulz (1985) have demonstrated how the reduction in expected bankruptcy cost (due to a lower probability of entering bankruptcy) can increase the firm's value, *ceteris paribus.* In addition, the lower probability of financial distress can help the firm make sales or invest in future profitable projects which

would have otherwise been lost. Cash flow is crucial to the investment process, and the investment process is a key factor for a corporate value creation. Cash flow can often be disrupted by movements in external factors such as exchange rates, commodity prices and interest rates, potentially compromising a company's ability to invest.

This theory examines the role of capital market imperfections in determining the demand for corporate hedging. The main hypothesis is that, if access to external financing (debt and/or equity) is costly, firms with investment projects requiring funding will hedge their cash flows to avoid a shortfall in their funds, which could precipitate a costly visit to the capital markets. An interesting empirical insight based on this rationale is that firms which have substantial growth opportunities and face high costs when raising funds under financial distress will have an incentive to hedge more of their exposure than the average firm. This rationale has been explored by numerous scholars, among others by Stulz (1990), Lessard (1990), Shapiro and Titman (1998), Froot, Scharfstein and Stein (1993), Getzy, Minton and Schrand (1997) and Haushalter, Randall and Lie (2002).

Froot, Scharfstein and Stein (1993) have accepted the basic paradigm of the financial distress model, but they rationalised the cost of bad outcomes by reference to Myers (1977) debt overhang argument. In their model, external financing is more costly than internally generated funds due to numerous capital market imperfections (see Myers and Majluf, 1984). These may include discrete transaction costs to obtain external financing, imperfect information as to the riskiness of the investment opportunities present in the firm, or the high cost of the potential future bankruptcy state. At the same time, the firm has an investment opportunity set which can be ordered in terms of net present value. The existence of the cost imperfections results in underinvestment in some states, where internally generated funds fall short of the amount of new investment that would be profitable in the absence of these capital market imperfections.

Stated in another way, the volatility of profitability causes the firm to seek external financing to exploit investment opportunities when profits are low. The cost of such external finance is higher than the internal funds due to the market's higher cost structure associated with the factors enumerated above. This

reduces optimal investment and the cost of volatility in such a model is the forgone investment in each period that the firm is forced to seek external funds. Recognising this outcome, the firm embarks upon volatility reducing strategies, which have the effect of reducing the variability of earnings. Hence, risk management is optimal in that it allows the firm to obtain the highest expected shareholder value. All else equal, the more difficulty a company has in obtaining outside financing, the more costly a shortfall in cash flow will be and the greater is the value hedging provides. Froot, Scharfstein and Stein (1993) have supported this theory with reference to evidence offered by Hoshi, Kashyap and Scharfstein (1991) which presented evidence that internal cash flow is, in fact, correlated to corporate investment.

Haushalter, Randall and Lie (2002) have conducted empirical tests of the theory that shareholders of financially constrained firms can benefit from corporate risk management. Their analysis of 68 oil producers for the period 1992 to 1994 has shown that the point at which a company encounters a cash shortfall varies across firms according to firm-specific characteristics. For many firms, in particular those with stable cash flows, minimal financial obligations, and therefore significant financial flexibility, the expected costs of underinvestment and financial distress are trivial. However, firms with higher levels of financial leverage, and therefore decreased financial flexibility, face a greater likelihood of encountering the costs of market imperfections. Overall, their findings indicate that capital markets incorporate the anticipated costs from cash flow variability into stock prices. These findings also support Smith and Stulz (1985), Froot, Scharfstein and Stein (1993) and Mello and Parsons (2000), who suggested that the benefits that shareholders realise from reducing cash flow variability by managing risks are associated with the likelihood that the firm will encounter underinvestment or bankruptcy.

Haushalter, Randall and Lie (2002) results complement and extend the findings of other corporate risk management studies. Specifically, Geczy, Minton and Schrand (1997), Graham and Rogers (1999) and Haushalter (2000) show that companies that are more likely to face market imperfections manage risks more extensively. Haushalter, Randall and Lie (2002) results indicate that these are the types of companies that can realise the greatest benefits from

reducing cash flow uncertainty. Therefore, in a broad sense, observed risk management policies are consistent with shareholder value maximisation.

Getzy, Minton and Schrand (1997) conducted a research on the 372 of the Fortune 500 nonfinancial firms in 1990, and proven the hypothesis that hedging is used to reduce variability in the level of investments. They have found that firms with greater growth opportunities and tighter financial constraints (low accessibility to external financing) are more likely to use currency derivatives. This result is consistent with the notion that firms use derivatives to reduce the variation in cash flows or earnings that might otherwise preclude firms from investing in valuable growth opportunities. This result was confirmed by Allayannis and Ofek (2001) as well. Their study has proven that, similar to Getzy, Minton and Schrand (1997)**,** firms with larger R&D expenditures are more likely to use currency derivatives.

A study by Gay and Nam (1998) has also provided strong support for the hypothesis that corporate hedging activity is carried out to minimise the underinvestment problem. Gay and Nam (1998) have found that firms with enhanced investment opportunity sets increase their use of derivatives as their levels of internally generated cash decline. They have shown that when internally generated cash flows are positively correlated with investment opportunities, firms use fewer derivatives. Gay and Nam (1998) results clearly support the shareholder value maximisation hypothesis. These results indicate that firms act in a manner consistent with the predictions of Froot, Scharfstein and Stein (1993) – minimising the underinvestment problem.

Risk managers spend much of their time examining the factors that cause cash flows to fluctuate. This is important work, since low cash flows may throw budgets into disarray, distract managers from productive work, defer capital expenditure or delay debt repayments. By avoiding these deadweight losses, risk managers can rightly claim they add to shareholder value. Consistent with this claim that cash flow volatility is costly, Minton and Schrand (1999) have documented that cash flow volatility is associated both with lower investment and with higher costs of accessing external capital. They have shown that higher cash flow volatility is associated with lower average levels of investment in capital expenditures, R&D, and advertising. This association suggests that firms

do not use external capital markets to fully cover cash flow shortfalls, but rather permanently forgo investment. Fazzari, Hubbard and Petersen (1988), Hoshi, Kashyap and Scharfstein (1991), Kaplan and Zingales (1997) and Lamont (1997) all found a negative relation between annual investment levels and liquidity, but could not distinguish whether firms with volatile cash flows time their investment decisions to match internal cash flow realisations or actually decrease their overall level of investment. In contrast to them, Minton and Schrand (1999) findings have revealed a negative relation between volatility, measured over a period, and the average level of investment measured over the same period, suggesting that firms that experience shortfalls ultimately forgo investment.

Another perspective related to Froot, Scharfstein and Stein (1993) pertains to the Myers and Majluf (1984) "pecking order" concept of financing. Hedging, by its ability to decrease the variability of cash flow, enables the firm to reduce the number of states of nature where it must obtain external financing (and thus hedging can help avoid sending a potentially negative signal to external investors). It is also important to note that although firms facing binding financial constraints can benefit from hedging, reducing firms' dependence on the capital markets, does not automatically translate to an increase in shareholder wealth. In fact, Tufano (1998) points out that hedging can lead to overinvestment. If hedging enables managers to take on projects without facing scrutiny from the capital markets, it can enable managers to finance projects that benefit managers but reduce shareholders' wealth. So although firms facing financial constraints hedge more extensively, this relation does not imply that hedging increases shareholder value.

2.4 Taxes

Smith and Stulz (1985) have argued that the structure of the tax code can make it beneficial for the firms to take positions in futures, forward, or option markets. If a firm's effective tax function is linear (the firm faces a constant effective marginal tax rate), the firm's expected tax liability is unaffected by the volatility of taxable income. But if effective marginal corporate tax rates are an increasing function of the corporation's pre-tax value, or stated differently, if a firm faces a convex tax function, then the after-tax value of the firm is a concave function of

its pre-tax value. If hedging reduces the variability of pre-tax firm values, then the expected tax liability is reduced and the expected post-tax value of the firm is increased, as long as the cost of the hedge is not too large. By reducing the effective long run average tax rate, activities which reduce the volatility in reported earnings will enhance shareholder value. More convex the effective tax schedule is, the greater is the reduction in expected taxes. Froot, Scharfstein and Stein (1993) have argued that the logic of this thesis is straight-forward - convexity implies that a more volatile earnings stream leads to higher expected taxes than a less volatile earnings stream. Convexity in the tax function is quite plausible for some firms, particularly those who face a significant probability of negative earnings and are unable to carry forward 100 per cent of their taxes losses to subsequent periods.

Statutory progressivity causes the tax schedule to be convex. In addition to statutory progressivity, tax preference items (for example, tax loss carry forwards, foreign tax credits, and investment tax credits) also make the effective tax schedule convex (Zimmerman, 1988). Tax preference items, which are subtracted from pre-tax income, indirectly create convexity in the tax liability (concavity in a firm value), because the present value of unused preference items decreases as they are carried forward to future periods. Reducing variance through hedging increases the expected value of tax benefits because the probability of using preference items increases with the level of a firm's taxable income. The tax code generally specifies that if the firm's pretax income falls below some level, the value of tax preference items is reduced by either the loss of the tax shield or postponement of its use (Gurel and Pyle, 1984). Hence, Nance, Smith and Smithson (1993) have concluded that the tax benefit is greater if the firm has more tax preference items.

Graham and Smith (1996) have used simulation methods in their work to investigate convexity induced by tax-code provisions. Authors have explored how uncertainty about future taxable income interacts with major provisions of the tax code, including statutory progressivity, tax-loss carry-backs and carry-forwards, investment tax credits, and the alternative minimum tax. From their analysis of more than 80,000 COMPUSTAT firm-year observations, they found that in approximately 50 per cent of the cases, corporations face

convex effective tax functions and thus have tax-based incentives to hedge. In approximately 25 per cent of the cases, firms face linear tax functions. The remaining firms face concave effective tax functions (which provide a tax-based disincentive to hedge). Among analysed firms facing convex tax functions, roughly one-quarter of the firms have potential tax savings from hedging that appear material - in extreme cases exceeding 40 per cent of the expected tax liability. For the remaining firms, the tax savings are fairly small - average tax savings from a five percent reduction in the volatility of taxable income are about 5.4 per cent of expected tax liabilities base.

Applied simulation methods also allowed Graham and Smith (1996) to decompose the basic structure of the tax code to examine the incremental impact of statutory progressivity, net operating loss, carry-backs and carry-forwards, investment tax credits, the alternative minimum tax, and uncertainty in taxable income. They found that much of the convexity is induced by the asymmetric treatment of profits and losses in the tax code. Carry-back and carry-forward provisions effectively allow firms to smooth their losses, thereby reducing tax-function curvature at its most convex points and making the function convex over a broader range of taxable income. In contrast, the alternative minimum tax and investment tax credits have only a modest effect on the convexity of the tax function.

Mayers and Smith (1982) have proven that firms with more convex tax schedules (e.g., due to large tax loss carry-forwards or very low net income) are more likely to engage in hedging activities. The evidence in Mian's study (1996) is mixed with respect to the hypothesis that hedging decisions are motivated by tax saving strategies. Consistent with the tax hypotheses, Mian has found incidence of foreign tax credit (as a proxy for tax shield) to be generally associated with a higher likelihood of hedging. Inconsistent with the tax hypothesis, there is no robust relation between hedging and incidence of progressivity in tax schedule, and between hedging and incidence of tax loss carry forwards.

It could be argued that, when judging the importance of the magnitude of the potential tax benefits, for firms with convex effective tax functions, the tax savings of hedging are not mutually exclusive from the hedging benefits of controlling underinvestment problems, increased debt capacity, or reduced agency

cost of various classes of the firm's claimholders. The total benefit of hedging is the combination of these motives. Therefore, with the appropriate choice of hedging instruments, a firm can simultaneously manage the impact on its value, reported income, and taxable income.

3. Managerial Utility Maximisation Hypothesis

Shareholders hire managers because they have specialised knowledge and skills that increase the value of the firm. Managers cannot use their expertise unless they have some discretion in the choice of their actions. Yet, it should be emphasised that, unless faced with proper incentives, managers will not maximise shareholder wealth. Firm managers have limited ability to diversify their own personal wealth position, associated with stock holdings and their career earnings from their own employment position. Therefore, managers prefer stability to volatility because, other things being equal, such stability improves their own wealth, at little or no expense to other stakeholders (see Jensen and Meckling (1976) and Fama (1980)). To avoid this problem, managerial compensation contract must be designed in a way that, when managers increase the value of the firm, they also increase their own expected utility.

This rationale was firstly proposed by Stulz (1984). This argument can be traced back to the literature on the theory of agency. Ross (1973) has argued that an agency relationship has arisen between two (or more) parties when one, called an agent, acts as representative for the other, called a principal, in a particular domain of decision problems. Jensen and Meckling (1976) and Fama (1980) have discussed the conflict of interest between the owners and the managers of a corporation. They have assumed that the contracting parties form rational expectations and seek to maximise their individual expected utilities within the effective constraints implied by their contracts. Thus, conflicts of interests arise among the contracting parties whenever discretionary behaviour is authorised. Jensen and Meckling (1976) demonstrated that incentives exist to write contracts which maximise the current market value of the firm. Conflicts of interest between the owners and the managers can provide a basis for the corporate demand for hedging.

Amihud and Lev (1981) have argued that two versions of motive for corporate risk reduction exist. In the first one, managers seek to reduce the probability of bankruptcy in order to enhance their job security and preserve their investment in firm-specific human capital. For example, the manager's working life is limited while the corporate form gives the firm an indefinite life. This difference in time horizons produces an incentive conflict. The second version of the agency motive for corporate risk reduction maintains that if risk-averse managers are compensated on the basis of their firm's earnings, they prefer a stable earnings stream. The manager's claim on the firm has a life which is related to the life of his job. If his compensation package includes a bonus based on reported earnings, postponing selected expenditures until after retirement can increase his expected compensation. In this context, Holmstrom (1979) has discussed that managers may take a variety of risk reducing actions at the expense of shareholders.

Manager's behaviour is predictable and will be anticipated by the owners of the corporation, therefore his overall compensation is going to be adjusted to reflect manager's anticipated actions. Because the adjustment will include anticipated avoidable costs, managers have incentives to make believable promises not to engage in these activities by allowing monitoring and offering to bond their actions (Mayers and Smith, 1982). In both versions, the agency problem arises because managers care about total risk (systematic risk as well as business risk). Shareholders, however, care only about the systematic component of total risk, since they can diversify their portfolios to compensate for business risk.

Fatemi and Luft (2002) have argued that, under such conditions, the managerial risk aversion hypothesis predicts that the managers will engage in full cover hedging. That is, they will attempt to eliminate deviations below, as well as those above the mean of the probability distribution of the firm's net cash flows. This pattern of risk management may be further strengthened by managerial compensation schemes that encourage the achievements of static performance targets. Therefore, the managerial risk aversion hypothesis assumes that risk management strategies are implemented, principally, to enhance the position of the firm's management. This brings into focus the agency costs arising from the

conflicts between management and shareholders. In analysing this problem, it should be emphasised that full cover hedging eliminates desirable (upper tail) outcomes as well as all the undesirable (lower tail) outcomes. As such, full cover hedging does not enhance the firm's or shareholder value. The benefits derived from it accrue only to the management. In its extreme form, Fatemi and Luft (2002) have emphasised that the full cover hedging can be used to protect the management at the expense of shareholder.

Smith and Stulz (1985) have claimed that managers' compensation plans can influence their hedging choices. Specifically, the incorporation of option-like provisions in managers' compensation increases the incentives for managers to take risks. The expected utility of managerial wealth has a shape of a convex function of the firm's expected profits when managers own unexercised options. Therefore, they have concluded that the more option-like features there are in the compensation plans, the managers will hedge less. In this case, managers can choose to increase the risk of the firm in order to increase the value of their options. For instance, bonus plans that make a payment to managers only if accounting earnings exceed some target number will induce managers to hedge less since this payment is a convex function of accounting earnings. Results of some empirical studies have confirmed this hypothesis (e.g. see Tufano, 1996; Gay and Nam, 1998), while, in contrast, Geczy, Minton and Schrand (1997) and Haushalter (2000) have not found evidence that corporate hedging is affected by managerial shareholdings. However, it will generally not be efficient to eliminate all incentives to hedge. While presenting shareholder maximisation hypothesis in previous sections of our thesis, it has been shown that hedging is value increasing strategy. Moreover, a compensation plan that eliminates all hedging incentives would be costly to negotiate and implement.

Smith and Stulz's prediction is confirmed by Tufano (1996) who examined commodity hedging activities in the gold mining industry on the sample of the 48 North American gold mines. He has found that firms' use of commodity derivatives is negatively related to the number of options their managers and directors hold, and positively related to the value of their stock holdings. This evidence is consistent with theories of managerial risk aversion, but such use of derivatives may not add to the value of a firm. One must be

careful not to over-interpret the results of a single-industry study of a few dozen observations per year. With this in mind, Tufano (1996) study has suggested that risk management practices in the gold mining industry appear to be associated with both firm and managerial characteristics, although theories of managerial risk aversion seem more informative than those of shareholder value maximisation.

A very different managerial theory of hedging, based on asymmetric information, is put forward by Breeden and Viswanathan (1990) and DeMarzo and Duffie (1992), who focus on managers' reputations. They have argued that managers may prefer to engage in risk management so as to better communicate their skills to the labour market. Breeden and Viswanathan (1990) and DeMarzo and Duffie (1992) have argued that younger executives are more willing to embrace new concepts like risk management, than are their older colleagues. Managerial tenure might play a similar role, because it is possible that short-tenure financial managers would have less developed reputations than longer-tenure managers. Therefore, they would have an incentive to signal their quality through hedging. To the extent these assumptions are correct, firms with younger managers, and those whose managers have shorter tenures on the job would be more willing to manage risk.

Contrary to Breeden and Viswanathan (1996) predictions regarding the managers tenure, May (1995) has argued that managers years with the firm should be negatively related to the firm risk characteristics, therefore creating a greater incentive to hedge. This is because managerial skills become more firm-specific as time spent with the firm increases. May (1995) has assumed that, if diversification reduces human capital risk, firms whose managers have more years vested are more likely to pursue hedging strategies.

Tufano (1996) has tested these assumptions and found that there is no meaningful relationship between CEO and CFO age and the extent of risk management activity, except a negative relationship between CFO age and risk management. The lack of association between age and risk management might be the result of age acting as a factor that influences both risk aversion and predilection to use sophisticated financial instruments. However, tenure's association with risk management is stronger. Tufano (1996) has proven that

firms whose CFOs have fewer years in their current job are more likely to engage in greater risk management activities, confirming the hypothesis that newer executives are more willing to engage in risk management activities than are their counterparts with long-tenures. Thus, the results can be seen as consistent with Breeden and Viswanathan (1996) theory. However, their model would seem to apply to CEOs as well as CFOs – the finding that tenure of the CEO is not related to the level of risk management is a warning not to over-interpret these results. However, Tufano's (1996) finding supports the general contention that managerial motives may be relevant in creating corporate risk management policy. On the other hand, the result could also reflect that firms wishing to do financial risk management, tend to hire new financial managers who are skilled with the appropriate tools and techniques.

4. Conclusion

For a long time it was believed that corporate risk management is irrelevant to the value of the firm and the arguments in favour of the irrelevance were based on the Capital Asset Pricing Model (Sharpe, 1964; Lintner, 1965; Mossin, 1966) and the Modigliani-Miller theorem (Modigliani and Miller, 1958). It has been only two decades that both scholars and practitioners have realised that managing corporate risk lies in the heart of a competitive corporate strategy. As an explanation for this clash between theory and practice, imperfections in the capital market are used to argue for the relevance of corporate risk management function. Based on seminal work by Mayers and Smith (1982) in the area of the corporate demand for insurance, researchers such as Stulz (1984), Smith and Stulz (1985), and Shapiro and Titman (1998) have examined why large, diversified firms actively engage in hedging activities. These authors argued that the earlier theories are applicable to individuals and small, closely held firms but could not be used as a solid theoretical rationale for hedging by large corporations. The authors demonstrated several theories of hedging which overcome the irrelevancy arguments of modern portfolio and corporate finance theory. Most of these theories rely on the introduction of some frictions into the M&M model, and argue that market imperfections enable firms to add value through hedges that can not be exactly duplicated by individual investors.

The survey of literature presented in this paper has revealed that there are two chief classes of rationales for corporate decision to hedge - *maximisation of shareholder value or maximisation of managers' private utility.* Positive theories of risk management, as a lever for shareholder value creation, argue that firm value is a concave objective function because of capital market imperfections. The first theory suggests that, by reducing the volatility of cash flows, firms can decrease costs of financial distress (Mayers and Smith, 1982; Myers, 1984; Stulz, 1985; Smith and Stulz, 1985; Shapiro and Titman, 1998). In the MM world, financial distress is assumed to be costless. Hence, altering the probability of financial distress does not affect firm value. If financial distress is costly, firms have incentives to reduce its probability, and hedging is one method by which a firm can reduce the volatility of its earnings. By reducing the variance of a firm's cash flows or accounting profits, hedging decreases the probability, and thus the expected costs, of financial distress.

The second hedging rationale suggests that, by reducing the volatility of cash flows, firms can decrease agency costs (see Jensen and Meckling, 1976). According to Dobson and Soenen (1993) hedging reduces uncertainty by smoothing the cash flow stream thereby lowering the firm's cost of debt. Since the agency cost is borne by management, assuming informational asymmetry between management and bondholders, hedging will increase the value of the firm. Therefore, management will rationally choose to hedge. Additionally, given the existence of debt financing, cash flow smoothing through exchange risk hedging will tend to reduce the risk-shifting as well as the underinvestment problems (see Jensen and Smith, 1985). Results of MacMinn (1987), MacMinn and Han (1990), Bessembinder (1991), Minton and Schrand (1999) and Haushalter, Randall and Lie (2002) supports this hedging rationale.

Another theory that focuses on risk management as a mean to maximise shareholder value argue that, by reducing the volatility of cash flows, firms can decrease expected taxes. This rationale is put forward by Smith and Stulz (1985) who have argued that, if hedging reduces the variability of pre-tax firm values, then the expected tax liability is reduced and the expected post-tax value of the firm is increased, as long as the cost of the hedge is not too large. By reducing the effective long run average tax rate, activities which reduce the volatility in

reported earnings will enhance shareholder value. More convex the effective tax schedule is, the greater is the reduction in expected taxes. This rationale has been supported by Zimmerman (1988), Froot, Scharfstein and Stein (1993), Nance, Smith and Smithson (1993), Mian (1996) and Graham and Smith (1996).

In addition, reducing cash flow volatility can improve the probability of having sufficient internal funds for planned investments eliminating the need either to cut profitable projects or bear the transaction costs of obtaining external funding. An interesting empirical insight based on this rationale is that firms which have substantial growth opportunities and face high costs when raising funds under financial distress, will have an incentive to hedge more of their exposure than the average firm. This rationale has been explored by numerous scholars, among others by Smith and Stulz (1985), Stulz (1990), Lessard (1990), Shapiro and Titman (1998), Hoshi, Kashyap and Scharfstein (1991), Froot, Scharfstein and Stein (1993), Getzy, Minton and Schrand (1997), Gay and Nam (1998), Graham and Rogers (1999), Minton and Schrand (1999), Haushalter (2000), Mello and Parsons (2000), Allayannis and Ofek (2001) and Haushalter, Randall and Lie (2002).

Other line of reasoning that differs from the shareholders value maximisation hypothesis refers to the managerial utility maximisation hypothesis. It argues that firm managers have limited ability to diversify their own personal wealth position, associated with stock holdings and the capitalisation of their career earnings associated with their own employment position. Therefore, they will have an incentive to hedge their own wealth on the expense of the shareholders. Usually that kind of hedging is not conducted to improve value of company's stockholders but to improve managers own wealth. To avoid this problem, managerial compensation contract must be designed so that when managers increase the value of the firm, they also increase their expected utility. This can usually be obtained by adding option-like provisions to managerial contracts. This rationale was firstly proposed by Stulz (1984) and has been further explored by Smith and Stulz (1985). Results of some empirical studies have confirmed this hypothesis (e.g. see Tufano, 1996; Gay and Nam, 1998), while, in contrast, Geczy, Minton and Schrand (1997) and Haushalter

(2000) have not found evidence that corporate hedging is affected by managerial shareholdings.

A very different managerial theory of hedging, based on asymmetric information, has been presented by Breeden and Viswanathan (1990) and DeMarzo and Duffie (1992), who have focused on managers' reputations. In both of these models, it is argued that managers may prefer to engage in risk management activities in order to better communicate their skills to the labour market. Breeden and Viswanathan (1990) and DeMarzo and Duffie (1992) have argued that younger executives and those with shorter tenures have less developed reputations than older as well as longer-tenure managers. Therefore, they are more willing to embrace new concepts like risk management with the intention to signal their management quality. Tufano (1996) has tested these assumptions and found that there is no meaningful relationship between CEO and CFO age and the extent of risk management activity. However, he has proven that firms whose CFOs have fewer years in their current job are more likely to engage in greater risk management activities, confirming the hypothesis that newer executives are more willing to engage in risk management activities than are their counterparts with long-tenures. Thus, the results can be seen as consistent with Breeden and Viswanathan (1996) and DeMarzo and Duffie (1992) theory.

Overall, the results of the literature review presented in this paper suggest that the use of derivatives and risk management practices are broadly consistent with the predictions of the theoretical literature, which is based upon value-maximising behaviour. By hedging financial risks such as currency, interest rate and commodity risk, firms can decrease cash flow volatility, which leads to a lower variance of the firm's value. This means that not only the firm value moves less, but that the probability of occurring low values is smaller than without hedging. The analysis has shown that, if hedging decisions are capable of increasing firm values, they can do so for reasons such as the following: they reduce the probability or costs of financial distress, they reduce taxes or transactions costs, they reduce the costs associated with information "asymmetries" by signalling management's view of the company's prospects to investors, or they reduce "agency" problems (conflicts of interest among

management, shareholders, and creditors), including distortions of management's incentives to undertake all value-adding investments.

However, it needs to be emphasised that, in spite of the extensive body of literature on corporate risk management and the efforts that have been devoted in developing rationales for hedging, there is not yet a single accepted framework which can be used to guide empirical hedging strategies. There is no consensus as to what hedging rationale is the most important in explaining risk management as a corporate policy. The total benefit of hedging is the combination of these motives - e.g. the benefit of increased debt capacity is not mutually exclusive from the hedging benefits of controlling underinvestment problems, tax savings, increased debt capacity, or reduced agency cost of various classes of the firm's claimholders. It can be concluded that, if the costs of using corporate risk management instruments, e.g. financial derivatives that include employee salaries, computers, training as well as transaction costs and the costs of the internal control systems, are less than the benefits provided via the avenues mentioned in this paper, or any other benefit perceived by the market, then risk management is a shareholder-value enhancing activity.

References

Allayannis, G. and E. Ofek (2001), Exchange Rate Exposure, Hedging, and the User of Foreign Currency Derivatives, *Journal of International Money and Finance* 20(2), pp. 273-296.

Allayannis, G. and J. Weston (2001), The Use of Foreign Currency Derivatives and Firm Market Value, *The Review of Financial Studies* 14(1), pp. 243-276.

Amihud, Y. and B. Lev (1981), Risk Reduction as a Managerial Motive for Conglomerate Mergers, *Bell Journal of Economics* 12(2), pp. 605-617.

Bartram, S. M. (2000), Corporate risk management as a lever for shareholder value creation, *Financial-markets, institutions and instruments* 9(5), pp. 279-324.

Bessembinder H. (1991), Forward Contracts and Firm Value: Investment Incentive and Contracting Effects, *The Journal of Financial and Quantitative Analysis* 26(4), pp. 519-532.

Black, F. and M. Scholes (1973), The Pricing of Options and Corporate Liabilities, *Journal of Political Economy* 81(3), pp. 637-654.

Brander, J.A. and T. Lewis (1986), Oligopoly and Financial Structure, *American Economic Review* 76(5), pp. 956-970.

Breeden, D. and S. Viswanathan (1996), Why do Firms Hedge? An Asymmetric Information Model, *Duke University Working Paper*, Place: Duke University.

Campbell, T.S. and W.A. Kracaw (1987), Optimal Managerial Incentive Contracts and the Value of Corporate Insurance, *Journal Of Financial And Quantitative Analysis* 22(3), pp. 315-328.

DeMarzo, P.M. and D. Duffie (1995), Corporate Incentives for Hedging and Hedge Accounting, *Review of Financial Studies* 8(3), pp. 743-771.

Dobson, J., and L. Soenen, 1993, Three Agency-Cost Reasons for Hedging Foreign Exchange Risk, *Managerial Finance* 19(6), pp. 35-44.

Dolde, W. (1995), Hedging, leverage and primitive risk, *Journal of Financial Engineering* 4(2), pp. 187-216.

Fama, F.E. (1980), Agency Problems and the Theory of the Firm, *The Journal of Political Economy* 88(2), pp. 288-307.

Fatemi, A. and C. Luft (2002), Corporate Risk Management: Costs and Benefits, *Global-Finance-Journal* 13(1), pp. 29-38.

Fazzari, S., R. Hubbard, B. Petersen (1988), Financing constraints and corporate investment, *Brookings Papers on Economic Activity* 1, pp. 141-195.

Froot, K.A., D.S. Scharfstein and J.C. Stein (1993), Risk Management: Coordinating Corporate Investment and Financing Policies, *Journal of Finance* 48(5), pp. 1629-1658.

Gay, G. D. and J. Nam (1998), The underinvestment problem and corporate derivatives use, *Financial Management* 27(4), pp. 53-69.

Geczy C., B.A. Minton and C. Schrand (1997), Why Firms Use Currency Derivatives, *The Journal of Finance* 52(4), pp. 1323-1354.

Graham J.R. and C.W. Smith, Jr. (1996), Tax Incentives to Hedge, *The Journal of Finance* 54(6), pp. 2241-2262.

Graham J.R. and D.A. Rogers (1999), Is Corporate Hedging Consistent with Value Maximization? An Empirical Analysis, *Duke University Working Paper,* Place: Fuqua School of Business, Duke University.

Gurel, E. and D. Pyle (1984), Bank Income Taxes and Interest Rate Risk Management: A Note, *Journal of Finance* 39(4), pp. 1199-1206.

Haushalter, G. David; R.A. Heron, E. Lie (2002), Price Uncertainty and Corporate Value, *Journal of Corporate Finance: Contracting, Governance and Organization* 8(3), pp. 271-86.

Haushalter, G.D. (2000), Financing Policy, Basis Risk, and Corporate Hedging: Evidence from Oil and Gas Producers, *The Journal of Finance* 55(1), pp. 107-152.

Holstrom, B. (1979), Moral Hazard and Observability, *Bell Journal of Economics* 10(1), pp. 74-91.

Hoshi, T., A. Kashyap and D. Scharfstein (1991), Corporate Structure, Liquidity, and Investment: Evidence from Japanese Industrial Groups, *Quarterly Journal of Economics* 106(1) pp. 33-60.

Jensen, C.M. and C.W. Smith Jr. (1985), Stockholder, Manager, and Creditor Interests: Application of Agency Theory, Altman E.I. and M.G. Subrahmanyam (eds.), *Recent Advances in Corporate Finance*, Homewood IL: Irwin, pp. 93-131.

Jensen, M. and W. Meckling (1976), Theory of the Firm Managerial Behaviour, Agency Cost and Capital Structure, *Journal of Financial Economics* 3(4), pp. 305-360.

Kaplan, S. and L. Zingales (1997), Do investment cash flow sensitivities provide useful measures of financing constraints, *Quarterly Journal of Economics* 112(1), pp. 169-215.

Lamont, O. (1997), Cash flow and investment: evidence from internal capital markets, *Journal of Finance* 52(1), pp. 57-82.

Lessard, D.R. (1991), Global Competition and Corporate Finance in the 1990s, *Journal of Applied Corporate Finance* 3(4), pp. 59-72.

Lintner, J. (1965), Security prices, risk and maximal gains from diversification, *Journal of Finance* 20(4), pp. 587-615.

MacMinn R.D. and L.M. Han (1990), Limited Liability, Corporate Value, and the Demand for Liability Insurance, *The Journal of Risk and Insurance* 57(4), pp. 581-607.

MacMinn, R.D. (1987), Forward Markets, Stock Markets, and the Theory of the Firm, *The Journal of Finance* 42(5), pp. 1167-1185.

MacMinn, R.D. (1987), Insurance and Corporate Risk Management, *Journal of Risk and Insurance* 54(4), pp. 658-677.

Maksimovic, V. (1988), Capital Structure in Repeated Oligopolies, *Rand Journal of Economics* 19(3), pp. 389-407.

May, O.D. (1995), Do Managerial Motives Influence Firm Risk Reduction Strategies?, *The Journal of Finance* 50(4), pp. 1291-1308.

Mayers, D. and C.W. Smith, Jr. (1982), On the Corporate Demand for Insurance, *The Journal of Business* 55(2), pp. 281-296.

Mayers, D. and C.W. Smith, Jr. (1987), Corporate Insurance and the Underinvestment Problem, *Journal of Risk and Insurance* 54(1), pp. 45-54.

Mello A.S. and J.E. Parsons (2000), Hedging and Liquidity, *The Review of Financial Studies* 13(1), pp. 127-153.

Mian, S. (1996), Evidence on Corporate Hedging Policy, *Journal of Financial and Quantitative Analysis* 31(3), pp. 419-439.

Minton, B.A. and C. Schrand (1999), The impact of cash flow volatility on discretionary investment and the cost of debt and equity financing, *Journal of Financial Economics* 54(3), pp. 423-460.

Modigliani, M. and M. Miler (1958), The Cost of Capital, Corporate Finance and Theory of Investment, *The American Economic Review* 48(3), pp. 261-297.

Mossin, J. (1966), Equilibrium in a Capital Asset Market, *Econometrica* 34(4), pp. 768-783.

Myers, C.S. (1984), The Capital Structure Puzzle, *Journal of Finance* 39(3), pp. 575-592, Papers and Proceedings, Forty-Second Annual Meeting, American Association, San Francisco, CA, December 28-30, 1983 (Jul., 1984).