Corporate Financial Risk Management

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Review of empirical research on corporate risk management

3.1 Introduction

In Chapter 2 we developed a theoretical framework that integrated existing theoretical work on rationalizations of corporate risk management. We identified four driving forces: *(i)* taxes, *(ii)* bankruptcy costs, *(iii)* investment distortions due to contracting problems between firms and financiers and *(iv)* managerialism due to imperfect contracting. We also established empirical predictions from these theoretical rationalizations. This chapter surveys the empirical evidence with respect to these theories of corporate risk management.[1]

A review of the empirical research is important for various reasons. First, it enables us to establish the validity of theories of corporate risk management. Second, it allows us to identify gaps in the empirical literature. Third, it may raise new issues not well understood or addressed by the current theoretical literature.

Until recently empirical research concerning the rationalizations of corporate risk management has been relatively scarce. An important reason for this is that data about the corporate use of derivatives have not been readily available. Corporations (are required to) disclose only minimal - if any - details on their risk management activities in their financial statements. For example, US firms have only been required to disclose the notional value of the derivatives portfolio in the footnotes of their annual reports since 1994. And even if firms disclose this information, it is hard to determine whether the derivatives are being used for hedging or for more speculative purposes. Although, guidelines with respect to the disclosure of derivatives have be-

[1] Again, we will primarily focus concerning empirical research on corporate hedging (use of derivatives). In Section 3.7 we will also discuss some empirical evidence on (the interaction with) other forms of corporate risk management.

come more strict, they still are not very informative about the degree of risk management in a particular firm.[2]

An alternative way to obtain information about the corporate use of derivatives is via surveys (often combined with financial statement data). This type of data is also not easy to obtain; it is relatively time consuming and has methodological drawbacks of its own. For example, one may expect that firms using derivatives for speculating purposes are less likely to respond to a survey, which may cause significant selection bias.

The setup of this chapter is as follows. In Section 3.2, we briefly describe some important common characteristics of the various studies that are focused on in this chapter. In subsequent sections we will discuss the empirical research related to each of the driving forces identified in Chapter 2. Section 3.3 and 3.4 concentrate on taxes and expected bankruptcy costs respectively. In Section 3.5 the emphasis is on investment distortions due to financial contracting problems. Section 3.6 focuses on the empirical evidence with respect to managerial motives for corporate risk management. Section 3.7 discusses other related research (among other things, it addresses whether financial risk management and other forms of risk management are substitutes or complements and to what extent risk management contributes to firm value). Section 3.8 summarizes and concludes.

3.2 Characteristics and approaches of empirical studies in corporate risk management

Table 3.1 summarizes some sample characteristics of recent empirical studies. We choose to concentrate primarily on empirical research in the US from the 1990's. The reason for this is twofold. The first is because most of the theories on corporate risk management date back to this period.[3] Second, tests could become more specific due to improved disclosure of derivatives usage in corporate annual accounts over this period in the US. As a result, most research therefore still focuses on large US (Fortune 500 or S&P 500) non-financial firms.[4]

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[2]Disclosure in other countries is generally even less informative. It therefore does not come as a surprise that most of the empirical work uses US data.

[3]Earlier studies that have looked at this issue include Block and Gallagher (1986) and Wald and Pringle (1989). These studies focus on the corporate use of a single financial instrument.

[4]Berkman and Bradburry (1996) consider listed firms in New Zealand where there is considerable disclosure about derivatives usage. Howton and Perfect (1998a) not only consider a sample of large firms from the S&P 500 but also a sample of smaller firms. In the discussion that follows, we will first only refer to the results of the large firms. Later, we will also comment on their results with respect to the smaller firms.

The general method employed in the empirical studies is to develop a set of firm-specific proxies that discriminate between theories and test whether there are significant differences in these proxies between derivative users and non-users. After these univariate tests, a multivariate test follows that combines the proxies in one regression equation (often a logit or tobit analysis).

In the early studies, the dependent variable in such a multivariate test was a binary variable that discriminated between derivatives users and non-users.[5] These studies test whether firm-specific proxies can explain if a firm hedges. Later studies benefit from improved disclosure or gather this information via a survey, and use a continuous dependent variable, namely the (net) notional or fair value of the derivatives position (often scaled by size).[6] In general, these studies jointly test variables that can explain both the decision to hedge and the decision on how much to hedge. Some recent studies separated these two hypotheses further. For example, Allayanis and Ofek (1998), Haushalter (2000) and Graham and Rogers (1999) perform a binomial probit analysis first to identify those independent variables that determine the hedge decision and then do a conditional regression (for those firms that use derivatives) to test for the variables that determine the amount of hedging.

The primary data source in most studies for both the dependent and the independent variables is information from financial statements. With respect to the dependent variable, some studies use a survey with questions about risk management practices and link these answers to financial statement data (Nance, Smith and Smithson, 1993; and Haushalter, 2000).

Some papers choose to concentrate on one or two groups of derivatives (e.g. currency and interest rate derivatives). Other studies take the whole spectrum of derivatives into account (see last column in Table 3.1). Most theories of corporate risk management do not explicitly refer to

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[5]Francis et al. (1993), Nance et al. (1993), Mian (1996) and Geczy et al. (1997) use such a binary dependent variable in multivariate (logit) analysis. Dolde (1995) uses three different definitions of hedging to indicate hedging versus non-hedging firms, but also uses a binary variable in his regressions.

[6]These studies generally use tobit analysis. Tufano (1996) uses equity analysts' reports on hedging practices in the gold mining industry combined with financial statements as data sources. Both Tufano (1996) and Haushalter (2000) work with a continuous variable that measures how much a firm has hedged. Tufano (1996) calculates how much of its exposure each firm has hedged over time (using equity analyst's reports) and uses this figure as the dependent variable in the regression when testing specific theories of corporate hedging. Haushalter (2000) gathered this information through a survey; he asked firms to indicate the proportion of their production that was being hedged. Berkman et al. (1996) and Howton and Perfect (1998a) benefit from improved disclosure over the years; and use the notional value, while Gay and Nam (1998) also use the fair value of the derivatives portfolio. Finally, Graham and Rogers (1999) use the *net* notional value of the derivatives portfolio as reported in the footnotes of the annual accounts, as dependent variable in the multivariate analyses. In general, it appears that the fair value of derivatives portfolios is not explained as well as the notional value of the derivatives portfolios.

Authors	Sample & primary source	Type
Graham et al (1999)	3,232 firms, 1995, Edgar database	currency & interest rate
Gay et al. (1998)	486 firms, 1996, Swaps Monitor/Compustat	all
Howton et al. (1998a)	451 Fortune/S&P500 firms, 1994, Compustat	currency & interest rate
Haushalter (2000)	100 Oil/gas firms, 1992-94, survey	oil & gas
Allayanis et al. (1998)	323 (401) S&P 500 firms, 1991(92), annual reports	currency
Geczy et al. (1997)	372 Fortune 500 firms, 1991, annual reports/10K	currency
Tufano (1996)	48 Gold Mining firms, 1990-93, analysts' reports	gold
Berkman et al. (1996)	116 New Zealand listed firms, 1994, annual reports	all
Mian (1996)	3,022 firms, 1992, annual reports/Compustat	currency & interest rate
Dolde (1995)	244 Fortune 500 firms, 1992/93, survey/Compustat	all
Nance et al. (1993)	169 Fortune 500/S&P 500 firms, 1986, survey/Compustat.	all
Francis et al. (1993)	434 firms, 1983-87, NAARS/Compustat	all

TABLE 3.1. Empirical tests of corporate hedging theories

the management of one type of price risk. We therefore choose to report the results for the total group.[7]

The approach taken in most studies is to test whether firms that are predicted (theoretically) to engage in risk management actually do so. We will refer to this as the ex ante approach. Some papers alternatively focus on the predicted impact of risk management. We refer to this as the ex post approach. An example may clarify the difference in these two approaches. According to the tax hypothesis of hedging, firms with more convex tax schedules benefit more from hedging. An ex ante empirical test would be to verify in a cross section whether firms with more convex tax schemes hedge more often (on average) than those that do not have such a tax scheme.

[7]Firms only engage in managing price risks if they have some exposure. Ideally, therefore, one should correct for the amount of exposure a firm is subject to. Some studies include proxies for exposure (for example, Allayanis and Ofek, 1998 and Dolde, 1995). Other papers (e.g. Geczy, Minton and Schrand, 1997 and Graham and Rogers, 1999) focus only on firms that at least have some ex ante exposure or do not take the firm's exposure into account. Besides a firm's exposure, the effectiveness of the use of derivatives is important. For example, Haushalter (2000) shows that basis risk is an important determinant of corporate use of derivatives in the oil and gas industry; that is, the larger the basis risk, the less firms tend to hedge. This basis risk, however, is often hard to measure and therefore generally not included in other studies.

However, one may also test whether on average taxes are lower (and less variable) for firms that hedge compared to those that do not hedge. These research approaches are complementary in establishing the importance of certain rationales of corporate risk management. However, most research in this area has been of the ex ante type.

In the following sections we discuss the empirical corporate risk management studies in more depth. In each of the following sections we will discuss the empirical evidence on one specific rationale for corporate risk management at a time. In our discussion below we discuss the significance of proxies used in the various multivariate analyses of the studies. It is important to stress that the setup of these studies is not always the same. Since the significance of one variable may depend on what other variables have been put in the regression analysis, we must be careful in our interpretation of a significant variable.

3.3 Taxes

In Chapter 2, we derived that corporate risk management may drive down a firm's expected corporate tax bill if taxes are a non-linear function of the pre-tax income (see Proposition 2 and the associated predictions in Table 2.1). The more progressive the tax schedule that the firm is subject to, the larger the benefits of corporate hedging. The tax hypothesis has been tested in almost all studies incorporated in Table 3.1. Different approaches can be distinguished to qualify a firm's tax function as convex. First, the availability of tax loss carry forwards and investment tax credits generates some progressivity. Some studies therefore take the value of these tax credits as a proxy for convexity.[8] Other studies use a dummy that indicates the presence of such tax credits. The evidence with respect to these proxies generally does not support the tax hypothesis of corporate risk management. Only Dolde (1995) and Berkman et al. (1996) find some weak evidence for a significant tax loss carry forward dummy. Investment tax credits appear to be unrelated to the corporate use of derivatives. Graham and Rogers (1999) even find a significant negative relationship between the presence of tax loss carry forwards (scaled by assets) and the amount of corporate risk management for a sample of firms that use interest rate derivatives.

Note that the presence of tax loss carry forwards induces firms to hedge only if they expect to be profitable in the near future. Otherwise, they may be better off not hedging in order to increase the probability of being profitable in the future and/or benefit from the existing tax loss

[8]Sometimes scaled by firm value to control for their size.

Proxy	Predicted sign	Significance	Source
Progressive region dummy	+	yes	Howton
Progressive region dummy	+	yes	Nance
Progressive region dummy	+	no	Mian
Average tax rate	-	yes, weakly	Francis
Foreign tax credit dummy	+	yes	Mian
Investment tax credit dummy	+	no	Mian
Investment tax credit dummy	+	no	Allyanis
Tax loss carry forward dummy	+	no	Allyanis
Tax loss carry forward/value	+	no	Geczy
Tax loss carry forward/value	+	no	Gay
Tax loss carry forward/value	+	no	Tufano
Tax loss carry forward dummy	+	yes weakly	Dolde
Tax loss carry forward	+	no	Nance
Tax loss carry forward dummy	+	no	Howton
Tax loss carry forward dummy	+	yes	Berkman
Tax loss carry forward/assets	+	yes but (-) for IR, rest no	Graham
Tax convexity	+	no	Graham
Tax convexity	+	no	Haushalter

TABLE 3.2. Taxes as rationale for corporate risk management

carry forwards. Moreover, tax loss carry forwards may simply proxy for poor performance.[9] Thus one should be careful with the interpretation of this proxy.

A second approach is to consider the first part of the firm's pre-taxable income ($0 - $100K). Income in this bracket is subject to a progressive tax scheme in the US. Some papers (e.g. Nance et al., 1993, and Mian 1996) therefore define a dummy that takes the value 1 if the firm's expected income is in the progressive region[10] and 0 otherwise. The evidence with respect to this dummy is mixed; Nance et al. (1993) find evidence that confirms the tax hypothesis of corporate risk management, while Mian (1996) does not. Moreover, the interpretation of this dummy is not without bias; relatively smaller firms will have an expected income in this region and thus the dummy may also represent a size effect.

[9]Firms accumulate carry forwards if they make losses over the years. Firms that operated poorly therefore have large carry forwards. If past figures tell something about the future, then tax loss carry forwards may proxy for (future) poor performance.

[10]More specifically, they estimate whether the firm's income is expected to fall within this region with some minimum probability based on the historical earnings distribution of that firm.

A third and probably best way to test for convexity is an approach originally developed by Graham and Smith (1999). They have simulated the US corporate tax scheme using 80,000 firm-year observations from COMPUSTAT taking all specific tax rules, tax carry forwards and tax credits into account in order to determine the specific form of this tax scheme. For approximately 50% of the firms in their sample they found a convex tax scheme (thus implying firms may have tax incentives to hedge). Graham and Smith (1999) estimate the average tax savings of a 5% reduction in volatility of taxable income at about 5.4%. Of all firms facing a convex tax scheme, about 25% can achieve material tax savings via hedging. The distribution, however, is heavily skewed. The highest percentile of firms can even achieve a reduction in the expected tax bill over 40% with a 5% reduction in volatility. Graham and Smith (1999, p. 3) further show that firms "*....are most likely to face convex tax functions when (1) their expected taxable incomes are near the kink in the statutory tax schedule (that is taxable income near zero), (2) their incomes are volatile, and (3) their incomes exhibit negative serial correlation (hence the firm is more likely to shift between profits and losses)*". Investment tax credits appear to have only a modest impact on the convexity of the tax scheme. The paper by Graham and Smith (1999) is important since it provides some estimate about the potential impact of the tax rationale on corporate risk management. It appears that for a subgroup of firms taxes may very well be a valid reason for firms to engage in risk management.

Graham and Rogers (1999) subsequently have used this simulation approach to test for the importance of tax scheme convexity as a rationale for risk management. They found that on average, a 5% reduction in the volatility of revenues leads to a modest contribution of firm value of only 0.153% (discounted value of expected tax benefits/market value).[11] Applying the Graham and Smith (1999) approach as a proxy for convexity, Graham and Rogers (1999) do not find any support for the tax hypothesis in cross section multiple regression analysis.[12] Haushalter (2000) also uses this approach but fails to find a significant relationship between either this variable and the decision to hedge or the amount of hedging. The results of these two latter studies are important since they use the most specific proxy to test whether a convex tax scheme induces firms to hedge.

Finally, Francis et al. (1993) find that the average tax bill is lower for hedgers versus non-hedgers. This ex post result may offer some support for the tax rationale. On the other hand, this study does not explicitly test the convexity argument as proposed by Smith and Stulz (1985). The findings may also be due to the benefits of more debt financing (see Section 3.5). Therefore, we don't see this result as explicit support for the tax hypothesis.

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[11]The paper argues that the major tax benefit lies in the increased debt capacity. We will discuss this in Section 3.5.

[12]More specifically, convexity is measured by the difference of the expected tax liability with full volatility and a 5% reduction in cash flows using a simulation approach for each firm.

Conclusion

The evidence indicates that, although for some firms the expected tax benefits arising from corporate risk management may be quite substantial, they do not seem to be a major driving force behind corporate risk management in a cross section of firms. Neither the decision to hedge nor the amount of risk management seem to be related to the convexity of the tax scheme in a multivariate analysis of a cross section of firms.[13] [14]

3.4 Bankruptcy costs

The second rationale for corporate hedging discussed in Chapter 2 was related to expected bankruptcy costs; firms facing high expected costs of financial distress benefit most from corporate hedging. In Chapter 2 we argued that firms financed with risky debt can reduce their expected bankruptcy costs by making debt as riskless as possible (see Proposition 3, and Table 2.1 for the general empirical predictions).[15]

A variety of proxies have been used to test this hypothesis. Table 3.3 summarizes the proxies and empirical evidence. The first proxy for financial distress is the debt ratio. The higher the debt ratio, the larger the probability of financial distress, and therefore the larger are the potential benefits of hedging.[16] Most studies find a positive significant relationship between the debt ratio and the extent to which firms use derivatives. Tests that use a binary variable (users or non-users) as the dependent variable, however, often do not find a significant relationship with the debt ratio.[17] Firms that hedge therefore do not have a higher debt ratio compared to firms that do not hedge. Tests on the other hand that use a continuous variable that measures the amount of hedging, e.g. the notional value of derivatives holdings, find a positive relationship with the debt ratio. Haushalter (2000) explains this by showing that, although the likelihood that firms' use derivatives is not positively related with leverage, the amount of hedging is positively related with leverage.

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[13] A possible explanation for this result is that most research focuses primarily on relatively large firms.

[14] Note also that the other side of the coin, firms with concave tax functions will speculate, has not been tested. This is not a major concern, since Graham and Smith (1999) have established that convex tax schemes - at least in the US - are far more important.

[15] The literature also predicts that firms commit to a hedging strategy over the life of the debt contract. Geczy et al. (1997) show that at least four firms induced such restrictions in their loan covenants. However, these were all related to the use of interest rate derivatives.

[16] The link however may be more complex as firms with larger expected bankruptcy costs will also tend to choose lower debt ratios.

[17] For example, Nance et al. (1993), Mian (1996) and Geczy et al. (1997).

Proxy	Predicted sign	Significant	Source
Debt/value	+	No	Nance
Debt/value	+	yes some weak	Dolde
Debt/value	+	no	Mian
Debt/value	+	yes	Berkman
Debt/value	-	no	Allyanis
(long term) debt/value	+	no	Geczy
Debt/value	+	yes weak	Tufano
Debt/value	+	yes	Haushalter
Debt/value	+	yes	Gay
Debt/value	+	yes	Howton
Debt/value	+	yes	Graham
Interest coverage ratio	_	no	Nance
Interest coverage ratio	_	no	Berkman
Interest coverage ratio	_	no	Geczy
Interest coverage ratio	-	no	Gay
Z score	-	no	Francis
Credit rating	-	no	Dolde
Credit risk spread	-	no	Dolde
ROA	-	yes	Graham
Debt*(M/B)	+	weak yes	Graham

TABLE 3.3. Expected bankruptcy costs as rationale for corporate risk management

A second proxy for financial distress is the interest coverage ratio. The smaller the interest coverage ratio, the worse the firm's financial condition, and higher are the potential benefits of hedging. Nance et al. (1993) and Geczy et al. (1997) however, do not find a significant relationship between the interest coverage ratio and the likelihood of risk management. Francis et al. (1993) uses Altman's Z-score as a measure for the likelihood of financial distress. This proxy however, also does not significantly discriminate between derivatives users and non-users.[18] Alternative measures for financial distress that have been used are the firm's credit rating, credit spread and return on assets. Changes in a firm's credit rating and the firm's credit spread have no relation with hedging (Dolde, 1995). The return on assets however appeared to be negatively related to both the extent and the amount of risk management in a firm (Graham and Rogers, 1999).

[18]Francis et al. (1993) also test this ex post; if firms use derivatives one would expect that the Z-score reduces after one year. They, however, do not find support for this hypothesis.

The approach taken by Dolde (1995) merits further discussion. Using linear regression analysis, Dolde tests to what extent primitive risk, leverage, and some interaction variables can explain the costs of financial distress. He finds that leverage increases these costs significantly, when controlled for primitive risks. Dolde furthermore finds a negative relationship for the interaction between hedging and amount of leverage (hedging*leverage), suggesting that hedging mitigates the negative effect of debt on the financial distress costs. However, this result is statistically insignificant. Firms exposed to price risks generally also carry less debt.[19] If one however controls for risk, then it is found that firms with higher levels of debt also are more often derivative users.

Finally, note that the financial distress hypothesis also includes the opportunity of losing tax deductions. In the previous section we presented some evidence that is inconsistent with this claim; the availability of investment tax credits and/or tax loss carry forwards was not significantly related to the use of derivatives. This lack of a strong relationship suggests that firms do not hedge to protect their existing tax shields.

Conclusions

We conclude from this evidence that firms with more debt indeed use more derivatives. However, the evidence with respect to the debt ratio is hard to interpret. Both the firm's debt ratio and the firm's risk management decision seem to be driven by the same forces. As a result, we should be cautious to interpret the positive relation between debt and (the likelihood) of risk management as evidence in favor of the bankruptcy costs theory. The positive relation between the use of debt and risk management is also predicted under alternative theories. Furthermore, firms may not only use derivatives to reduce the costs of financial distress, but the causality may also work the other way around; firms that hedge more frequently may do this to increase their debt capacity. These alternative explanations will be discussed in the two following sections. With respect to the other proxies, we only find mixed support for the financial distress theory of corporate risk management.

3.5 Investment distortions due to contracting problems between firms and financiers

3.5.1 Introduction

The third driving force proposed as a rationale for corporate risk management is related to contracting problems between firms and financiers and the associated investment distortions. In Chapter 2 we roughly grouped the investment distortions in two groups: investment distortions

[19] See also Allayanis and Ofek (1998).

due to asymmetric information between debtholders and shareholders which result in agency costs of debt financing (underinvestment and asset substitution) and investment distortions due to asymmetric information between the firm's old shareholders and new shareholders or the firm's shareholders and the firm's new debtholders. This asymmetric information makes external finance costly and may lead to underinvestment. We also concluded that risk management and capital structure were related.

Below we will discuss the empirical evidence. Section 3.5.2 discusses empirical evidence with respect to investment distortions caused by information frictions. Section 3.5.3 considers the interaction with the firm's capital structure and section 3.5.4 concludes on this issue.

3.5.2 Investment distortions

A first observation (from the empirical work on corporate risk management) is that almost all studies focus on the relationship between potential underinvestments either caused by an agency problem (see Proposition 4 in Section 2.3) or by the costs of external finance (see Proposition 7). Proposition 4 (in line with Bessembinder, 1991) argues that Myers' underinvestment problem may be reduced if firms enter into risk management. The underinvestment problem is larger the more debt a firm holds, and increases with the growth opportunities of a firm. We therefore expect firms with relatively high levels of debt and growth opportunities to be active in risk management (see Table 2.2).[20]

Proposition 7 (in line with Froot, Scharsfstein and Stein, 1993) argues that firms hedge to prevent underinvestment due to costly external finance. Corporate risk management allows firms to better coordinate financing and investment decisions if they protect their cash positions. The more financially constrained firms are, the larger the potential benefits of corporate risk management. The benefits of risk management are positively related to the amount of debt in a firm and the firm's growth (investment) opportunities (see Table 2.3). The theory furthermore links the benefits of corporate risk management to the firm's liquidity. The more liquid a firm, the less likely it is to benefit much from risk management.

Results with respect to the firm's debt ratio have already been reported in Table 3.3. A positive relationship between risk management and the debt ratio supports both underinvestment rationales of corporate risk management. As pointed out in the previous subsection, such a positive relationship exists, especially if we consider the *amount* of hedging as the dependent variable.

[20] Again we should stress that hedging only reduces underinvestment costs if the firm commits on a hedging contract over the life of a financial contract.

Proxy	Predicted sign	Significant	Source
R&D	+	yes, weakly	Nance
R&D/sales	+	yes some weakly	Dolde
R&D/sales	+	no	Allyanis
R&D/sales	+	yes	Geczy
R&D/assets	+	no	Howton
R&D/assets	+	yes	Gay
R&D/assets	+	yes	Graham
E/P	-	no	Dolde
E/P	-	no	Berkman
P/E	+	yes	Gay
Book/Market	_	no	Nance
Market/Book	+	no	Mian
Market/Book	+	no	Allyanis
Market/Book	+	yes, but (-)	Haushalter
Market/Book	+	yes	Gay
Debt*(M/B)	+	yes	Geczy
Debt*market/book	+	no	Graham
Cumulative abnormal returns	+	yes	Gay
Asset growth/cash flows	+	no	Berkman
Exploration activities/assets	+	yes but (-)	Tufano
Acquisition activity/size	+	no	Tufano
Capital expenditures	+	no	Graham
Investment expenditures/size	+	no	Geczy
Investment (operating) expenditures	+	no	Haushalter
Cash flow/total assets	-	yes	Howton
Costs/sales	+	yes, weak	Dolde
Advertising costs/sales	+	yes weak	Dolde
Bond rating dummy	-	yes	Haushalter
Debt constraint dummy	+	yes	Haushalter

TABLE 3.4. Underinvestment as rationale for corporate risk management

A proxy for growth opportunities are investments in research and development (R&D). There is considerable evidence in support of a positive relationship between derivatives usage and investments in R&D (often scaled with a proxy for size of investment, see Table 3.4).[21]

An alternative measure for growth opportunities is the market to book ratio (or the P/E ratio). The larger the market to book ratio (or the smaller the reverse ratio) the larger the firm's growth opportunities. Hence, a positive relation is predicted between the market to book ratio and derivatives usage. Table 3.4 shows that there is almost no evidence that supports this prediction.[22]

Gay and Nam (1998) try to more carefully identify several proxies for a firm's growth opportunities. They use five different proxies for growth opportunities, market to book ratio, Tobin's q, the P/E ratio, R&D investments and cumulative abnormal returns. The study finds that each of them is significant, when taken separately in the multiple regression analysis with other control variables, and conclude that there is strong support for a positive relationship between derivative usage and growth opportunities.

It is further shown that firms with larger investment opportunities and lower than average liquid assets (cash) make greater use of derivatives (again for each of the five measures of growth opportunity). A dummy identifying high growth opportunity and lower (than average) cash appears to be significant in determining the usage of derivatives. Finally, they find for firms that exhibit a positive relationship between the firm's pre-risk cash flows and its investments (as predicted by FSS) less derivatives usage.[23] The findings of Gay and Nam are therefore strongly in favor of the Froot, Scharfstein and Stein (1993) underinvestment story of derivatives usage (Proposition 7 in Chapter 2).

Firms with higher growth opportunity *and* high debt levels benefit most from hedging. Another specific proxy to test the underinvestment hypothesis therefore is to use an interaction variable; the product of the debt and the market to book ratio (debt*M/B). Some support for

[21]However, the use of investments in R&D as a proxy for growth opportunities is not undisputed. Allyanis and Ofek (1998) for example, suggest that investments in R&D may proxy for multinationality and therefore for the firm's exposure. R&D investments might also proxy for asymmetric information (these investments are harder to collateralize) rather than that they measure growth opportunities. They further argue that (poor) managers might use R&D investments to hide their true quality. If one finds a positive relation between risk management and R&D investments it may very well be the case that managers hedge in order to protect their own pet projects (as in Tufano, 1998, see also Proposition 12). They show that after correction for exposure the R&D/sales ratio is not significant any more. Hence, the positive relationship between R&D investments and risk management does not necessarily support both underinvestment rationales, but may simply reflect that firms with larger exposures tend to hedge more.

[22]Haushalter (2000) even finds a significant negative relationship in the oil and gas industry. Berkman et al. (1996) use the asset growth as a proxy for growth opportunities but also find it to be insignificant.

[23]They do this by focussing on interest rate derivatives.

such a relationship has been found, but the results are mixed (see Table 3.4).[24] Geczy et al. (1997) only find a significant relationship with respect to the firm's decision to hedge but not with respect to the amount of hedging.

An empirical prediction in line with Froot, Scharfstein and Stein's (1993) paper (see also Proposition 7 and Table 2.3) is that firms that are more financially constrained benefit more from hedging. Haushalter (2000) uses two proxies to test this hypothesis: a dummy indicating that a firm has a credit rating and a dummy that measures whether a firm has already more than average debt outstanding and a lower than average current ratio.[25] Both proxies are significant implying that the less financially constrained a firm is, the lower its derivatives usage.

Several recent studies explicitly focus on underinvestment due to costly external finance as the rationale for corporate risk management. For example, Allyanis and Mozumdar (1999)[26] examine the link between a firm's (pre-hedging) cash flows and its investments. If the theory of FSS is valid, then we expect that for hedging firms the correlation between a firm's pre-hedged cash flows and investments is low and non-positive. Moreover, one expects that firms whose future investments are sensitive to fluctuations in cash flows hedge more; hedging is particularly beneficial for these firms as the use of derivatives reduces this sensitivity. The results confirm this hypothesis; the investment cash flow sensitivity of the group of hedgers is significantly lower than that of non-hedgers. Allyanis and Mozumdar also find that for new users of derivatives, this sensitivity drops significantly. This paper therefore also provides support for the FSS theory.

Finally, Adam (1999) focuses on the underinvestment hypothesis for the goldmining industry since Tufano (1996) failed to find support for this hypothesis in this industry. Adam (1999), however, shows with an adjusted research design that derivatives users generally rely less on external capital sources compared to non-users and that the degree to which they hedge depends on their financial condition and ability to access the financial market.[27] Hence, he finds strong support for this hypothesis also in the gold mining industry.

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[24]Moreover, the interpretation is not undisputed. Graham and Rogers (1999) for example, consider this as a proxy for financial distress costs.

[25]Firms with a credit rating have easier access to the financial market and are therefore less likely to be financially constrained.

[26]Allayanis and Mozumdar (1999) also focus on S&P 500 non-financial firms and use the sample period 1990-1995.

[27]The difference in research design is the definition in the dependent variable. Tufano (1996) uses the firm's delta or the proportion of production that was being hedged as the dependent variable, Adam (1999) uses the income from derivatives/investment expenditures as the dependent variable.

3.5.3 Corporate risk management and the firm's capital structure

The last two sections have shown that the corporate use of derivatives is positively related to the amount of debt in a firm. Until now, we have considered this positive relationship as evidence for the hypotheses that firms hedge to reduce the expected bankruptcy costs and financial contracting costs associated with a given level of debt. However, as was argued in Chapter 2, both the costs of financial distress and contracting are also major determinants in a firm's capital structure decisions. This creates concern about the causality of the relationship between risk management and debt; does hedging increase the debt capacity of the firm (for example via an increased interest tax shield), or does hedging reduce the costs of financial distress and contracting costs associated with a high level of leverage. In this section we discuss some empirical work that explicitly analyzes the causality between debt and derivatives usage.

Geczy et al. (1997) use a two-stage estimation technique and show that a higher debt ratio induces firms to hedge more in order to reduce the agency costs of debt and bankruptcy costs. They however, do not find evidence for the reverse effect.

Graham and Rogers (1999) also apply a two stage technique. However, unlike Geczy et al. (1997) they do not use a binary dependent variable (hedge versus non hedge) but a continuous measure (net-notional value of derivatives) for derivatives usage. As in Geczy et al. (1997) they find evidence that derivative usage reduces the costs of financial distress and financial contracting costs. However, Graham and Rogers (1999) also find that the predicted value of the currency derivatives is significant in explaining the debt ratio. This is evidence that hedging also increases the debt ratio, which supports Leland (1998) and Ross (1998).[28] More specifically, Graham and Rogers, show that hedging increases the firm's debt ratio by 2.9% for interest rate derivatives and 6.9% for foreign currency derivatives. Taking this argument one step further, they use these figures to calculate the value of the tax shield associated with such an increase in the amount of debt. They estimate that due to the increase in debt capacity (from hedging) firm value increases between 2.2% and 3.5%. This expected tax benefit is ten times larger than that from a 5% reduction in cash flows due to the convexity of the tax function in Graham and Rogers (1999).

These observations are important. Hedging both serves to increase the debt capacity of firms and reduces the financial distress and agency costs related to debt financing. The increase in debt capacity is material; the tax savings are considerable especially when confronted with the tax convexity argument.

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[28]Geczy et al. (1997) do not find this. Graham and Rogers (1999) argue that this may be caused by the fact that they use a binary measure for hedging (derivatives user versus non-user) and therefore test the likelihood that hedging affects the debt ratio. Graham and Rogers (1999) use a continuous measure and thus test whether the amount of hedging affects the debt ratio.

3.5.4 Conclusions

We conclude this section with some observations. First, we have shown that risk management reduces agency costs of debt financing. Risk management seems more important for growth firms, especially with a higher debt ratio. This suggests that risk management indeed is being used to reduce Myers' (1977) agency costs of debt. We furthermore conclude that risk management at the same time allows the firm to take on more debt. Hence, the major benefit of risk management is probably not that it reduces agency costs, but more likely that it enables the firm to capitalize on its - more optimal - capital structure.

A second observation is that the empirical literature has neglected the asset substitution problem (see Propositions 5 and 6 in Chapter 2) as a rationale of corporate risk management. This may be due to the fact that clear empirical predictions have not yet been drawn from the literature.

Finally, we found particularly strong empirical support for the Froot, Scharfstein and Stein (1993) underinvestment rationale of corporate risk management caused by costly external finance. Financially constrained firms seem to hedge in order to exploit future investment opportunities. This rationalization of corporate risk management appears to be very important.

3.6 Managerialism

This section focuses on empirical evidence behind managerial incentives to engage in corporate risk management. In the previous chapter we identified several propositions in this respect. A first managerial explanation of risk management is that risk averse managers have incentives to use corporate risk management to increase the expected utility of their wealth (see Table 2.4). Managers/directors often have invested a large proportion of their wealth in the corporation and as a result hold an undiversified portfolio. These managers therefore have an incentive to reduce the variance in the cash flows received by them. Moreover, management compensation contracts are increasingly linked to the performance of the firm. Managers with compensation plans based on equity may have an incentive to engage in risk management to reduce risk. Managers holding options on firm value, on the other hand, might not even be willing to hedge.[29] Table 3.5 summarizes the proxies and the major results of this literature.[30] Standard proxies used in most of the empirical studies are the log of the total market value of common shares owned by

[29] Also performance related bonuses or targets may induce managers to engage in both hedging (to protect the outcome if a target has been reached) but also in speculating (to increase the probability of reaching some target).

[30] In a separate study (on the same dataset) Howton and Perfect (1998b) conclude that managerial motives (as a group) cannot explain corporate risk management. Howton and Perfect (1998b) use a nested Tobit model in which they include all proxies for independent variables frequently included in

officers and directors and the fraction of shares held by insiders. The more equity managers hold, the larger the private benefits from risk management. Many studies find a significant positive relationship between both the likelihood and the amount of derivatives usage and the value of managerial shareholdings. Some studies have included a proxy for large blockholders; for example the percentage of shares held by large blockholders (e.g. Tufano, 1996 and Haushalter, 2000). Large blockholders are generally well diversified and less likely than management to act like undiversified shareholders. Therefore, a negative relationship between this proxy and derivatives usage is predicted. In general, the proxy for large blockholdings is not significantly related to risk management.

With respect to options, the number or value of outstanding stock options held by management is generally positively related to derivatives usage. If the convexity of the manager's wealth with respect to the firm's stock price outweighs the concavity of the manager's utility function (thus with sufficient convexity in the manager's compensation plan) managers prefer not to hedge despite their risk aversion. Studies of management compensation show that the exercise price of these options is often set equal to the stock price at the time of the issue.[31] As a result, these options very quickly end up far in the money and thus show an apparent similarity with common stocks. It should therefore not come to a surprise that most studies find a positive relationship between the holdings of options and the use of derivatives.[32] [33] Some studies have estimated the delta and the vega of the manager's options portfolios (e.g. Graham and Rogers, 1999).[34] The latter is especially a precise proxy for convexity. The authors however do not find this to be significant in explaining the firm's risk management.

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other studies. They then leave out one group of explanatory variables at a time. This enables them to establish whether this group of variables has explanatory value.

[31] In 1998, 94% of option grants to S&P 500 CEO's were at the money (Hall and Murphy, 2000, p.1).

[32] Even if they look like stocks, they may induce managers not to hedge when a firm comes close to financial distress. It is in these cases that one should expect managers not to hedge in order to play their option. It is important however to examine the options they have; a common procedure has been to also replace the options for bad performing firms. In that case managers' option holdings are always in the money.

[33] In a recent paper, Rajgopal and Shevling (1999) find that executive stock options encourage managers in the oil and gas industry to make risky investments (exploration risk). Executive stock options however also induce managers to hedge oil price risk. They take this as evidence that CEO's hedge to avoid underinvestment in exploration projects.

[34] See Guay (1999) for an explicit discussion about compensation, convexity and the incentives to manage risk. He shows that stock options play an important role in increasing the convexity of the relation between a manager's wealth and equity value. Moreover, he shows that this convexity is increasing with a firm's growth opportunities finding some support that options are also used to reduce risk related agency costs.

Proxy	Pred. sign	Significant	Source
Log market value of management shares	+	No	Geczy
Log market value of management shares	+	yes	Tufano
Log market value of management shares	+	No	Haushalter
Log market value of management shares	+	No	Gay
Natutal logarithm of CEO stock value	+	yes weakly	Graham
Percentage of shares held by management	+	no	Berkman
Fraction of shares owned by insiders	+	yes weak but (-)	Haushalter
Log of market value of shares obtainable by man. using options (<60 days)	_	yes but (+)	Tufano
Number of outstanding management options exercisable within 60 days	_	yes	Gay
Options awarded to CEO/ salary+ bonus comp.	_	some but (+)	Haushalter
Managerial options holdings (number)	_	yes but (+)	Tufano
Total options per officer	_	no	Haushalter
Exercisable options/insider	_	yes some	Haushalter
CEO stock options holdings (number)	_	no	Graham
Percentage of large blockholders (>10%)	_	no	Tufano
5% blockholders	_	no	Haushalter
Presence of multiple classes of common stock	+	yes	Graham
Fraction of shares hold by insiders	+	no	Haushalter
Tenure of CEO's	_	no	Tufano
Tenure of CFO's	_	yes	Tufano

TABLE 3.5. Managerialism as rationale for corporate risk management

An alternative managerial explanation for corporate risk management is related to the manager's reputation. We argued in Chapter 2 that managers may have an incentive to engage in risk management to hide or to signal managerial ability. Hedging (not hedging) makes a firm's income more (less) informative with respect to managerial ability. Hence, managers may want to use risk management to affect the informativeness of a firm's income with respect to managerial ability. Hypotheses in this area have not been tested extensively (see Table 2.10). One major exception is Tufano (1996). He explicitly tests for the tenure of CEO's and CFO's as a proxy for managerial reasons for corporate risk management. More explicitly, Tufano finds a negative relationship between the tenure of a firm's CFO and risk management. Tufano suggests that this may be supporting evidence for the Breeden and Viswanathan hypothesis that good managers have incentives to hedge to more accurately signal their quality.[35] Tufano (1996) furthermore added the CEO's or the CFO's age as a proxy for his or her risk aversion; the older the manager, the larger the degree of risk aversion, and therefore the more inclined they will be to engage in risk management.[36] He however does not find any evidence of this. Other empirical studies have not tested this last hypothesis.

Two alternative hypotheses also have not received much attention in the empirical literature. First an empirical test of Tufano's (1998) hypothesis that managers hedge to reduce the firm's dependence on external capital and as such circumvent the monitoring role of financial markets (see Table 2.6 for empirical predictions).

A second managerial hypothesis that has not received much attention is that by Stulz (1990). Firms that hedge increase their debt ratio and as such reduce the costs of managerial discretion (see Table 2.5 for empirical predictions). Despite the lack of attention in the empirical literature, the positive link between debt and derivative usage (and especially the fact that hedging increases the debt capacity in a firm) supports this hypothesis. However, it remains unclear whether this results in smaller agency costs of managerial discretion.

Conclusions

We conclude with the observation that, although there is room for managerial (opportunistic) use of risk management, this is still relatively an unexplored area in the empirical research. Most of the empirical literature focuses on the interaction between derivative usage and management's stake in the corporations. The only well established relationship therefore is that between the managers' compensation package and the use of derivatives. Risk averse managers

[35] Alternatively, he suggests that it is simply due to the fact that new (and thus younger) managers are more knowledgeable about the use of derivatives and are therefore more likely to use them.

[36] As a counterargument, Tufano refers to "the over-45 factor"; older managers may be more reluctant to use derivatives since they are less familiar with these technologies. This argument would reverse the relationship.

indeed use risk management (hedging) to protect their holdings in the firm and as such increase their expected utility. In addition, risk management is related to the structure of the management compensation packages.[37]

3.7 Additional findings

3.7.1 Introduction

In this section we will briefly discuss some more empirical findings from the studies captured in Table 3.1. More specifically, we will discuss empirical evidence with respect to the relationship between risk management and firm size and we will discuss empirical evidence on alternative ways (rather than derivatives) to reduce risk. Finally, we discuss some other empirical studies that have analyzed the impact of financial risk management on the riskiness of the firm or on the value of the firm. This helps in evaluating whether firms are using derivatives for hedging or for speculating purposes.

3.7.2 Does size matter?

A common observation in most studies is that firm size matters in determining whether or not to engage in risk management. Size measured by the book or market value of the firm is in nearly all studies significantly (positively) related to the use of derivatives (see Table 3.6), but not necessarily so with respect to the amount of hedging. For example, Mian (1996) found that the mean firm value of hedging firms are significantly larger ($ 5.849 billion) than that of non-hedgers ($ 803 million). There is further evidence that the amount of hedging by a firm is negatively related to firm size. For example, Gay and Nam (1998) find for interest rate derivative usage that larger firms tend to hedge less. Haushalter (2000) finds that for those firms that hedge, the amount of derivative use is negatively related to the market value of assets. Tufano (1996) also finds a weakly significant effect.[38]

Some authors take the positive relationship between firm size and derivative usage as evidence of considerable economies of scale in setting up a risk management program. Setting up a risk management program (treasury) with sufficient control is relatively too expensive for

[37] This is in line with evidence related to managers' diversification strategies; managers holding a large fraction of the firm's stock are more likely to engage in conglomerate mergers (see May, 1995).

[38] In the empirical literature it has also been suggested that size proxies the exposure to price risks (large firms tend to have larger exposures than smaller firms). Seen in this light one would expect a positive relationship between the use of derivatives and firm size. The larger the firm is, the larger the exposure and thus also the more likely a firm will use these derivatives. Several studies (e.g. Dolde (1995) and Allayanis et al. (1998)) correct for exposure. Although this often reduces the magnitude, size remains significant in these studies.

smaller firms. It is therefore more likely that smaller firms do not hedge.[39] Another argument along this line has been made by Mello and Parsons (2000). They stressed the intertemporal financing implications of hedging decisions (see Section 2.3) and suggested that small firms simply may lack the financial strength to engage in risk management. But it is not completely clear whether these arguments hold for the typical firm size considered in these studies. The average firm size of non-derivative users in the studies presented here is generally considerable. Economies of scale would especially hold with respect to the *decision* to use derivatives and not with respect to the *amount* of risk management. Transaction costs of hedging seem relatively low; the existence of economies of scale with respect to the amount of hedging therefore is unlikely.

Irrespective of the costs of setting up a treasury, theory predicts generally a negative relation between risk management and firm size; small firms are more likely to face (relatively) larger costs of financial distress and therefore are also expected to benefit more from corporate risk management than larger firms. This suggests that larger firms should use less derivatives. With respect to the amount of hedging this conjecture seems to be confirmed.

An alternative explanation is that for smaller firms the option value of equity is higher than for larger firms because they are more likely to be in a less healthy financial condition than their larger counterparts. Shareholders of smaller (and less healthy) firms have an option that is at the money. Such an option is convex in the underlying value and therefore not hedging is the optimal risk management strategy.[40] For larger (and generally more healthy) firms, the shareholder's option is deep in the money and therefore almost linear in the underlying value. The shareholders then may even want the firm to hedge in order to protect the value of their option. This suggests that small firms should not hedge, while large firms should.

A final alternative interpretation of the size effect is that it is related to the amount of asymmetric information between firms and financiers. Larger firms generally face less asymmetric information. But how is derivatives usage related to asymmetric information? First, we can argue that the larger the asymmetric information, the larger the financial contracting costs. This would predict a positive relationship between risk management and asymmetric information. A second interpretation is that hedging reduces noise. DeMarzo and Duffie (1991) have argued that risk management enables investors to optimize their portfolios. On the other hand, if managerial discretion drives the hedging decisions, we may expect either more or less hedging. Risk averse managers will hedge less when there is a lot of asymmetric information (DeMarzo and Duffie, 1995). However, managers with private information about their high ability may want

[39]PriceWaterhouseCoopers (1995, p. 3) estimate the annual costs for a treasury function operating as a service center for a leading international corporate between UK 400k and 600k pound sterling per annum.

[40]This follows directly from Proposition 6 in Chapter 2.

Proxy	Predicted sign	Significance	Source
Firm size	+	yes	Nance
Firm value	+	yes	Berkman
Firm value	+	yes	Mian
Firm value	+	no	Tufano
Firm value	+	no	Gay
Market value of equity	+	yes	Francis
Market value of equity	+	yes, weakly	Howton
Sales	+	no	Dolde
Reserves	+	yes, weakly negative	Tufano
Log of total assets	+	yes	Geczy
Log of total assets	+	no	Graham
Market value of assets	+	yes, neg. for hedgers	Haushalter

TABLE 3.6. Size and corporate risk management

cash flows to become more informative about this and therefore choose to hedge (Breeden and Viswanathan, 1996). Hence asymmetric information can drive the hedging decision either way.

Some studies (Geczy et al., 1997 and Graham and Rogers, 1999) have included additional proxies for the existence (and extent) of asymmetric information. Both studies find a positive significant relationship between, respectively, the number of analysts following the firm and institutional ownership and derivative usage. This is in line with Breeden and Viswanathan's (1996) observation that good managers will hedge but also with the DeMarzo and Duffie (1991) explanation. An alternative explanation is that managers whose firms' equity is followed more intensely, feel more pressure and thus prefer fewer earnings surprises (and thus hedge more). Note that this idea has no theoretical underpinnings, yet. Another important result is that size remains significant in these studies. This suggests that size not only proxies for asymmetric information.

We furthermore would like to stress that most of the empirical research published thus far focuses on large firms. Risk management in smaller firms seems neglected in the literature. An exception that reveals the importance of more research on risk management by smaller firms is Howton and Perfect (1998a). They consider two samples (of large and small firms) in their empirical research on risk management. In the former sections we only presented the results for the group of large firms. This is not without reason, however, as almost all the independent variables were insignificant in explaining the cross sectional use of derivatives in the sample with smaller firms. This may point to two explanations. First, the sample with small firms may be too diverse and thus lacks the power to detect statistical significance. Alternatively, theories that appear to hold for large firms do not necessarily apply to small firms. These findings warrant further research that focuses especially on risk management of smaller firms.

3.7.3 Alternatives for derivatives in corporate risk management: substitutes or complements?

Financial risk management using derivatives is only one way to reduce firm specific risk. Firms may also engage in operational hedging. Furthermore, commodity linked bonds, diversification (functional or geographical)[41], the choice of a pension fund scheme[42], discretionary accounting decisions, changes in operating leverage (flexibility) and the purchase of insurance[43], may all help to reduce firm specific risk. Apart from that, firms can decide to choose a more conservative financial policy (lower debt ratio, and dividend pay-out and higher liquidity) and carry the risk rather than transferring it. Finally, firms can use convertibles, preferred stock, loan commitments and other very specific financial instruments to reduce incentive problems in financial contracting. Theories of corporate risk management predict only that firms engage in risk management, not so much how they should do this. Many studies therefore include proxies for some alternatives to derivatives usage in order to reduce risk as control variables. Table 3.7 summarizes these proxies and their significance in multivariate analyses of corporate financial risk management.

In general, the evidence confirms that hedging firms generally have more debt, are less liquid; and payout more dividends than non-hedgers do (see Table 3.7 and Table 3.3). This evidence suggests that the use of derivatives and financing decisions are substitutes rather than complements.

It is, however, not so clear whether cash and derivative usage are complements or substitutes. Tufano (1996) finds a positive relationship between the use of derivatives and the amount of cash balances a firm has (which suggests that they are complements). Haushalter finds no such relationship between the cash ratio (Cash flow/assets) and derivatives usage. In a recent study about the determinants of corporate cash holdings Opler, Pinkowitz, Stulz and Williamson

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[41] May (1995) and Denis, Denis and Sarin (1997) provide some evidence of managerial incentives to engage in diversification.

[42] Petersen (1994) for example, shows that firms in the US can and do use the choice of pension plans as a way to reduce cash flow volatility. Firms with more volatile cash flows and higher costs of financial distress are more likely to choose a defined contribution plan. Under such a plan, the firm makes a contribution each year and since the final retirement benefits are not specified (which other alternative firms can opt for), employees take a large part of this risk. Moreover, under defined contribution plans, firms may adjust their annual contributions to match fluctuations in cash flow. Hence, the pension plan serves as a cheap hedging instrument for these firms.

[43] Hoyt and Khang (1999) and Mayers and Smith (1990) have empirically tested for rationalizations of the corporate purchase of insurance. They found support for the claim that purchasing insurance reduces expected taxes and the agency costs associated with stakeholders conflicts in addition to providing real services.

Proxy	Predicted sign	Significance	Source
Convertible debt/value	_	no	Nance
Convertible debt/value	_	no	Gay
Convertible debt/value	_	no	Geczy
Conv.+ preferred stock/value	_	no	Howton
Preferred stock/value	_	no	Geczy
Preferred stock/value	_	no	Nance
Preferred stock/value	_	no	Gay
Dividend yield	+	yes, weak	Nance
Dividends	+	yes, weak	Francis
Dividend yield	+	yes	Mian
Dividend yield	+	yes	Geczy
Dividend pay-out	+	yes	Mian
Dividend pay-out	+	yes	Haushalter
Liquidity	-	yes	Nance,
Liquidity	-	yes	Berkman
Liquidity	-	yes	Mian
Liquidity	-	yes	Geczy
Liquidity	-	yes	Howton
Cash ratio	-	yes weak	Howton
Cash balances	?	yes +	Tufano
Cash ratio	?	no	Haushalter
Debt maturity	-	yes but (-) for interest rates	Mian
Diversification	?	yes (+)	Tufano
Diversification	-	no	Haushalter
Accounting method	?	yes, some but complements	Haushalter
Production mix	?	yes for amount, no for decision	Haushalter

TABLE 3.7. Alternatives for corporate risk management

(1999) do not find support that derivative usage and cash are substitutes but find some evidence that the amount of derivative usage and cash are complements.[44]

With respect to diversification, the results are even less clear to interpret. Tufano (1996) finds a positive relationship between the amount of diversification and the amount of risk management, while Haushalter (2000) finds a negative relationship for the oil and gas market. The use of convertibles and preferred stock appears not to be significantly related to the use of derivatives.

Two recent papers focus more explicitly on the choice among several risk management strategies: Petersen and Thiagarajan (1997) and Geczy, Minton and Schrand (1999). Petersen and Thiagarajan (1997) focus on the risk management strategies of two firms in the goldmining industry (both in the sample used by Tufano, 1996), each firm at one end of the spectrum of hedging strategies. Homestake Mining hardly hedged any of its exposure, while American Barrick hedged almost 100% of its exposure to gold price risk.[45] Petersen and Thiagarajan, however, found that the equity returns of both firms were similarly exposed to gold price risk suggesting that Homestake Mining used several alternative mechanisms to reduce risk. More specifically, they show that Homestake Mining had lower costs of adjusting the quality of ore that they extracted over time and thus were better able to adjust their cost structure to changes in gold prices. Petersen and Thiagarajan furthermore signal a difference in strategy that may explain American Barrick's emphasis on hedging; Homestake Mining built a reserve through exploration, while American Barrick built a reserve via (capital intensive) acquisitions. Most investment opportunities for American Barrick took place at times the gold price risk was low. To reduce the reliance on external capital, it was more important to engage in hedging for American Barrick. Petersen and Thiagarajan (1997) furthermore present some evidence that the compensation structure in American Barrick was different from that in Homestake Mining; American Barrick was more equity focused while Homestake Mining had more bonuses related to firm profitability. Both compensation structures induce managers to hedge, however, not in the same way. Homestake Mining used more risk management instruments directed to hedge the accounting impact on earnings (costs and changing accounting definitions) and thus risk management focused upon firm profitability. American Barrick on the other hand used derivatives to affect the volatility in cash flows (and thus equity value). The use of derivatives and alternative forms of risk management are substitutes rather than complements in this study.

Also Geczy, Minton and Schrand (1999) explicitly focus on the interaction among alternatives that firms may use to engage in risk management. They examine risk management choices

[44]Opler et al. (1999) show that cash/total assets are significantly positively related to size, growth opportunities and a firm's credit rating.

[45]Tufano (1996) excludes American Barrick in most of his empirical multivariate tests because of the firm's unique characteristics.

in the gas industry and find that the use of financial derivatives is a substitute for both cash holdings and storing gas underground.[46] Moreover, they show that firms that extensively use derivatives are less profitable and more likely to be in financial distress compared to firms that hold cash or store gas themselves.[47]

Finally, Carter, Pantzakis and Simkins (2001) empirically tested how US multinationals use operational versus financial hedging in foreign exchange risk management. They find that multinationals use these alternative forms of risk management as complements rather than as substitutes in corporate risk management.

We conclude from this that it still remains an open question whether derivative usage and other forms of risk management are complements or substitutes. It seems that this depends very much on the alternative forms of risk management that are being considered. Derivatives usage and self-insurance (through a conservative financial strategy) seem to be substitutes, while derivatives usage and other specific forms of risk management are more often complements.

3.7.4 Does risk management effect the riskiness and the value of the firm?

In this subsection we briefly describe the results of some empirical work that explicitly analyzed the impact of risk management on firm value and risk.

Hentschel and Kothari (1997) and Guay (1999) examine to what extent derivative usage increases or decreases firm risk. Hentschel and Kothari (1997) analyze data from the 425 largest US firms and find that firms using derivatives do not have a higher risk profile compared to non-users. Firms thus do not speculate but the amount of risk reduction is not all that impressive.

Guay (1999) studies 254 non-financial firms in the US that just started using derivatives. He first shows that (non) users are larger (smaller), have higher (lower) leverage (changes), a higher (lower) operating income volatility, lower (higher) total risk and lower (higher) firm-specific risk than new users of derivatives. Guay then shows that new users of derivatives significantly reduce their price risk, total risk and firm-specific risks. The mean reduction in stock return volatility, interest rate exposure and exchange rate exposure was approximately 5%, 22% and 11% respectively. New derivative users do not change their market risks. These results are robust over a variety of specifications and confirm some of the theories of corporate risk management (financial distress, and the underinvestment hypothesis). Note that the amount of risk reduction due to the use of derivatives in both Guay (1999) and Hentschel and Kothari (1997) is quite moderate. This may partly be explained by the observation that firms not using derivatives typically apply alternative ways to reduce risk.

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[46] Cash holdings and gas storing appear to be complements.

[47] They further show that accounting earnings management strategies do not have a real affect on cash flow volatility and that diversification is unrelated to financial derivatives usage.

Allayanis and Weston (1999) study the impact of derivative usage on a firm's Tobin's Q. Firms that use derivatives have a 5.7% higher market value on average, compared to those that do not.[48] This result is robust for a large variety of control variables. Moreover, the amount of hedging (measured by the ratio of foreign currency derivatives to foreign sales) is fairly well explained by firm characteristics. Regressing a firm's Q ratio on the amount of derivatives usage on a variety of proxies for derivatives usage [49] together with proxies that traditionally explain a firm's Q ratio fairly well, reveals that the level of hedging is unrelated to firm value. This suggests that there is no universal optimal level of hedging, but that the optimal level is firm-specific.

Hence, preliminary evidence indicates that risk management generally reduces risk and increases firm value. The benefits of risk management (hedging) therefore on average seem to outweigh the potential negative impact on firm value of managerial corporate risk management.

3.8 Discussion

We have presented a wide variety of theories that have received some empirical support. The empirical evidence brings both good and bad news. The good news is that most of the theory is not completely without empirical support. The bad news is that the dispersion in empirical results among the different studies (both in content and methodology) is significant; there is not too much congruence among the different studies. Table 3.8 for example summarizes for which hypothesis each study finds the strongest support. The results are widely dispersed. In addition, there are still quite a few gaps; in particular managerial rationalizations for corporate risk management have not received sufficient attention in the empirical literature. Below we comment on the empirical importance of each driving force.

With respect to taxes as a rationale for corporate risk management, we conclude that the empirical evidence is very weak. Empirical work does not support the notion that firms with income in the convex part of their tax scheme will hedge more. On the other hand, simulation-based evidence suggests that a small group of firms may benefit considerably from a reduction in volatility in their taxable income (especially for smaller firms).

We do find support for the bankruptcy costs rationale hypothesis. However, it is difficult to explicitly identify and isolate the benefits of risk management in relationship with reducing the expected costs of bankruptcy; proxies for bankruptcy costs and financial contracting costs are related.

With respect to the investment distortions (due to financial contracting problems) rationale of corporate risk management, we find the strongest empirical support. Leverage and growth

[48] They focus on 700 firms from Compustat with assets over $ 500 million over the years 1990-1995.

[49] The authors use foreign currency derivatives/foreign sales, and the square and cube of this ratio.

Authors	Find strongest support for:
Graham and Rogers (1999)	Increase debt capacity/reduce fin. contracting costs
Gay and Nam (1998)	Reduce underinvestment
Houston et al. (1998)	Reduce fin. contracting costs/underinvestment/taxes
Haushalter (2000)	Reduce underinvestment/bankruptcy & fin. contracting costs
Allayanis et al. (1998)	Reduce financial contracting costs/underinvestment/Exposure
Geczy et al. (1997)	Reduce fin. contracting costs/ underinvestment
Tufano (1996)	Managerial risk aversion
Mian (1996)	Size
Berkman et al. (1996)	Bankruptcy costs/taxes
Dolde (1995)	Reduce fin. contracting costs/underinvestment
Nance et al. (1993)	Reduce underinvestment/Size
Francis et al. (1993)	Size/bankruptcy costs

TABLE 3.8. Major conclusions of empirical studies on rationalizations of corporate risk management.

opportunities of a firm are positively related to derivatives usage while liquidity is negatively related; firms hedge more if they face a higher probability of being financially constrained (Froot, Scharfstein and Stein, 1993). The empirical evidence furthermore suggests that risk management not only reduces the costs of financial distress and contracting costs associated with a financial structure, but also that it facilitates a more aggressive financial structure (with more debt) and therefore increases the expected value of tax shields (and other potential benefits of having more debt).[50]

With respect to managerial reasons for corporate risk management, we conclude that there is evidence that managers hedge to protect the expected value of their compensation package. Managers compensated with stocks tend to hedge more. Managers with more options also tend to hedge more. These observations are perfectly in line with Smith and Stulz (1985). The evidence is not on its own; May (1995) for example found that managers holding a large fraction of shares in the firm were more likely to engage in conglomerate mergers.

Other managerial reasons have not been subject to empirical scrunity. Proxies derived from information-based theories (e.g. DeMarzo and Duffie, 1995; Degeorge et al., 1996; Ljungqvist, 1994; and Breeden and Visvanathan, 1996) have been scarce in the empirical research to date.

[50]To allow for interdependencies between these policies one should require a specification of a simultaneous equations model that reflects such interaction. (See for example Smith and Watts, 1992 and Mian, 1996 for a discussion and Titman and Wessels, 1988 for such a setup.) Mian (1996) however, argues that empirical tests based on such a simultaneous equations model may potentially be even worse. Since the current finance theory does not allow one to describe the structural form of such a system of equations adequately, the results will be biased when the structure is incorrect.

The most important challenge for future empirical research in this area therefore is to develop and test hypotheses derived from these theories. This is especially important since managers seem to have strong incentives to use risk management to their advantage as described in the literature.

What else is apparent from the empirical evidence? Small firms less frequently use derivatives than large firms, even when corrected for other firm-specific proxies such as exposure. For those firms that use derivatives, however, there is a negative relationship between firm size and the amount of risk management. The evidence supports that there are scale economies in the use of derivatives and that the use of derivatives is fairly well explained by the desire to reduce financial contracting costs or the reliance on external financing. Firms that can easily tap the financial markets (large, unconstrained firms) generally take smaller hedge positions. Apart from that, we conclude that our empirical knowledge of risk management seems restricted to relatively large firms. The benefits/costs of financial risk management of small firms are relatively unexplored.

Another interesting finding is with respect to financial and other forms of risk management. It is important to realize that the use of financial derivatives is only one way for firms to reduce cash flow volatility. Diversification of activities, operating leverage, the choice of accounting principles, and cash holdings also may reduce cash flow volatility. An interesting and unresolved question remains as whether these instruments and corporate hedging are substitutes or compliments. The evidence is still mixed. Some preliminary evidence suggests that taking risk (self-insurance) and a less aggressive financial strategy is a substitute for financial risk management. Other alternatives for financial risk management (e.g. operational hedging) seem to complement financial hedging. An interesting area for future research is to determine conditions that make one form of risk reduction more optimal compared to others.