Theoretical explanations of corporate hedging

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ARTICLE INFO	ABSTRACT
	This study surveys theoretical models providing alternative rationales for corporate hedging. Across the revised models, corporate hedging is defined, variously, as any insurance contract, as any activity reducing the correlation of the firm value with some random variable and as holding derivative financial instruments. Alternative models can be separated into those arguing that reducing risk at the corporate level may be value-enhancing (failure of the Modigliani-Miller theorem) and those arguing that corporate hedging is an outgrowth of shareholder-manager conflicts (failure of the Fisher Separation theorem). Few studies model or simply suggest possible incentives to increase risks through derivatives. This survey emphasises the relevance of models that do not focus on the firm's capital structure only, but rather conceive hedging as a tool to coordinate both financial capital and investment. This stream is potentially important to interlink financial and real decisions under uncertainty. A thorough examination of the contributions within the so called "managerial risk aversion hypothesis", often interpreted as providing similar predictions, reveals that different, sometimes opposite, predictions can be identified and lead to the conclusion that most of the empirical tests on corporate hedging based on stock options can be considered uninformative on the managerial incentives to hedge.

1. Introduction

This study surveys the theories of corporate hedging arising from financial market imperfections, seeking reasons why a non financial firm might decide to hedge.

The theoretical literature on corporate risk management developed between the middle of the 80s and the 90s as an outgrowth of the corporate finance standard models. Alternative hypotheses explaining corporate hedging have been proposed, each of them derived by introducing one or more imperfections into the neoclassical set of assumptions on which both the Fisher Separation and Modigliani-Miller Theorems hold. During the last decade, the theoretical research has lost vivacity and the studies on corporate hedging have specialised almost exclusively on empirical testing. This survey could be conceived as an instrument for scholars wanting to revitalise the theoretical research as well as to scholars researching new directions for the empirical work.

The study of Smith and Stulz (1985) is broadly considered the first theoretical model aiming to explain corporate hedging, founding this stream of economic literature. Since then, different studies have explained corporate hedging as arising from the corporate tax schedule (Smith and Stulz, 1985), the costs of financial distress (Smith and Stulz, 1985, Shapiro and Titman, 1985; Cooper and Mello, 1999; Downie and Nosal, 2001), the external finance costs (Bessembinder, 1991; Froot et al., 1993; Spanò, 2004),the agency costs (Smith and Stulz, 1985; Stulz, 1984, 1990; Li-Ming and MacMinn, 2006), the signalling problems (Rebello, 1995; De Marzo and Duffie, 1995) or a combination of a number of these factors (Leland, 1998).The study of Leland (1998) can be considered as the last tentative integration of several existing approaches that had

arisen over thirteen years into a single general model.

One reason why the theoretical research has not advanced could be found in the excess of analytical complication and problems of endogeneity, as well as in the loss of clear guidance to empirical work involved in the ambitious program of pursuing a general model of corporate hedging. As a result, researchers have been progressively interested in comparing different existing partial models in the light of the empirical evidence rather than exploring new hypotheses or more general models. Nevertheless, new directions for the theoretical research are still desirable. For example, recent empirical studies have underlined the lack of theoretical explanations for the empirically documented practices of corporate risk increasing policies (Faulkender, 2005; Adam and Fernando, 2012). To follow this suggestion, this survey emphasises how some of the hypotheses produced to explain hedging can also be adapted to explain speculation.

Most of the contributions examined in this survey are regularly mentioned in the empirical studies on corporate hedging. However, they are often oversimplified or even misinterpreted in order to focus on testable predictions. In the interest of both theoretical and empirical research, this survey provides an accurate synthesis of the theory of corporate hedging by emphasising the differences across studies, especially those that are usually grouped together and are broadly believed to have reached more or less the same conclusions. In this respect, special attention will be paid to a stream of models dealing with conflicts between managers and shareholders, which are often considered as belonging to a single "managerial risk aversion hypothesis" explaining hedging.

A further purpose of this survey is to underline the importance of a subset of studies where corporate hedging results in affecting not only the financial capital structure but also the investment decision of a firm. Deriving - rather than assuming - the investment decision allows for modelling the link between financial structure and real activity, therefore it is potentially helpful to any study working to overtake single firm models and to embed risk management analysis into a description of the wider economy.

The reminder of the paper is organised as follows: Section 2 places the studies explaining corporate hedging in the perspective of the economic literature; section 3 distinguishes between different definitions of corporate hedging adopted in the literature; section 4 surveys the contributions justifying corporate hedging gas a value-enhancing strategy which arises from financial market imperfections; section 5 surveys the studies interpreting corporate hedging as an outgrowth of the conflict of interests between managers and shareholders; section 6 concludes.

2. Corporate hedging in the context of economic literature

Risk management was first discussed in the context of finance theory, where only financial markets and not corporations are considered. Only from the middle 80s did corporate finance theory also start to deal with risk management.

This topic, which is at the heart of the analysis of the connections between financial and real decisions under uncertainty, covers fields of research treated by both finance and economics. Although these disciplines have been developing separately and autonomously, they share a common cornerstone, which can be traced back to the theoretical results of the Fisher Separation theorem and the Modigliani-Miller theorem (Eichberger and Harper, 1997; Brennan, 1996). The Fisher Separation theorem holds that shareholders can agree unanimously that profit maximisation is the appropriate objective for the firm, which implies that owners can fully delegate the control of the firm to managers. This result makes it possible to rule out the firms, in the finance literature, or to reduce them to profit maximising operators liquidating profits to shareholders, in the macroeconomic literature (Cochrane, 2001). Regarding risk management, shareholders should only be concerned with this, the firm's risk strategy being irrelevant if not wasteful. The Modigliani-Miller theorem holds that "the average cost of capital to any firm is completely independent of its capital structure"(Modigliani and Miller, 1958, p.268.), thus shareholders are indifferent to a firm's financial policy as they are able to diversify unsystematic risk perfectly and require a risk premium as compensation for systematic risk (the market risk, generally known as "beta" in the CAPM model). In other words, *unsystematic (diversifiable) risks do not affect the value of the firm* (Cuthberson, 1997, Eichberger and Harper, 1997).

Yet the theoretical research has established that, when there is uncertainty, both separation and the irrelevance of finance propositions hold under very restrictive conditions (Eichberger and Harper, 1997, pp.140-165), and also the empirical evidence is hardly consistent with them. The theory of corporate finance can actually be seen as an outgrowth of the rejection of these results, as it develops models of a firm operating under alternative settings (Harris and Raviv, 1991; Shleifer and Vishny, 1996).

As Shapiro and Titman (1985) wrote, "modern finance theory holds that the value of a firm is equal to its expected future cash flow discounted at the appropriate interest rate. Financial economists have concerned themselves almost exclusively with the effect of risk on market discount rates, for the most part ignoring its effect on expected cash flow"(Shapiro and Titman, 1985, p.41; see also Stulz, 2002).Risk exposure can generate costs, which ultimately affect the firm's stream of future cash flow, thus the firm's value, given the discount rate. As will be shown in more detail throughout this survey, hedging at the corporate level can help to reduce these costs, thus to increase the firm's value. Risk, in other words, can be optimally reduced at the corporate level and risk management can legitimately be appropriated and treated by the theory of corporate finance.

As Froot, Scharfstein and Stein (1993) point out, once the assumptions of the Modigliani-Miller theorem are violated, corporate finance theory can try to answer questions that are left unanswered by finance theory: while finance theory provides some instruments to implement the portfolio management of some marketable risk (for example, oil price, exchange rate, interest rate, share prices risks and so on), and specifically to price the hedging instruments used (Baxter and Rennie, 1999),[2] it provides "much less clear cut guidance .... on the logically prior questions of hedging strategy: What sorts of risks should be hedged? Should they be hedged partially or fully? What kinds of instruments will best accomplish the hedging objectives?" (Froot et al., 1993, p.1629-30).

In the light of the two aforementioned neoclassic theorems describing a frictionless world, the studies explaining corporate hedging can be divided into two groups. A first group of studies, surveyed in section 4, maintain that the objective of the firm is to maximise shareholder wealth, but they claim that this can be increased by reducing risk at the corporate level (failure of the Modigliani-Miller theorem). Other contributions, surveyed in section 5, also challenge the view that the objective of the firm is to maximise shareholder wealth and claim that corporate hedging is a decision made by self-interested managers having information that shareholders (or new investors) do not have (failure of the Fisher Separation theorem).

Table 1 summarises the classification of the theoretical studies surveyed in the next sections, by grouping them on the basis of two dimensions: the rationale for corporate hedging (rows, from sections 4 and 5) and the definition of hedging(columns, from section 3).

By contrast, there is a number of studies on corporate hedging, which are not surveyed in this work because they do not focus on the question: "Why could a non financial firm decide to hedge?". These are, firstly, theoretical models describing risk management at the corporate level as the consequence of a firm's risk aversion. An assumption that a firm hedges simply because it is risk averse is nowadays exposed to the criticism of "ad hocery": firms in economic theory are normally seen as risk-neutral operators, whereas the attitude towards risk is rather related to the preference structure of the individuals. Examples of studies that assume a risk averse firm are earlier models such as Johnson (1960), Stein (1961) Feder, Just, and Schmitz (1980), Rolfo (1980), Anderson and Danthine (1981) Marcus and Modest (1984), Detemple and Adler (1988), or more recent contributions such as Neuberger (1999), Broll and Eckwert (1999), Battermann, Braulke, Broll and Schimmelpfennig (2000), Axel and Muller (2003). This survey does not treat models, such as Diamond (1984), Merton and Perold (1993), Froot and Stein (1998), describing risk management strategies in financial companies. Financial firms are different from non financial ones, either because of their type of business or because they play the role of the *principal* in the principal-agent conflicts. Finally, this surveys does not discuss contributions applying risk exposure measuring techniques to a firm's cash flow (Cash Flow at Risk), such as Linsmeier and Pearson (1996), Miller (1998), Daripa and Varotto (1998), Froot (2001), Stein, Usher, LaGattuta and Youngen (2001).

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[2] The most famous model associated with finance theory is Black and Scholes (1973), which allows any investor to price the options issued against some marketable risk.

Table 1.1: Rationales for Hedging (rows) vs. Definitions of Hedging (columns)

	Insurance contract	Reducing correlation	Derivatives
Expected taxes	Mayers and Smith (1982)	Smith and Stulz (1985)	MacMinn (1987)
Financial distress	Mayers and Smith (1982)	Shapiro and Titman(1985) Smith and Stulz (1985)	Cooper and Mello (1999) Downie and Nosal (2001)
Agency problems (managers-shareholders)		Smith and Stulz (1985) Stulz (1990)	Stulz (1984)
Adverse selection problems (insiders-outsiders)	Rebello (1995) Huberman (1997)		
Agency/signalling problems (managers-shareholders)	Breeden and Viswanathan (1990) De Marzo and Duffie (1995)	Li Ming and MacMinn (2006)	
Underinvestment		Stulz (1990)	Bessembinder (1991) Froot, Scharfstein and Stein (1993) Spanò (2004)
Integrated approach			Leland (1998) Leland and Toft (1996) Brown and Toft (2002) Ross (1997) Stulz (1996)

Although this work surveys theories of corporate hedging, it should not be forgotten that derivative financial instruments can be used to increase as well as to reduce risk exposure. Some authors carrying out empirical work have addressed the question of whether the use of financial derivatives is value-enhancing as it reduces risk exposure or whether it is value-enhancing in itself. In the latter case, the purpose of using derivatives is not to hedge but to speculate. Faulkender (2005) and Adam and Fernando (2012) document some evidence supporting this second hypothesis and claim that the purpose of speculation "has received little attention in the literature on corporate risk management" (Adam and Fernando, 2012, p.284). Little attention is better than no attention. This survey will underline where the existing hypotheses explaining corporate hedging are able to provide, or at least implicitly to suggest, rationales for speculating at the corporate level.

3. What is corporate hedging: different definitions

This section distinguishes three definitions of corporate hedging adopted in the theoretical literature. Hedging has been viewed: (i) as a generic insurance contract, (ii) as any action reducing covariance between a firm's value and a state contingent variable or, more specifically, (iii) as the activity of holding derivative financial instruments to reduce the exposure to marketable risks.

3.1 Hedging as generic insurance contract
The study of Myers and Smith (1982) can be thought of as the very first attempt to bring the risk management issue into the modern theory of corporate finance. Apart from establishing the field of research, their contribution is certainly relevant in that it provides a first definition of hedging.

Hedging is in Myers and Smith (1982) is defined as a *purchase of an insurance contract*. The authors' concern was specifically oriented to explaining the determinants of a firm's insurance in the context of a theory – which takes its origin from the studies of Coase (1960) and, successively, Fama and Miller (1972) – describing the corporation as a sort of primary market of explicit and implicit long-term contracts among different claimholders: bondholders, shareholders, employees, customers, suppliers. As the contracting

process is expensive, it is optimal for the corporation to allocate risk to those claimholders able to bear the risk at a lower cost (through diversification), i.e. bondholders and shareholders. Corporate hedging arises in that the amount of risk to allocate to stockholders and bondholders is limited by the amount of capital. Insurance contracts thus offer the possibility to reallocate the risk from the other claimholders that cannot diversify to a generic insurance company. The higher such claim holders' fraction of claims, the higher the insurance purchased at the corporate level.

Purchasing an insurance contract is thus seen by Myers and Smith (1982) as a specific way to allocate the risk, the alternative being diversification in the financial markets. Following the formal definition of Huberman (1997), let N and K be the number of non insurable and insurable states of nature, respectively, occurring with probabilities p_n and q_k. There are thus NK possible states of nature. The firm evaluation of the state (n, k) is $y_n + z_k$. The insurable component has zero expected value: $\sum q_k z_k = 0$. A fair insurance arrangement is a set of insurable-state contingent claims $\{w_k\}$ such that $\sum q_k w_k = 0$. After the insurance arrangement, the firm's payoff in state (n, k) becomes $y_n + z_k + w_k$.

Focusing on reducing risk through means that are alternative to shareholder diversification is a first step that makes the theory of corporate finance concerned with hedging. It should be noticed, however, that this insurance-like definition of hedging involve adverse selection and moral hazard problems that cannot be dealt with in the market of derivatives. Although alternative and more precise definitions of hedging have been proposed in subsequent research, some studies on risk management, for example, Rebello (1995) and Huberman (1997), still treat the activity of hedging through derivatives as equivalent to the activity of stipulating insurance contracts.

3.2 Hedging as reducing correlation

A more general definition of hedging is provided by Smith and Stulz (1985), whose article can be considered as path-breaking in the literature on corporate risk management. Although Smith and Stulz (1985) refer explicitly to hedging as holding derivative financial instruments, their definition includes other ways to hedge, for example, a merger, or a change in a real operating decision, as well as a decision on the optimal capital structure (debt maturity, debt-equity ratio, etc.). What such actions have in common to be considered as "hedging" is the reduction of the dependence of the firm's value to some specific, state-contingent variable. Therefore, *hedging is any action that reduces or eliminates the covariance between the firm's value and the value of a generic state variable*.

In a more formal way, the value of the firm, V, depends on a vector of state variables, S. Let $V(S)$ be the value of a firm that does not hedge, and let a and b be two firms that differ from $V(S)$ only in their hedging choices with respect to the state variable i. Firm a is said to hedge more than b if the absolute value of its value's covariance with i is lower than that of firm b (Smith and Stulz, 1985, p.392). The action of the opposite sign, i.e. any action that raises the dependence of the firm's value to a state variable, is defined as "reverse hedging" (Smith and Stulz, 1985, p. 402) or, in common language, speculation.

Smith and Stulz (1985) argue that addressing the problem of hedging in terms of the definition outlined is slightly different to addressing the risk management in terms of purchasing an insurance contract, as Myers and Smith (1982) do, because the latter is a real service provided by some professional skilled in evaluating and managing specific types of risks, whereas "forwards or futures contracts provide no apparent real services" (Smith and Stulz, 1985, p.391, note 3).

However, the definition of Smith and Stulz (1985) can be considered as sufficiently broad to include the insurance contract among the actions defined as hedging, in that it is a possible means to reduce the covariance between the firm's value and a state variable. For the same reason, in this definition there is no distinction between financial and real risk-reducing techniques, as hedging may refer to a purchase of a forward contract as well as to a change in a project of investment.

An example of real risk reducing technique is the localisation of the production in different countries to hedge against currency risk. Multinational companies may be incentivised to implement an operational hedging policy by locating the production in different countries with the purpose of aligning local currency production costs and revenues more closely. As Chowdhry and Howe (1999) point out, the cost of the operational hedge is certainly higher than the cost of the financial hedge (through derivatives). Operational hedging, therefore, is a sensible strategy to hedge risks that cannot be managed with financial instruments, such as demand uncertainty, for which financial derivatives, due to moral hazard problems, cannot be issued.[3]

3.3 Hedging as holding derivatives

Other authors, such as Froot, Scharfstein and Stein (1993), De Marzo and Duffie (1995), Breeden and Viswanathan (1990), Broll and Eckwert (1999), Neuberger (1999), Battermann, Braulke, Broll, and Schimmelpfennig (2000), use a narrower definition of hedging, explicitly referring to it as the activity of holding derivative financial instruments. In their definition, *hedging means holding derivative financial instruments to reduce or eliminate the covariance between the firm's value and the value of an underlying asset subject to market price fluctuations* (typically, commodity price, exchange rate, interest rate fluctuations).

Hedging in terms of holding derivatives implies the absence of asymmetric information and moral hazard problems, which are typically dealt with by the insurance companies. This underlines a peculiarity of purchasing derivatives with respect to purchasing insurance contracts, which cannot be captured by the general definition of Smith and Stulz (1985).The authors defining hedging as holding derivatives are often interested in investigating the different effects of different derivative financial instruments (for example, the effects of linear vs. non linear hedging, i.e. futures and forwards vs. options). The following example is taken from Froot, Scharfstein and Stein (1993), p.1645-1647.

The linear hedging can be formalised as a contract that allows one to reduce or amplify the firm's value fluctuations in the following way:

$$V = V_0[h + (1-h)\varepsilon],$$

where V_0 is the initial value of the firm, ε the market variable to be hedged and h the hedging ratio. It is linear as the sensitivity of the firm's value to the variable to be hedged is constant:

$$\frac{dV}{d\varepsilon} = (1-h)V_0.$$

The purpose of the firm is to maximise its profit with respect to h, which would be set independently from the realisation of the state of nature. On the other hand, with a non linear hedging instrument, such as an option, the hedging ratio, h, would be state-dependent, hence, the derivative of the firm's value to the variable to be hedged would not be constant. Let $p(\varepsilon)$ be the frequency distribution of ε. Under the assumption of complete markets, the firm's maximisation problem would be to choose a profile of its value across states of nature to maximise expected profit,

$$\max_{V(\varepsilon)} \int \pi(\varepsilon, V(\varepsilon)) p(\varepsilon) d\varepsilon,$$

subject to the constraint that hedging does not change the expected value (fair-pricing constraint):

$$\int_\varepsilon V(\varepsilon) p(\varepsilon) d\varepsilon = V_0.$$

Froot, Scharfstein and Stein (1993) show that the solution of this problem implies that the optimal profile of the firm's value, $V^*(\varepsilon)$, solves a differential equation which is a function of both the value of the firm and the variable to be hedged:

$$\frac{dV^*(\varepsilon)}{d\varepsilon} = l(V^*(\varepsilon), \varepsilon).$$

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[3] See also the comment of Hau (1999) on a possible improvement of the model and Mello, Parsons, and Triantis (1995) for another example of a multinational firm managing operational and financial hedging.

4. Corporations hedge to maximise expected value

The article by Smith and Stulz (1985) is the first one in which the rationale for hedging is not assumed but rather derived from financial market imperfections, invalidating the Modigliani-Miller result on the irrelevance of the capital structure. By explicitly modelling the market imperfections on the origin of the motivations for hedging, Smith and Stulz (1985) completed the process of appropriation of risk management issues by the theory of corporate finance. This change in perspective with respect to the earlier studies opened the way to modern research on the rationales for corporate hedging: as hedging is no longer justified by some *ad hoc* assumption of risk aversion, it becomes necessary to investigate possible sources for the concavity of the firm's value which induces hedging, holding the assumption that the firm is risk-neutral.

Some of the models on corporate hedging, following the contribution of Smith and Stulz (1985), hold that the objective of the firm is to maximise shareholder wealth and share the view that corporate hedging can increase the expected value of a risk-neutral firm as long as some market imperfection makes the value a concave function of some state contingent variable. According to this approach, and in contrast with models surveyed in the next section, managers' interests are aligned to those of the firm's shareholders.

4.1 Expected tax (effective tax code)

Smith and Stulz (1985) derive a model where the concavity of the post-tax firm value is due to the tax structure. Shareholders are interested in maximising the post-tax value. The crucial assumption is that the marginal tax rate on a corporation is an increasing function of its pre-tax value, i.e. taxes are a convex function of the corporate income. Consequently, the post-tax value is a concave function of the pre-tax value. Reducing the variability of the pre-tax value without changing its expected value implies that the expected post-tax value increases (as the expected tax liabilities decrease).

In the absence of hedging costs, the first best solution is fully to hedge the fluctuations of the pre-tax profit in order to minimise the expected tax liabilities. In this case the (pre-tax and post-tax) profit would be fixed at its expected level, and would not depend on the hedgeable state contingent variable. Full hedging is no longer optimal when hedging is costly. In such a case it is convenient to reduce the profit variability up to the point where the cost of hedging equals the benefits.

The benefits of hedging for an unleveraged company are modelled in the following way. Let $\pi(0)$, the post-tax value of the firm, be given by

$$\pi(0) = \sum_{i=1}^{S} p_i(\pi_i - T(\pi_i)\pi_i),$$

where p_i is the current price of a unit of money to be delivered in state of the world i (i.e. the probability that the state of the world i occurs), π_i the pre-tax value, and $T(\pi_i)$ the tax rate of the pre-tax value. Suppose there are only two alternative states of the world, j and k. To eliminate the firm's value variability, the firm chooses a hedge portfolio H_i, such that $\pi_j + H_j = \pi_k + H_k$. The hedge portfolio is assumed to be self-financing, i.e. $p_j H_j + p_k H_k = 0$. Let $\pi^H(0)$ be the value of the firm that completely hedges. The benefits of hedging are given by the difference between $\pi^H(0)$ and $\pi(0)$:

$$\pi^H(0) - \pi(0) = p_j\big((T(\pi_j)\pi_j - T(\pi_j + H_j)(\pi_j + H_j)\big) + p_k\big((T(\pi_k)\pi_k - T(\pi_k + H_k)(\pi_k + H_k)\big).$$

By the concavity of the payoff function, this difference is always higher then zero. Hence, hedging increases firm value if the transaction costs of hedging do not exceed $\pi^H(0) - \pi(0)$.

Corporate taxes and tax credits are also examined in the theoretical work of MacMinn (1987), which demonstrates that a firm can hedge its production decision in order to protect either depreciation deductions or tax credits, thereby raising its value. More recent contributions involving corporate tax motivations to hedge are surveyed in subsection 4.4.

4.2 Financial distress (bankruptcy costs)

Smith and Stulz (1985) introduce a further possible factor that may determine the concavity of the firm value into their simple framework. They assume that the firm can raise debt in order to create a tax shield, and that bankruptcy is costly. In the presence of bankruptcy costs, the assumption of the convexity of the tax function can be relaxed, as even with a linear tax function, the bankruptcy costs again imply a concave post-tax value function. Smith and Stulz (1985) show that, within this framework, hedging can reduce the firm's financial distress by reducing the probability of the firm being unable to repay the debt.

This approach to hedging brings into discussion the conflict of interests between shareholders and bondholders, first analysed in the studies of Jensen and Meckling (1976), Myers (1977), and Smith and Warner (1979), which show that shareholders have an incentive to change a project from safer to riskier after bonds are issued and priced. Although hedging increases the expected value of the firm, it redistributes wealth from shareholders to bondholders by reducing the probability of bankruptcy, thus the expected bankruptcy cost, which is borne by bondholders. Smith and Stulz (1985) mention this problem and state that a promise to hedge after issuing debt is not credible as it is not in stockholders' interests. In their model, in which the investment project is given by assumption, shareholders can maximise their wealth by deciding not to hedge. Based on the authors' argument, one might argue that shareholders could even carry out a so called "reverse-hedging" (or speculation) policy, which increases the riskiness of the firm's payoff and redistributes the expected wealth to shareholders further. Although Smith and Stulz (1985) do not refer to this possibility, their model is clearly open to extensions explaining corporate speculation within a framework where bondholders and stockholders have conflicting interests.

In a more recent theoretical contribution, Cooper and Mello (1999) model a corporation which hedges to raise its equity value by reducing the expected cost of bankruptcy. The model does not simply incorporate the conflicts of interest between the different parties in the firm, but it also accounts for the conflict between the firm and the counterparty of the hedging program. As the authors point out, the price of the hedging contract cannot ignore default risk, nor can it be independent of the particular hedging application for which the contract is used. Therefore, while the theoretical research on optimal hedging usually ignores the cost of hedging, this model integrates optimal hedging and the cost of hedging in a unified framework. A first implication of the framework built on these assumptions is that corporate hedging is viable when debt holders can price the debt to include the valuation of a particular hedging policy. This can be done by including explicit covenants enforcing the hedging policy or by directly committing the management to it. By contrast, when bondholders only write covenants to protect the value of the debt, hedging can be optimal only if the hedging counterparty holds a significant portion of the firm's debt. Therefore, banks lending to corporations are "in the best position to become the counterparty of the hedging transaction", whereas bondholders may undermine the possibility for a corporation to hedge at a favourable cost (Cooper and Mello, 1999, p.197). The model also underlines how different hedging contracts affect both hedging policy and the firm's value.

Downie and Nosal (2001) build a model in which hedging (through futures contracts) prevents default on contractual obligations in a non-competitive Stackelberg market setting. The model describes two firms competing for a given market demand. In order to gain a first-mover advantage, a firm may decide to sell its output at a precommited delivery price, thereby being exposed to the risk of input price fluctuations, leading to default in some states of the world. The firm commits to delivery "if the expected profit associated with delivery in all states is greater than the expected profit associated with default in some states" (Downie and Nosal, 2001, p.3). If this is the case, the firm can commit to delivery in all states of the world by purchasing futures contracts whose underlying asset is sufficiently correlated with its input prices. By demonstrating that hedging may reduce the firm's expected payoff, the model also explains why a firm could decide not to hedge against the risk of default.

4.3 Underinvestment (costs of external finance)

Most of the models on corporate hedging do not pay attention to the investment decisions of the firms, as they assume the investment to be fixed and they focus instead on the choices of the optimal capital structure. A valuable exception is the model of Stulz (1990), which will be discussed further in subsection 5, as it addresses the link between capital structure, investment and risk management in a setting of conflict of interests between managers and shareholders. Other models investigating the link between financial capital, hedging and investment are those of Bessembinder (1991) and Froot, Scharfstein and Stein (1993). The underinvestment effect is similar to the mechanism described in Myers (1977), where a firm takes a

decision about investment by endogenising the costs of financial distress.

Bessembinder (1991), following Myers (1977), builds a model where senior claims generate incentives to under invest for the firm's shareholders. Hedging is value-enhancing as it reduces such incentives and bounds the firm's equity holders to undertake additional positive net present value (NPV) projects.

In Froot, Scharfstein and Stein (1993), the link between investment and risk management is addressed in a general context of costly external finance, which may well include an assumption of manager-shareholder conflict as a special case, as long as it makes externally obtained funds more expensive (Froot et al., 1993, pp. 1633-34). The key point of the explanation for hedging is that "without hedging, firms may be forced to under invest in some states of the world because it is costly or impossible to raise external finance" (Froot et al., 1993,pp. 1633).

The general framework of Froot, Scharfstein and Stein (1993) is articulated in different settings. The first simplest setting considers a firm facing an investment and financing decision with costly external finance. The internal funds are hit by a random shock, and the risk management decision is about whether or not to hedge against their fluctuations. The expected profit function is a concave function of the internal funds, the concavity depending on both the investment technology and the financing cost function. In this setting it is optimal for the firm completely to hedge its internal fund fluctuations.

A second setting introduces a possible specification of the external cost function in terms of costly-state verification approach. The costly external function is thus derived as an optimal solution of the behaviour of rational maximising agents and not just assumed, as in the simplest framework.

A third setting describes the optimal hedging solution when either investment or financing opportunity changes. In particular, it derives non closed-form solutions for hedging when internal fund fluctuations are related (partially or fully) to either investment opportunities or financing opportunities. Compared to the simplest setting, now the risk strategy includes the two alternatives of fully hedging or not hedging at all as special cases, whereby partial hedging, over-hedging or reverse-hedging (speculation) can be optimal choices as well. The hedging strategy appears to be strongly dependent on the value of the coefficient expressing the relation between internal funds and investment (or financing) opportunity. Spanò (2004) developed this setting further, by specifying the external cost function in terms of expected bankruptcy cost. He derived a closed form approximate analytical solution for hedging and thoroughly analysed its properties and empirical implications. According to this extension, based on numerical simulations of the model, the event of speculation may occur when a firm (for example, a high-tech company)faces both increasing costs of borrowing and high profitability of its investment, in which case the firm prefers to increase the cash flow volatility in order to stabilise the debt around its expected level.

A fourth setting describes the hedging behaviour in a context where a multinational firm has sales and production opportunities in a number of different countries. The optimal hedging strategy determines in which currency the wealth is held (domestic currency, foreign currency or a combination of the two).

Finally, a fifth setting introduces non linear hedging instruments, i.e. options. The hedging ratio becomes state-dependent, as discussed in subsection 3.3 of this survey. Options appear to be better hedging instruments when value-maximising hedge ratios are not constant.

4.4. Integrated approach (tax motivations, financial distress and agency costs)
Other theoretical contributions consider how some of the approaches to corporate hedging surveyed in this section can interact with each other.

Tax motivation and financial distress motivation to hedge are examined jointly in Stulz (1996) and Ross (1997), on the intuition that hedging, on one hand, reduces the probability of financial distress while, on the other hand, it increases debt capacity and interest deductions.

Brown and Toft (2002) build a model in which any of the motivations to hedge (corporate taxes, bankruptcy costs, agency costs, etc.) can generate costly states of nature. The model's aim is not to explain corporate hedging but to describe how a firm could hedge when it faces costly state verification and multiple sources of uncertainty, some of which are unhedgeable. Under these assumptions, a firm designs an optimal hedging strategy involving different hedging instruments, such as forwards, simple options or

exotic derivatives. The authors conclude that exotic derivatives are better hedging instruments than simpler derivatives when prices are highly correlated to quantities and when quantity risks are substantially higher than price risks.

Leland and Toft (1996) and Leland (1998) integrate tax motivations, financial distress and agency cost motivations to hedge. They aim at building up a theory that is able to offer quantitative advice to corporations on their capital structure. The model by Leland and Toft (1996) describes a firm that chooses the amount and the maturity of its debt by balancing tax advantages of debt, bankruptcy costs and agency costs. The risk issue enters into the model to the extent that "the model predicts different shaped term structures of credit spreads for different levels of risk" (Leland and Toft, 1996, p.987); however, the risk level is given exogenously.

In a subsequent work, Leland (1998) introduces the optimal choice of the risk level. It describes a firm that simultaneously chooses the capital structure (level and maturity structure of debt) and the investment risk in a framework where, again, tax advantages, default costs and agency costs are balanced. In Leland (1998) the firm chooses the risk strategy *ex post*, i.e. after setting the level of the debt. The comparison between the firm choosing the risk strategy ex-post and an otherwise-similar firm choosing its risk strategy *ex ante* (precommitment) gives a measure of agency costs associated to the asset substitution (stockholder-bondholder conflicts). This measure is calculated for a range of environments. It appears that, for realistic values of the parameters, the agency costs are not higher than the tax advantages of debt, and "hedging benefits are not necessarily related to environments with greater agency costs" (Leland, 1998, p. 1237). Therefore, shareholders may agree to hedge even though hedging benefits the bondholders, because the tax advantages of reducing risk (which allows for raising debt) more than offset the agency costs.

The tentative integration between tax motivation and agency cost motivation of capital structure, together with risk management issues, justifies the ambition of the model of Leland (1998) to be a sort of further step towards a general theory of corporate capital structure. The agency costs considered, however, are those generated by the stockholder-bondholder conflict only. Neither in Leland and Toft (1996) nor in Leland (1998) are the stockholder-manager conflicts considered. Furthermore, "dividend (payout) policies and investment scale are treated as exogenous. And information asymmetries are ignored." (Leland, 1998, pp. 1214-5).

5. Corporation hedge because managers are misaligned

The Fisher Separation theorem states the conditions under which, in a context of uncertainty, "delegating authority to a group of managers whose instructions are to maximise the firm's profit is consistent with shareholder expected utility maximisation" (Eichberger and Harper, 1997, p.139). While this theorem, as well as the Modigliani-Miller theorem, leaves no role for a manager who may have superior information about project returns, the corporate finance literature has developed several contributions, the first one being that of Jensen and Meckling (1976), based on settings where shareholders are not able to observe the action of their managers perfectly (or without paying a cost). In the presence of agency costs due to asymmetric information between shareholders and managers, the latter can pursue their own interest, which may conflict with shareholders' wealth maximisation.

5.1 Managerial discretion (agency problems)
The agency problem can be applied to corporate risk management. As Smith and Stulz (1985) pointed out, risk management depends not only on the sign, but also on the curvature of the relationship between managerial wealth and firm value. The managerial compensation contract is therefore crucial in this matter as a disciplining tool available to shareholders so that managers increase their own expected utility by increasing the expected value of the firm. A widely used example to illustrate this concept is based on the assumption that the manager is a risk averse individual who (partially or totally) holds the corporation. If his/her wealth is invested in the corporation, then the manager may be motivated to reduce firm risk more than an unaffiliated, diversified shareholder. Therefore, one possibility to align the manager to the shareholder's expected wealth is to provide the manager with stock options, which creates a convexity in the managerial remuneration structure that offsets his/her risk aversion (Prowse, 1992, p.1127; see also Panousi and Papanikolaou, 2012).

Li-Ming and MacMinn (2006) deepen the analysis of stock option incentives to hedge and reach a quite mixed conclusion. In their model, two types of hedging instruments are considered: a forward contract and an insurance contract. Differently from Smith and Stulz (1885), corporate executives can hold a portfolio as a personal account or diversify that portfolio. As a result, stock options in managerial compensation schemes do not align managers to shareholders, rather they encourage managers to carry out overinvestment and increase risk. Managers paid in common stock are indifferent between carrying out a corporate hedging policy through forward contracts or not, whereas managers paid in stock options do not purchase forwards, in order to avoid reduction in the option value. On the other hand, managers paid in stock options may gain from purchasing corporate insurance, thereby reducing the investment closer to the optimal level. In conclusion, managerial incentive to hedge is positive with an insurance contract and negative with a forward contract.

In Stulz (1984) a continuous-time model is presented in which managers decide the hedging policy against foreign currency fluctuations and shareholders decide managerial compensation. This model emphasises the role of the managerial compensation, the exchange rate dynamics and the hedging costs on the active hedging policy. Managers maximise lifetime utility function, which is an increasing function of the changes in the value of the firm. The hedging policy is implemented by holding both foreign bonds and forward contracts. The optimal hedging strategy depends on the setting adopted as follows: (1) when the price of consumption goods is fixed, the exchange rate affects managerial remuneration only through the firm's income; (2) when the price of consumption goods changes stochastically, the optimal hedging depends on the contrast between the terms of trade effect and the price effect on the foreign exchange rate; (3) when holding forwards is costly, the total holding of foreign bonds decreases and the currency exposure of the firm is larger.

While the investment decisions are given in Smith and Stulz (1985) and Stulz (1984), where only the links between financing policy and hedging are discussed, Stulz (1990) addresses the problem of the investment decision in connection with managerial motivations to hedge. The model of Stulz (1990) is another tentative link, different from that of Froot, Scharfstein and Stein (1993), between the capital structure, the investment and the risk management policies of the firm. The model builds on the conflict of interests between managers and shareholders and develops the idea, previously addressed by Jensen (1986), of an overinvestment possibility due to some free cash flow available to the managers. What is meant by overinvestment is investment in negative NPV projects. The basic assumption that generates the conflict of interests is that managers' expected wealth increases with the total amount of the investment, therefore, managers tend to invest as much as possible, even though the amount of investment does not maximise shareholders' wealth. Shareholders can issue debt in order to force the managers to pay out cash flow, reducing the funds available and inhibiting investment. This is a good solution to avoid the free cash flow and the overinvestment, but it has a negative effect in the case of low cash flow, as positive NPV projects are not undertaken and the management is forced to under invest. Neither the investment decisions nor the cash flow available can be observed by shareholders. In this framework, Stulz (1990) derives the optimal capital structure (debt-equity ratio) under different assumptions about the management wage structure. The optimal capital structure appears crucially to depend on the probability distribution of the cash flow, thus on risk management.

The first best value of the firm, π^*, is given by the return on the positive NPV investments plus the present value of the firm's cash flow:

$$\pi^* = PI^* - I^* + E(V),$$

where I^* is the quantity of positive NPV projects, the projects being ordered from the highest to the lowest NPV, $P > 1$ is the revenue on the positive NPV investment (assuming constant returns to scale on positive NPV projects), V is the cash flow. For the reasons outlined before, such a first best is not reachable and the shareholders have to deal with agency costs and choose the capital structure of the firm. The value of the firm is given by

$$\pi = \pi^* - \int_{I^*}^{\infty} (V - I)(1 - N)g(V)dV - \int_0^{I^*} (I - V)(P - 1)g(V)dV,$$

where $N < 1$ is the revenue of the negative NPV project and $g(V)$ the distribution of V. The two terms under the integral represent, respectively, the overinvestment and the underinvestment costs. Both terms

crucially depend on the distribution of the cash flow available to the managers.

Hedging in this work is defined as any action that replaces the cash flow distribution, $g(V)$, with a distribution that dominates $g(V)$ in the sense of second-order stochastic dominance. The cash flow volatility, and consequently the hedging strategy, appears to be crucial for determining both the amount of the investment and the optimal capital structure.

Stulz (1990) shows that a reduction in volatility improves the ability of the financing policy to reduce the cost of managerial discretion. The less volatile the cash flow, the more likely are the funds available to be close to the target. Therefore, there exists an incentive for the shareholders to force managers to commit themselves to a hedging policy, on one hand, and an opposite incentive for the managers to increase the cash flow volatility, i.e. potentially to speculate, on the other hand. In Stulz (1990) only the shareholders' risk-reducing incentive is mentioned. This theoretical result contrasts with the predictions of the model of Smith and Stulz (1985); nevertheless, it has received little attention in empirical studies on corporate hedging. The problem of what sort of incentive should be designed for the managers to behave well is left open in Stulz (1990).

5.2. Adverse selection (signalling problems)

The literature on managerial signalling about the firm's quality originates from the contributions of Akerlof (1970), Ross (1977), Leland and Pyle (1977), Myers and Majful (1984). Rebello (1995) develops a model of adverse selection with hedging as a signalling instrument. More precisely, the firm's quality is signalled to outsiders through both operating revenues and insurance risk. High quality firms are always associated with high expected cash flow, although their insurance risk may be either higher or lower than low quality firms. The manager is informed about the firm's quality. His/her objective is to maximise the intrinsic value of the existing equity holders by choosing both the optimal level of insurance coverage and a security (new equity or debt) to finance the hedging policy and the positive NPV project. Due to the investors' uncertainty about the firm's quality, both the security issued and the insurance contract may be mispriced. Rebello (1985) points out that there are "trade-offs between mispricing of the firm's financing and the insurance contract" (Rebello, 1985, p.23) and analyses the effects on both insurance and finance decisions of the variables affecting the adverse selection costs on insurance contracts. The determinants of the magnitude of adverse selection costs are the size of the insurable loss, the sensitivity of insurable risk to firm quality, the sign of the relationship between firm quality and insurance risk.

Rebello (1985) finds that the insurance decision can strongly affect the optimal security design, and therefore the firm's capital structure. There are two extreme cases: when the firm does not purchase insurance at all, either equity or debt can be optimal financing tools; when the firm purchases full coverage to the insurable risk, only the debt is optimal. It appears that the firm has different insurance policies depending on the magnitude of its insurable losses. When such insurable losses are small, the firm chooses either self-insurance with equity financing or full insurance with debt financing. When insurable losses are high, debt more than equity facilitates signalling favourable information, for a large set of parameters.

The model of Rebello (1985) implies the following empirical predictions about announcement effects of debt and equity issues: (i) the variance of the announcement effects is larger for samples of firms with high information asymmetries on insurance risk, low information asymmetries on operating revenues, large insurable losses; (ii) the returns on announcements increase with the level of insurance coverage; (iii) announcement returns are higher for samples of debt issues (debt is more likely to signal favourable information); (iv) the variance of the coverage ratios is larger as firms have smaller insurable losses; (v) insurance premia are increasing and convex in coverage level; (vi) insurance premia are higher for firms that rely more heavily on debt.

Huberman (1997) builds another model that justifies corporate hedging based on adverse selection problems. The setup describes heterogeneous borrowers facing interest rate risk. A comparison is carried out between an economy where the interest risk is not insurable and an economy where the firms can hedge against it. It appears that in the former economy there are higher adverse selection problems than in the latter. The explanation relates to the reasons why a firm fails to repay the debt. Failure can be due to either a bad state of nature incurred or to the firm's bad quality. In the economy without hedging possibility, the lenders are not able to distinguish between these two cases, therefore there can be adverse selection.

When interest rate hedging is possible, the bad states of nature are compensated for by a positive flow of cash given by the hedging contract; therefore, if the firm fails to repay the debt, it is not because of bad states of nature outside its control, but rather because it is a bad quality firm. Better firms are thus encouraged to hedge against the exogenous risk, and hedging gives a positive signal about the firm's quality.

5.3 Disclosure of hedging policy (agency/signalling problems)

De Marzo and Duffie (1995) and Breeden and Viswanathan (1990) develop other models of hedging in between the signalling and the agency cost approaches. They see risk management as a signal of the managers to the shareholders in a setup of asymmetric information.

The intention of the model of De Marzo and Duffie (1995) is to provide some insight into the question, debated in the early 90s, about whether or not firms should account for their hedging policy by disclosing their use of financial derivatives.[4] The optimal hedging policy adopted by the managers in this model appears to be strongly dependent upon the type of accounting practices enforced by the law on hedging activity disclosure. The main result of the model is that, in shareholders' interest, managers should not be legally forced to disclose ex ante their hedging policy, even though the disclosure increases the value of the firm. The authors stress the informational effect of hedging to derive this result.

The environment described by De Marzo and Duffie (1995) is a shareholder-manager conflict where shareholders learn about the quality of the investment projects by observing the firm's performance (profits), which is thus linked to future wages. The source of the asymmetric information is not the quality of the managers, on which there is perfect information, but the risk exposure of the investment project to some potentially hedgeable risk, on which the managers are more informed. As the managers are concerned with the accounting consequences of their hedging decision, they make their decision on hedging accordingly. In this setup there are two opposite equilibrium solutions depending on the accounting standard in force. If the firm is not committed to disclosing its hedging policy, full hedging appears to be the best strategy, as it reduces profit variability, which in turn reduces the wage variability of risk averse managers. If disclosure is compulsory and hedging is observable, full hedging, by eliminating a source of noise, would align the profit to managerial performance; therefore, risk averse managers are incentivised to not fully hedge, in this way reducing the informative signal associated with the profit performance.

5.4. Empirically relevant considerations

The studies on managerial motivations to hedge are heterogeneous and provide different and sometimes opposite predictions. However, the empirical literature on managerial incentives to hedge generally agrees on the validity of the following proposition, considered representative of all theoretical studies: *firms with a higher proportion of assets held by the management hedge more*. Such a prediction derives from the argument that corporate managers investing part of their own wealth in the corporation may lead a firm to hedge against marketable risks as their wealth becomes more sensitive to the firm's market value. However, as this section has clarified, the theoretical studies do not unequivocally agree on this prediction. While Smith and Stulz (1985) point out that the manager whose wealth is invested in the corporation may be motivated to reduce firm risk more than an unaffiliated, diversified shareholder, Stulz (1990) argues that shareholders are more motivated to hedge than managers, as a reduction in volatility improves the ability of the financing policy to reduce the cost of managerial discretion. De Marzo and Duffie (1995) also stress that the effect of the compulsory disclosure of hedging is to motivate risk averse managers to not fully hedge against the risk exposure of the investment project, whereas Rebello (1995) and Huberman (1997) point out that, because managers pursue the objective to signal the quality of the firm to the market, the hedging strategy strongly affects the security design and the firm's capital structure.

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[4]Since the 90s companies have been committed to disclosing their derivative usage: the US companies from 1995 (after SFAS 119 was issued), the UK companies only from 1999 (after FRS 13 was issued). See also Graham and Rogers (2002).

Table 2: Managerial shareholder conflicts and empirical implications
Panel A. Alternative theoretical predictions

	Traditional managerial risk aversion hypothesis	Untraditional managerial risk aversion hypothesis
Authors	Smith and Stulz (1985) Rebello (1995) Huberman (1997) Li-Ming and MacMinn (2006)- insurance	Stulz (1990) De Marzo and Duffie (1995) Li-Ming and MacMinn (2006) – forwards
Who wants the firm to hedge?	Managers	Shareholders
Firms whose managers hold a higher share of assets hedge…	more	less

Panel B. Empirical implications of traditional managerial risk aversion hypothesis
Smith and Stulz (1985), Rebello (1995), Huberman (1997), Li-Ming and MacMinn (2006) - insurance

	Firms whose managers hold common stock hedge…	Firms whose managers hold stock options hedge…
Firms whose managers hold a *higher* share of assets hedge…	more	less
Firms whose managers hold a *lower* percentage of assets hedge…	less	more

Based on the (wrong) assumption that the aforementioned proposition is generally agreed, the empirical studies have extensively tested the prediction that *firms with more executive stock options in their remuneration schemes hedge less than firms whose managers own common stocks*, as stock options create a convexity in remuneration that offsets risk aversion (Tufano, 1996; Géczy et al., 1997; Schrand and Unal, 1998; Guay, 1999; Knopf et al., 2002; Rogers, 2002;Rajgopal and Shevlin, 2002; Ertugrul et al., 2008). This test, moreover, relies on the further assumption that the share of managerial wealth does not vary significantly across firms. If managerial ownership is sufficiently low for some firms (or, alternatively, if the same quote of the company's stock is distributed across many managers), then the incentive to hedge might be weaker for managers than for shareholders and shareholders may be incentivised to increase, rather than mitigate, managerial risk aversion. Moreover, as the aforementioned study of Li-Ming and MacMinn (2006) establishes, stock option incentives to hedge may be strongly dependent on the hedging instrument adopted. Finally, as Rogers (2002) points out, option-based incentives present serious problems of endogeneity, as firms with higher ex ante risk levels attract managers less averse to risk, and CEOs of risky firms may demand more stock options in their portfolio structure. As a consequence, the empirical test based on stock options may not be informative any longer, in that there might be cases of firms with more executive stock options which hedge more than firms whose managers own common stocks.[5]

In the light of this section, Table 2, in Panel A, divides the existing contributions usually grouped together into two groups providing opposite predictions: a "traditional" one, pooling studies whose predictions are usually tested in the empirical work, and an "untraditional" one, whose predictions are generally left unmentioned. Panel B illustrates how the prediction on stock option interacts with the level of managerial ownership, according to the "traditional" types of prediction.

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[5]Spanò (2007) presents an empirical study on managerial incentives to hedge that is not committed to the assumption that the relationship between the manager's stake and corporate hedging is unequivocally positive.

7. Concluding remarks

This survey has focused on the theoretical models able to explain why a non financial firm might decide to hedge.

The theoretical studies surveyed are different in their adopted definition of corporate hedging. This is defined, variously, as any insurance contract (Myers and Smith, 1982), as any activity (operational and/or financial) which reduces the correlation of the firm value with some random variable (Smith and Stulz, 1985) and, more specifically, as the activity of managing financial risk through the use of derivative financial instruments (Froot et al., 1993).

The models aiming at explaining rationales for corporate hedging maintain that the firm is risk neutral. Alternative explanations rely either on the argument that reducing risk at the corporate level may increase shareholders' wealth (failure of the Modigliani-Miller theorem) or on the argument that corporate hedging is at the centre of the conflicts of interest generated by asymmetric information (failure of the Fisher Separation theorem). The rationale for corporate hedging may thus arise from alternative hypotheses, such as the corporate tax schedule (Smith and Stulz, 1985), the costs of financial distress (Smith and Stulz, 1985; Shapiro and Titman, 1985; Cooper and Mello, 1999; Downie and Nosal, 2001), the external finance costs (Bessembinder, 1991; Froot, et al., 1993; Spanò, 2004), the agency costs (Smith and Stulz, 1985; Stulz, 1984, 1990; Li-Ming and MacMinn, 2006), the signalling problems (Rebello, 1995; De Marzo and Duffie, 1995) or a combination of a number of these factors (Leland, 1998).

Although the surveyed theoretical models of risk management focus on policies reducing risks, some of them suggest that there can be motives for corporate speculation through derivative financial instruments. Both shareholders in conflict with bondholders (Smith and Stulz, 1995) and managers in conflict with shareholders (Stulz, 1990) may be incentivised to speculate. Moreover, speculation could be an optimal solution in a setting of increasingly costly external finance (Froot et al., 1993; Spanò, 2004). As Adam and Fernando (2012) point out, theoretical research on corporate speculation has not (yet) sufficiently developed.

Most of the existing studies consider the firm's output as given and focus on hedging as a tool to determine the firm's optimal financial capital structure only. Aminor stream of models conceives hedging as an instrument to coordinate both financial capital and investment. Among them, Froot, Scharfstein and Stein (1993) outline different settings where the use of derivative financial instruments reduces the incentive to underinvest, and Stulz (1990) addresses underinvestment in connection with managerial motivations to hedge. These approaches, in that they interlink financial and real decisions under uncertainty, can be conceived as attempts to bridge the gap between studies belonging to the generally separate fields of corporate finance and macroeconomics. If future research providing a micro foundation to macroeconomics wants to deal with corporate hedging issues, the aforementioned models in which the investment is endogenously determined are likely to prove more helpful than others.

The empirical literature has often presented authors building models on managerial incentives to hedge as belonging to a single hypothesis and providing similar predictions. This survey has established that, within the so called "managerial risk aversion hypothesis", different, sometimes opposite predictions can be identified. In the light of a more accurate examination of the theory, it can be argued that empirical tests on corporate hedging based on stock options, which have been widely carried out, can be hardly considered as informative on the managerial incentives to hedge. A more thorough knowledge of the theory should suggest new ideas and tests for future empirical work.

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