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Abstract

Classic financial theory relies on the absolute perfection of capital markets, which results in one of the milestones of theoretical corporate finance: the firm's value is invariant to the choice of capital structure. As an extension to the aforementioned proposition by Modigliani and Miller (1958), corporate risk management is also futile.

Nevertheless, it is clear that capital markets do not work with absolute perfection. There exist frictions which make risk management decisions essential for firm's value. Moreover, derivatives' market vast importance is a good proxy of the relevance of hedging decisions for corporate finance.

There is a remarkable volume of literature which tests the effects of risk management and hedging decisions for the value of the firm, mainly for the US corporate market. However, there is little effort on this subject for markets which work even farther from absolute perfection.

This document undertakes such task for the Colombian market. Focused on non-financial firms and the local's most liquid derivatives market, we find that for a panel of eight large Colombian corporations the growth rate of Tobin´s Q depends significantly on firm´s size and hedging. After controlling for relevant financial variables such as firm´s profitability and leverage, and other variables such as firm´s age, results suggest that an increase in hedging leads to a higher growth in firm´s value.

Keywords: Modigliani-Miller, risk management, hedging, firm value, emerging market, Tobin´s Q.

JEL Classification: G32, G30, L25.

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1. Introduction

Classic financial theory relies partly on the absolute perfection of capital markets. This assumption states that markets are highly competitive and their participants are not subject to frictions.[1]

Under such assumption, Modigliani and Miller[2] -MM- develop three propositions, of which this paper deals mostly with the first one:

> […] *the market value of any firm is independent of its capital structure and is given by capitalizing its expected return* […].

The main consequence of this proposition is that no matter what *financial transactions* the firm contracts, its market value is the sum of the net present value of the cash flows produced by the existing assets and the net present value expected from future investments.

Within the term *financial transactions* there are a broad number of transactions, including derivatives contracts. Then, according to MM, there is no reason why a non-financial firm would enter into a derivatives contract, either for hedging or speculative purposes.

Notwithstanding this enduring theoretical proposition, firms do contract derivatives. The main explanations for such disagreement between theory and reality hover around the existence of frictions such as agency costs, bankruptcy costs, transactions costs, commissions, contracting and information costs, taxes, among others.[3]

A noteworthy volume of literature tests the effect of such frictions on risk management decisions and on the value of the firm, but mainly for the US corporate market. Unfortunately, little literature exists on this subject for emerging markets.

In order to contribute to the analysis of risk management decisions for emerging markets' firms, this document undertakes the task of testing if Colombian non-financial firms that decide to hedge via derivatives contracts exhibit a market value premium.

Two issues have to be acknowledged for this task. First, Colombian derivatives market is relatively small, where the foreign currency derivatives account for the majority of the volume and number of transactions; thus, the analysis uses foreign currency derivatives as the universe of derivatives.

Second, very few firms in Colombia are listed in the stock exchange. In this study we use a balanced panel of eight of the most traded non-financial corporations. This second issue has an important implication in terms of the estimation methodology: unlike traditional panel data

[1] A highly competitive market implies that there is atomistic competition, where the number of consumers and firms is large enough so that no agent is in a position to influence or manipulate market prices; that is, all agents take prices as given (Danthine and Donaldson, 2002). The absence of frictions means that costs are nonexistent.
[2] Modigliani and Miller (1958).
[3] Modigliani and Miller (1958), Damodaran (2002) and Crouhy *et al.* (2006).

analysis, where the number of panels is relatively large vis-à-vis the number of time periods, in this case we have a large number of time periods and a short number of cross-sectional units. In this context, it results reasonable to specify a unique conditional mean function across units and to model heterogeneity across large units in the specification of the variance-covariance matrix. (Greene, 2003)

This document is organized as follows. The next section is dedicated to a review of the literature on risk management and hedging rationale for corporate finance. The third section covers a brief survey of the Colombian derivatives market. The fourth part presents the methodology and main results. The last section concludes.

2. Risk management and hedging rationale for corporate finance

Risk management, as defined by Condamin *et al.* (2006), is a continuous for making and carrying out decisions that will reduce to an acceptable level the impact or uncertainties of the exposures bearing on a firm.

In order to reduce the impact or uncertainties of its exposure, the firm may choose to hedge using an on-balance-sheet strategy or an off-balance-sheet strategy. The former relates to changing the exposition of its balance sheet (e.g. relocating production facilities or matching the currency denomination of the assets and liabilities to avoid currency risk, also known as operational hedge), and the latter to contracting instruments such as derivatives.[4] Given the authors' purpose, risk management and hedging will be treated indistinctly, meaning the acquisition of off-balance-sheet financial assets with the purpose of reducing the variance of the firm's payoffs.[5]

Whether to hedge risk or not has been an issue since the beginning of risk management. Most of the foundations of financial theory conclude that under some assumptions financial risk management is vain. Not only those theoretical assumptions are clearly unrealistic, but the evidence shows that firms and investors do manage financial risk, and they devote a great amount of resources to do so.

This section will make a brief review of both theoretical and practical basis for corporate risk management.

2.1. Financial theory and the rationale against risk management

Modern capital structure theory began in 1958 with Modigliani and Miller[6] –MM- paper on the effects of capital structure on firm's value, which has been recognized as the most influential

[4] Nance *et al.* (1993).
[5] This definition of hedging is similar to the one by Smith and Stulz (1985), but the inclusion of the off-balance-sheet feature is our own.
[6] Modigliani and Miller (1958).

financial article ever written[7]. Their main finding relates to the irrelevance of the capital structure, namely the mix of debt and equity, for the firm's value.

MM irrelevance of the capital structure (also known as MM's Proposition-I) relies on the following assumptions[8]:

- Firms can issue only two types of securities: risk-free debt and equity;
- Financial markets are frictionless (there are no transaction costs);
- There is no corporate or personal taxation;
- Firms cannot go bankrupt;
- Information symmetry (insiders and outsiders have the same information);
- No agency costs (management acts on behalf of shareholders);

According to MM, because investors can take debt just like any firm, in a perfect market they have no reason to pay a premium for firms doing something they can do at no cost by themselves. As Ross (1977) points out, the simplest proof of MM's argument is that if the leverage of a firm changes and decreases its value, then by purchasing the firm (or a proportion of it) and reissuing the value maximizing financial package on personal account (or as a reformed corporate structure), individuals could realize an arbitrage profit; since such profits are inconsistent with equilibrium, the value of the firm must be constant across all financial packages.[9]

The main intuition behind MM's is that the cost of capital of the debt-issuing firm is higher than the only-equity issuing firm because the shareholders of the former bear both operating risk and debt (financial) risk, whereas the shareholders of the latter incur operational risk only. This intuition is then formalized in MM's Proposition-II, which recognizes that by increasing the leverage, the shareholder is charged with an increasing financial risk for which he will demand a premium; thus, under the perfect market assumptions, the raise in expected returns related to leverage is cancelled out by the rise in risk, so shareholders' wealth is unaffected.[10]

As MM concludes, their findings also lay out the foundations for a theory of the valuation of firms and shares in a world of uncertainty. As a natural inference from MM's first proposition, the firm's market value results solely from the sum of the net present value of the cash flows produced by the existing assets and the net present value expected from future investments; therefore, the value of a firm cannot be changed merely by means of *financial transactions*[11].

According to MM and given that the definition of *financial transactions*[12] contains the derivatives concept, it can be inferred that the value of a firm cannot be changed by means of contracting such instruments.

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[7] Brigham and Houston (1998).
[8] Quiry *et al.* (2005).
[9] Nevertheless, due to i) higher interest rates for individual borrowing; ii) limitations on amount on debt that individuals can borrow from the market iii) transaction costs and iv) special tax provisions, individual borrowing is no substitute for corporate borrowing. (Stiglitz, 1974)
[10] Quiry *et al.* (2005).
[11] Crouhy *et al.* (2006). The italic emphasis is our own.
[12] Financial transaction refers to the creation, liquidation, or change in ownership of financial assets. (Kaliski, 2001)

Another influential article by Sharpe (1964) would entail a similar conclusion. CAPM (Capital Asset Pricing Model) establishes that in a world of perfect capital markets, firms should not try to diversify their idiosyncratic risks, but worry about their systemic risks only. As discussed by Aretz *et al.* (2007), CAPM assumes that investors can achieve risk reduction at least as efficiently themselves through diversification or hedging[13], thus making any risk management transaction by the firm redundant[14]; likewise, Quiry *et al.* (2005) asserts that under Sharpe's assumptions, investors are not interested in the firm's underlying financial engineering, because they could duplicate such operations themselves.

Moreover, the perfect capital market assumption also implies that the prices of all assets will fully reflect their risk characteristics. Hence, as derivative's prices should fully reflect their characteristics, to acquire such instruments cannot increase the value of a firm in any lasting way. This would mean that corporate risk management is a zero-sum game, unable to increase earnings or cash flows.[15] Additionally, Bartram (2000) points out that those arguments supporting the irrelevance of corporate risk management are based on international parity conditions between currencies, interest rates and commodity prices.

Some other non-theoretical reasons not to hedge risk can also be found. For example, Crouhy *et al.* (2006) mention some practical objections to hedge: the potential distraction from the firm's core business; the skills, knowledge, infrastructure and data acquisition and processing requirements[16]; the potential risks of a not carefully structured and monitored risk management strategy; the new U.S. SEC disclosure requirements and new accounting standards, which increase the cost of compliance and may reveal the firm's intentions or future transactions.

2.2. Risk management rationale and evidence

MM's and Sharpe's findings, despite being the foundations of modern capital structure theory and of modern pricing theory, rely on some unrealistic and questionable assumptions. As Aretz *et al.* (2007) concludes, in the presence of capital market imperfections, which consist of agency costs, transaction costs -such as bankruptcy and financial distress costs, and taxes-, corporate risk management constitutes a means to enhance shareholder's value.

Literature exhibits a consensus around the aforementioned factual distortions that justify risk management. This paper will classify and present those distortions as opportunities for the firm to exploit by means of taking advantage of i) tax shields; ii) financial flexibility; iii) the

[13] CAPM assumes that all idiosyncratic risks (or firm's specific risk) are diversified by the investors when constructing a well diversified portfolio, where the perfect capital markets assumption of a costless diversification and absence of economies of scale also apply. (Allayannis *et al.*, 2001; Crouhy *et al.*, 2006) The remaining risks (systematic) which investors cannot diversify in financial markets, may also not increase shareholder value, as investors receive an appropriate rate of return for holding such securities. (Aretz *et al.*, 2007)

[14] It is because of this investor's ability to achieve his desired risk reduction that the manager should not worry about the different degrees of risk aversion of all the investors, but should just make sure that a good project is a good project […]. (Rebonato, 2007)

[15] Crouhy *et al.* (2006).

[16] For example, Geczy *et al.* (1997) finds evidence that suggest that economies of scale in costs are important determinants of currency derivatives use.

disciplinary role of debt; iv) mitigating agency problems and v) information asymmetries and proper signaling. The analysis of each of these opportunities will consider that firm value can generally be increased by reducing the discount rate (cost of capital) and/or by enlarging the free cash flows (flow to equity).[17]

2.2.1. Tax shields

The evident advantage of tax shielding is commonly the most common critique to MM's Propositions. This distortion and its effects were addressed by MM (1963) themselves, concluding that different degrees of leverage result in different distributions of returns after taxes, thus disabling the arbitrage process by which the values of the non-leveraged and the leveraged firms converge.

Thus, tax shielding should be included in the valuation of a firm. As mentioned by Quiry *et al.* (2005), the value of the levered firm is equal to that of an unlevered firm plus the present value of the tax savings arising on the debt, where this savings result from the fact that interest expenses can be deducted from firm's tax base.[18]

Regarding risk management, tax shielding maximization, which is equivalent to tax liability minimization, justifies hedging. Aretz *et al.* (2007) asserts that corporate risk management can reduce fluctuations in pre-tax income and thus lower the tax burden of firms if corporate income is subject to a convex tax schedule[19], where the convexity of tax schedules result from progressively increasing marginal tax rates or limitations of special tax preference items, such as the inability to carry losses forward or backward for an unlimited number of years.

This argument, shared by Smith and Stulz (1985), Froot *et al.* (1993), Nance *et al.* (1993) and Geczy *et al.* (1997), is based on an application of Jensen's inequality[20] to the corporate tax liability as a function of pre-tax firm value. Following Smith and Stulz (1985), if hedging reduces the variability of pre-tax firm values, then the expected corporate tax liability is reduced[21] and the expected post-tax value of the firm is increased. In that sense, as shown in Graph No.1, despite the expected value E(V) may be alternatively obtained by stabilizing the pre-tax firm value close to E(V) trough hedging or by weighting pre-tax firm values such as V_p and V_q, it is value maximizing for the firm to undertake such stabilizing strategy since it will result in a lower expected corporate tax liability (since E(T*) < E(T)) for the same pre-tax expected firm value:

[17] Bartram (2000).

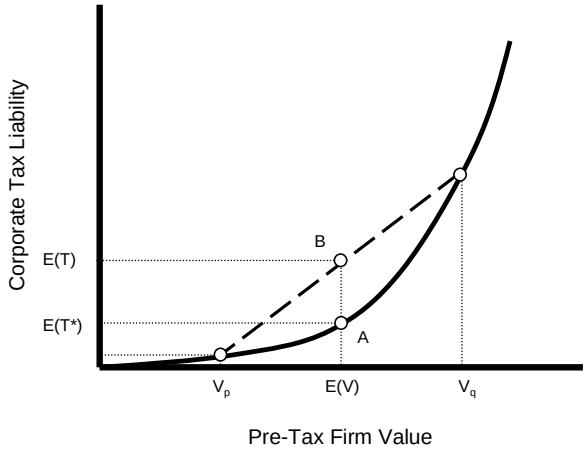
[18] Deducting interest expenses is a kind of subsidy the state grants to leveraged firms. Nevertheless, to benefit from this subsidy, the company must generate a profit. (Quiry *et al.*, 2005)

[19] This implies that the after-tax value of the firm is a concave function of its pre-tax value. (Smith and Stulz, 1985)

[20] Jensen's inequality implies that the expectation of a non-linear function of a random variable does not equal the function of expected value; mathematically, $E[f(x)] \neq f[E(x)]$. If the function is convex, then $E[f(x)] \geq f[E(x)]$. (Danthine and Donaldson, 2001; Cuthbertson and Nitzsche, 2004)

[21] As long as the cost of the hedge is not too large.

Graph No.1
Corporate tax liability as a function of pre-tax firm value



Source: authors' elaboration, based on Smith and Stulz (1985).

This rationale implies that costless hedging will always increase firm value. Nevertheless, as Smith and Stulz (1985) states, when costs are to be considered, hedging will increase firm value only if costs of hedging do not exceed the potential increase in firm value. Therefore, the derivatives market development is a key factor for the firm's exploiting tax shielding maximization by hedging.

2.2.2. Financial flexibility

As mentioned before, MM's Proposition-I states that market value results solely from the sum of the net present value of the cash flows produced by the existing assets and the net present value expected from future investments. Regarding the latter, the firm's ability to undertake the expected future investments will depend on its capacity to fund such investments; thus, there exists an incentive for the firm to guarantee a future cash flow which allows mitigating a potential underinvestment problem[22].

One way to mitigate firm's potential underinvestment problem is through corporate hedging. As stated by Aretz *et al.* (2007), corporate risk management can align internal corporate cash flows and investment expenditures by reducing the cash flows surplus when cash flows exceed investment expenditures and providing cash when cash flows are below investment expenditures.

Geczy et al. (1997), based on a 372 non-financial firms sample from Fortune 500, found that firms with greater growth opportunities and tighter financial constraints are more likely to use currency derivatives; they use derivatives to reduce variation in cash flows or earnings that might otherwise preclude firms from investing in valuable growth opportunities. Consequently, Geczy *et al.* concludes that hedging mitigates the underinvestment problem by reducing not only the

[22] The underinvestment problem may result from an agency problem between the firm's managers or shareholders and the bondholders. Agency problems will be considered below.

costs of obtaining external funds, but also a firm's dependence on external financing. Such rationale for mitigating the underinvestment problem is shared by Froot *et al.* (1993), Nance *et al.* (1993), Bartram (2000), Crouhy *et al.* (2006), and Aretz *et al.* (2007).

Particularly, Froot *et al.* (1993) emphasizes that the underinvestment problem arises not only from the inability to undertake investment plans, but from the inability to accomplish financing plans; if external finance were perfectly elastic, investment plans could remain unaltered in the face of internal cash flows variations. Therefore, Froot *et al.* concludes that variability in cash flows disturbs both investment and financing plans in a way that is costly to the firm, justifying hedging to the extent that it can reduce this variability and increase the value of the firm.

Evidence also suggests that hedging levels will differ across industries. Nance *et al.* (1993) asserts that the evidence of firms with more investment options having both lower leverage and more hedging suggest that firms that use hedging instruments have more growth options in their investment opportunity set; Nance *et al.* mentions evidence from a R&D intensive firm such as Merck.

Froot *et al.* (1993) and Aretz *et al.* (2007) recognize that firms will want to hedge less the more closely correlated are their cash flows with future investment opportunities; a good example is the oil industry, which will find less attractive to explore new oil reserves when market price of oil is low and vice versa, thus making hedging not an issue. Carter *et al.* (2002) finds that the opposite is also true: airlines with a desire for expansion may find value in hedging future purchases of jet fuel because hedging reduces underinvestment costs.

Finally, Crouhy *et al.* (2006) asserts that risk-reduction activities may offer synergies with the operations of the firm. For example, a firm which hedges the price of a commodity that is an input to its production process will be able to stabilize its costs and gain a competitive advantage that could not be replicated by any outside investor.

2.2.3. The disciplinary role of debt

Financial distress is a state in which a firm is in, near or emerging from bankruptcy. Bankruptcy consists of a court proceeding in which the assets of an insolvent firm are liquidated, where insolvency is a condition in which a firm is unable to pay its debts when they fall due, or when its liabilities exceed the value of its assets.[23]

MM's irrelevance of the capital structure also implies that there is no difference between a low-levered and a high-levered firm. Nevertheless, the evidence shows that for highly-levered firms expected costs of financial distress affect negatively the firm's value.

MM's propositions ignore the expected costs of financial distress given that i) it is assumed that firms cannot go bankrupt[24], and ii) even if bankruptcy is considered, in a perfect capital market

[23] With Kaliski (2001).
[24] Quiry *et al.* (2005).

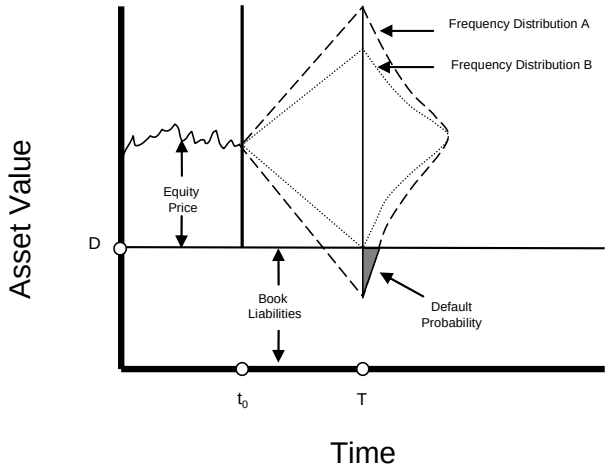
world, it leads to a costless negotiation of the firm's assets, which normally ends in a transfer of assets from stockholders to bondholders[25].

The expected costs of financial distress (ECFD) depend on the probability of entering into financial distress (π) and the costs related to financial distress (CFD):

$$ECFD = \pi \times CFD$$

The probability of entering bankruptcy –one of financial distress' states- may be measured by the firm's distance to default or insolvency. Based on Black and Scholes' model premises and assumptions, Merton (1974) measures the probability that the firm's assets won't suffice to satisfy its liabilities (i.e., the probability of default or insolvency), where the dynamics of the value of the firm through time can be described by a diffusion-type stochastic process, the liabilities of the firm are known (book value) and, thus, the equity value is perfectly correlated to the firm's value, as presented in Graph No.2.

Graph No.2
The Black-Scholes-Merton structural model of default

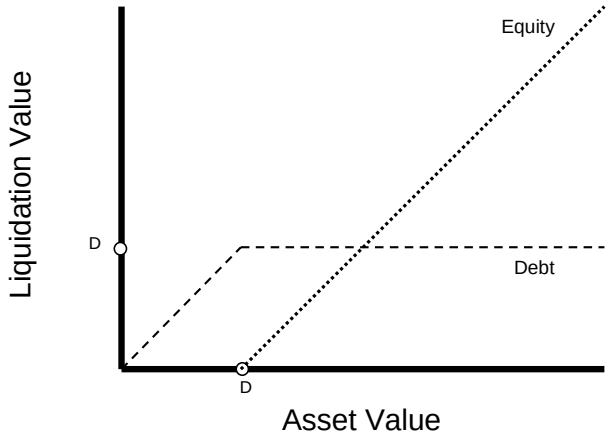


Source: authors' elaboration, with Duffie and Singleton (2003)

Merton (1974) also identified the payoff or liquidation profile of a firm's shareholder and bondholder across different firm's assets value. Shareholder's profile is similar to a call option and the bondholder's is similar to a put option, both with the firm's assets as underlying and the debt level (D) as strike price[26]:

[25] Aretz *et al.* (2007).
[26] Mathematically, the liquidation or payoffs for the bondholder are min[A,D] and for the shareholder are max[0, A-D], where A is the value of the assets of the firm and D is the face value of debt, which coincide with a put and a call option, respectively, where D equals the strike value of the option and A is the underlying's spot price.

Graph No.3
Liquidation values of debt and equity



Source: authors' elaboration, based on Duffie and Singleton (2003)

According to the previous Graph, when the asset value is equal or greater than the debt value (D), the bondholder will receive the face value of his claim (D), whilst the shareholder will receive the residual from the firm's total value (or asset value) and the payment made to the bondholder. If the asset value is below the bondholder's claim, the value of the firm will be transferred from the shareholder to the bondholder and the former will receive nothing.

The shareholder's payoff corresponds to his limited liability feature, which protects equity owners against losing more than their stake in the firm (limited downside), but provides the shareholder with an unlimited upside; thus, akin to a call option on the firm's stock. The bondholder has a limited upside fixed at the face value of the debt (D), but a sizeable downside which may result in a total capital loss; consequently, analogous to a put option on the firm's stock.

At first sight the shareholder will try to profit from its call option-like position, favoring excessive risk taking against the bondholder's interests. As presented in Graph No.2, shareholder has incentives to choose Frequency Distribution A instead of B[27] because the former offers an increase in the upside which is not compensated by an equal increase in the downside; since the increase in the probability of bankruptcy comes at no apparent cost for the shareholder, he will try to maximize the firm's value via risk taking.[28]

Nevertheless, in reality, bankruptcy –and also the probability of bankruptcy- creates substantial costs for the firms, with negative impact on the firm value. (Aretz *et al.*, 2007) Financial distress includes direct and indirect costs. Direct costs, which are related to the costs incurred in the bankruptcy proceeding, may include lawyer's and accountant's fees, administrative costs, expert witnesses, and shareholder's efforts to receive a liquidation dividend. Meanwhile, indirect costs

[27] Frequency Distribution A and B have the same mean and shape, but different dispersion.
[28] This misalignment between shareholders and bondholders incentives constitutes a case for agency problem, which is the subject of the next item on this section.

are those not directly related to the bankruptcy proceeding and arise when the probability of bankruptcy is perceived by the market, therefore include reluctance to deal with the firm, order cancellations, loss of suppliers and clients, distraction of management's core objectives, loss of human capital, high employee turnover, among others. Estimations on the direct and indirect costs of financial distress state that as a percentage of total firm value, direct costs are in the 1%-7.5% range, whereas indirect costs are in the 8.7%-20% range.[29]

Because financial distress costs do exist and may represent a significant portion of the firm's value, shareholders won't be able to easily profit from its call option-like position as presented before. As asserted by Aretz *et al.* (2007), bondholders will try to anticipate shareholder's opportunistic –but rational- behavior and will protect themselves against the expected losses by demanding higher returns or by designing covenants accordingly.

Therefore, in an attempt to maximize firm's value, shareholders will minimize expected financial distress costs and avoid bondholders demanding higher returns[30]. Such attempt, which will consist of decisions that minimize the probability of entering into financial distress, may include hedging. In fact, as asserted by Nance *et al.* (1993), because the probability of the firm encountering financial distress is directly related to the size of the firm's fixed claims relative to the value of its assets, hedging becomes more valuable as the firm's fixed claims raise.

Smith and Stulz (1985) recognize that for hedging to increase shareholder wealth as presented before, the firm must also convince potential bondholders that it will hedge after the bond sale. If the firm borrows frequently, market forces will create incentives for shareholders to pursue a hedging policy, so the firm's reputation will increase the price for its new debt and permit a continuous financing program to take place.[31]

Finally, by stabilizing the value of the firm and ensuring that asset value falls below the liabilities in fewer states of nature, hedging increases the value of the firm. By reducing cash flow volatility, firms face a lower probability of default and thus have to bear lower expected costs of bankruptcy and financial distress; a lower probability of default enables firms at the same time to diminish financial distress costs, increase their leverage, and therefore to benefit from greater tax shields[32]; thus, hedging enables the firm to exploit the disciplinary role of debt.

2.2.4. Mitigating agency problems

Agency theory says that a firm is not a single, unified entity. It calls into question the claim that all of the stakeholders in the company (shareholders, bondholders and managers) have a single

[29] With Quiry *et al.* (2005) and Aretz *et al.* (2007).
[30] Bondholders demanding higher returns results in a lower firm value due to increasing costs of capital.
[31] If information is asymmetrically distributed between the buyers and sellers of financial instruments, then certain financial markets may break down or be severely limited, and accordingly the free access to all forms of financing envisaged by MM's propositions may not exist. In loan markets, there may be credit rationing. (Stiglitz, 1990) The information asymmetries and their effects are analyzed below.
[32] Aretz *et al.* (2007). This argument for hedging as means to increase debt capacity, increase debt related advantages and decrease expected financial distress costs is shared by Bartram (2000) and Froot *et al.* (1993).

goal: value creation.[33] Agency theory recognizes that within the relations between the stakeholders there is an "agent" that makes decisions on behalf of the other, the "principal", even when their interests and incentives differ completely.

As asserted by Greenwald and Stiglitz (1990), if information is asymmetrically distributed between those who make decisions (agents) and the theoretical beneficiaries of those decisions (principals), then the reward functions that govern firm decision making may not have the form of simple value maximization assumed in neoclassical theory.[34]

As recognized by Smith and Stulz (1985) Nance *et al.* (1993), Froot *et al.* (1993), Geczy *et al.* (1997), Crouhy *et al.* (2006) and Aretz *et al.* (2007), there is a case for hedging when facing agency problems. Agency problems result in the following issues:

2.2.4.1. Underinvestment problem

As mentioned before, exploiting the advantage of financial flexibility (section 2.2.2 of this document) depends on the firm's ability to undertake the expected future investments that will increase the present value of the firm, where hedging may guarantee a future cash flow which allows mitigating a potential underinvestment problem.

Nevertheless, even if the firm is able to undertake any future investment project, there may be incentives for the managers and the shareholders to forego positive net present value projects, hence resulting in an underinvestment problem. Bartram (2000) states that this arises from the fact that increases in firm value generally have to be used to satisfy bondholders first. As also recognized by Aretz *et al.* (2007), in the presence of agency costs, managers acting in the best interest of shareholders invest only when gains from the project exceed the initial outlay plus fixed payment obligations.

Risk management may mitigate this agency problem. Because any promised payment will lead the firm to abandon a project with positive net present value in some future states (Myers, 1977), hedging allows the firm to reduce the states of the nature in which the bondholder is the sole or main recipient of the project's gains, therefore mitigating the underinvestment problem and maximizing the value of the firm via taking any positive net present value project.

Nance *et al.* (1993) recognizes that the presence of this case of agency problem may induce bondholders to demand higher returns for their investment. Then, in order to induce bondholders not to demand higher returns, the firm must assure bondholders that such wealth transfers will not take place, either via restrictive covenants or hedging; if bondholders do not demand higher returns the cost of capital will decrease and the value of the firm will increase. Bartram (2000) and Nance *et al.* state that the underinvestment problem increases with leverage and low firm value, thus making hedging more likely for highly indebted firms.

[33] Quiry *et al.* (2005).
[34] The information asymmetries and their effects are analyzed below.

2.2.4.2. Asset substitution or risk shifting problem

As already mentioned, due to the shareholder's and bondholder's option-like payoffs, shareholders have incentives to favor risky projects, since those provide an increase in their upside without an equal increase in their downside.

Because shareholder's payoff resembles a call option on the firm's asset value with the strike equal to the face value of liabilities, the incentive to favor risky projects by the managers –who act on behalf of shareholders- increases with leverage; in options jargon, the more at-the-money is the call option for the shareholder, the more benefits he receives from a marginal increase in volatility.[35]

Geczy *et al*. (1997), Bartram (2000) and Aretz *et al.* (2007) support this view. The former affirms that if equityholders view their shares as options on the value of a levered firm, we would expect them to support any speculation that increases firm volatility when the firm is close to (or in) financial distress.

As with the underinvestment problem, the presence of this case of agency problem may induce bondholders to demand higher returns for their investment. Then, in order to induce bondholders not to demand higher returns, the firm must assure bondholders that such wealth transfers will not take place, either via restrictive covenants or hedging; if bondholders do not demand higher returns the cost of capital will decrease and the value of the firm will increase.[36]

2.2.4.3. Managerial risk aversion and incentives

Shareholders hire managers to create value for the firm. In exchange, managers demand compensation. Nevertheless, managers have some incentives of their own, which may not match those of the shareholders.

First, it should be acknowledged that shareholders have the opportunity to easily mitigate their idiosyncratic risk via portfolio diversification, whilst managers, due to their extensive exposure to the firm's idiosyncratic risk[37] and their competitive disadvantage to diversify[38], will prefer to reduce their risk exposure at the firm level; thus, some managerial decisions within the firm may be of the interest of the manager, but not of the shareholder.

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[35] When the option is at-the-money (assets value equal debt face value) the shareholder has already reached a zero payoff level. Then, he will be tempted to scale assets' volatility because he has already reached the worst possible outcome, but he may profit from a good outcome. This price sensitivity of an option with respect to volatility movements (also known as *vega*) reaches its maximum when the strike price equals the underlying price (At-the-money).

[36] Nance *et al.* (1993).

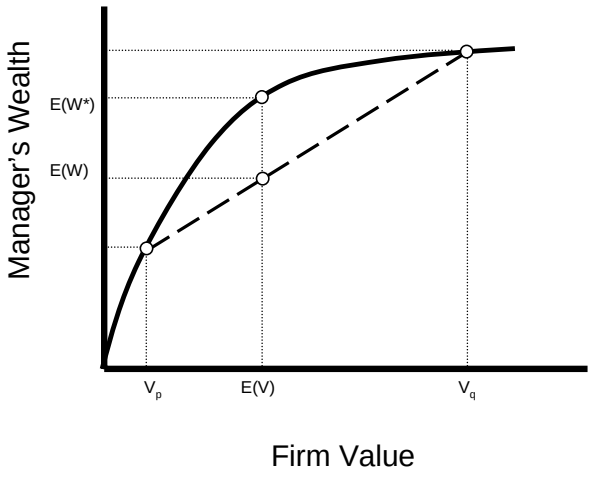
[37] Managers' idiosyncratic risk arises from through the tied relationship between them and the firm, which is manifested in managers' proportion of wealth invested in the firm, years worked for the firm, specific asset expertise, reputation, awards, promotions, etc. (May, 1995; Bartram, 2000)

[38] Managers are in a clear competitive disadvantage when compared to the firm when trying to diversify their wealth portfolios. The combination of transaction costs and economies of scale are some factors which make this disadvantage likely. (Smith and Stulz, 1985) Bartram (2000) also mentions manager's difficulties to sell short the stock of their firm to reduce their exposure as an incentive to undertake corporate hedging.

As a result, some managerial decisions –such as the engagement in conglomerate mergers, acquisitions or suboptimal debt levels[39]- benefit managers, as they lower the risk exposure of their wealth positions, while they are not value maximizing for the firm and not beneficial for the shareholders. The agency costs resulting from this type of managerial behavior, which decrease firm value, may be reduced via hedging. As presented by Aretz *et al.* (2007), corporate risk management reduces the variability in the firm value and thus accommodates the risk aversion of undiversified managers who have now fewer incentives to engage in non-value maximizing decisions.

Second, manager's compensation schemes may create incentives for incurring in underinvestment problems or taking decisions which are not value maximizing for the firm and shareholders. As pointed out by Smith and Stulz (1985), if managers' compensation is a concave (or not too convex) function of firm value, they will have incentives to reduce variance[40], thus creating incentives for rejecting variance-increasing positive net present value projects. As shown in Graph No.4, despite the firm's expected value E(V) may be alternatively obtained by stabilizing the firm value close to E(V) or by weighting pre-tax firm values such as V_p and V_q, it is wealth maximizing for the manager to undertake such stabilizing strategy since it will result in a higher expected wealth (since E(W*) > E(W)) for the same expected firm value.

Graph No.4
Manager's wealth as a function of firm value



Source: authors' elaboration

[39] May (1995) finds the following evidence: i) conglomerate mergers are more numerous when shareholdings are widely dispersed, because in such cases managers are better able to pursue policies that serve their own interests; ii) managers pursue variance reducing acquisitions when they have higher levels of personal wealth vested in firm equity; iii) there is a negative relation between CEO years vested and firm debt ratios as well as equity return variances.

[40] This is also a consequence of Jensen's inequality. Please refer to footnote No.21.

To avoid this behavior from managers, if hedging costs are negligible[41], shareholders may let managers hedge as this increases incentives to take variance-increasing positive net present value projects; in the other hand, if hedging is prohibited, managers will focus more on nonpriced risks. (Smith and Stulz, 1985)

2.2.5. Information asymmetries and signaling

MM's propositions assume that the market possesses full information about the activities of firms. (Ross, 1977) Nevertheless, it is unrealistic to assume that information is fairly distributed to all parties at all times; on the contrary, asymmetric information is the rule.[42] Such asymmetry results in firms acting in a risk-averse manner and in mean-preserving changes in distributions of prices and sales having real effects on firm's value. (Greenwald and Stiglitz, 1990)

Furthermore, implicit in MM's propositions is the assumption that the market knows the (random) return stream of the firm and values this stream to set the value of the firm. What is valued in the marketplace, however, is not the effective but the perceived stream of returns for the firm. Therefore, changes in the financial structure can alter the market's perception. (Ross, 1977)

Due to the fact that hedging reduces the amount of "noise" and increases the informational content of the firm's profits (DeMarzo and Duffie, 1995), managers will try to take advantage of their informational position[43] in order to change market's perception of the perceived stream of returns for the firm and to maximize their own wealth.

Concerning manager's and shareholder's interest in changing market's perception of the perceived stream of returns, Rebonato (2007) finds that the senior management of a good firm in general has an interest in dampening the wildest earnings fluctuations, so that the good underlying trend can be more readily revealed by investors, even at the cost of giving up some expected return, because the ability to spot with ease the good underlying trend may more than compensate for some loss in expected returns.[44] Similarly, DeMarzo and Duffie (1995) expect that good managers (or those with good news) will prefer to hedge so as to preserve the likelihood of a good outcome, while incompetent managers (or those with bad news) might prefer to increase risk and hope for a lucky draw.

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[41] If hedging is costly, shareholders may also design compensations schemes that reduce the concavity of manager's wealth as a function of firm value. This can be accomplished by including firm's stock options to the remuneration; the more option-like features in a firm's compensation plan, the less the firm is expected to hedge. (Smith and Stulz, 1985) Contrarily, including stock-price related compensation schemers intensify the risk aversion of undiversified managers. (Graham and Rogers, 1999; Aretz *et al.*, 2007)

[42] Quiry *et al.* (2005).

[43] Managers informational advantageous position arises from them being better informed about the sources and magnitude of the risks the firm faces. They have better and more current information regarding firm-specific events and foreign exchange, interest rate or commodity exposure of the firm. (With Dierkens, 1991; DeMarzo and Duffie, 1995)

[44] According to Rebonato (2007), investors like low volatility because they like to be able to estimate the true trend of a firm's profits as accurately as possible, and fear that earnings noise will prevent them from doing so; reducing the volatility of a firm's returns by hedging can make investing in the firm much more easy to understand, and therefore more appealing to investors.

In this sense, Affleck-Graves *et al.* (2002) find that firms with relatively less predictable earnings have a higher cost of equity capital than comparable firms with more predictable earning streams, *ceteris paribus*.

Regarding manager's interests, the information revealed by the firm's financial results affects their reputation and wealth. As DeMarzo and Duffie (1995) assert, in absence of disclosure requisites[45], because hedging reduces the risk of the firm's profits and the variance of their wage, risk-averse managers will try to attain full hedging.[46] Likewise, Bartram (2000) finds that good managers –interested in protecting their reputation- have a strong incentive to communicate their skills by hedging effectively; on the contrary, less qualified managers will be tempted to make a correct assessment of their performance difficult.

As to shareholder's interests, hedging may reduce the impact of unrelated financial risks (e.g. exchange rate risk, interest rate risk) on firm value and thus strengthen the relationship between stock price and management performance, making it easier to distinguish between efficient and inefficient managers. (Aretz *et al.*, 2007)

2.3. Evidence of hedging on firm value

Literature provides some support for an increase in shareholders' wealth via corporate risk management; nevertheless, the evidence is still fairly mixed and inconclusive (Aretz *et al.*, 2007), where technical issues represent a challenge still to be properly addressed. (Aretz and Bartram, 2009; Bartram *et al.*, 2006) A comprehensive survey of the main findings of the literature on this subject is now presented:

- Graham and Rogers (1999), based on a March-December 1995 3,232 firms sample, finds that hedging conveys a greater debt capacity, which results in higher firm value via a higher tax shield. For the average firm, interest rate hedging results in an increased debt ratio by 2.85%, which increases firm value by 1.4%; currency hedging results in an increased debt ratio by 6.87% and firm value by 2.1%.

- Allayannis and Weston (2001) find evidence consistent with the hypothesis that hedging increases firm value. Based on a 720 non-financial US firms sample for the 1990-1995 period, they find that, on average, firms that face currency risk and use currency derivatives have a 4.87% hedging premium, regardless of the foreign exchange behavior[47]. Moreover, they find that firms that begin a hedging policy experience an increase in value above those firms that choose to remain unhedged, and that firms that

[45] According to DeMarzo and Duffie (1995), the absence of hedging disclosure requirements makes that firm's profits risk reduction results in a reduced wage variability for the managers, whose managerial ability is taken as given by the shareholders. If disclosure requirements do exist, hedging eliminates a source of noise form firm's profits, making profits a more informative signal of managerial quality, which results in more variable wages; thus, a disclosure rule might prevent managers from engaging in effective hedging.

[46] Crouhy *et al.* (2006) coincides with this argument, stating that it is not easy for shareholders to differentiate between healthy volatility and volatility caused by manager's incompetence.

[47] The hedging premium is larger during dollar's appreciation period than during dollar's depreciation period. (Allayannis and Weston, 2001)

quit hedging experience a decrease in value relative to those firms that choose to remain hedged.

* Carter *et al.* (2002), based on a sample of 26 US airlines during 1994-2000, find evidence of the existence of a 12-16% hedging premium and of a positive relation between changes in hedging and changes in firm value. They conclude that this premium results from the firm's ability to mitigate the underinvestment problem and the expected costs of financial distress. Particularly, Carter *et al.* found that the premium is due to i) the opportunity to buy underpriced assets from distressed airlines during periods of high jet fuel prices; ii) avoiding the possibility of selling assets at below-market values during periods of high jet fuel prices; and iii) from the ability to meet previously contracted purchase commitments during periods of high jet fuel prices.

* Callahan (2002), based on 20 North American gold mining industry firms from 1996-2000, confirms that gold investors are interested in the volatility of gold prices –they view gold firms as real options-, thus volatility reduction makes firm less valuable; in fact, author's findings avow that investors actually place a premium on more risk for gold mining firms. Moreover, an industry specific characteristic, such as the fact that the commodity (gold) is buried while the hedging instrument is marked-to-market on a daily basis, results in a liquidity issue which may affect negatively the theoretical effect of hedging[48].

* Guay and Kothari (2003), using a US sample of 234 large non-financial corporations that use derivatives, asserts that the magnitude of the derivatives positions and the cash flows generated by hedging portfolios is economically small in relation to firm's typical risk exposures, thus unlikely to explain large changes in firm value. Authors find their results consistent with derivatives being just a tool for "fine-tuning" other types of risk management strategies, such as operational hedging.

* Lookman (2004), based on a sample of 125 oil and gas exploring and producing firms from 1999-2000, tests whether commodity price hedging creates value or not. The authors differentiate between firms which bear commodity risk as their primary risk (undiversified firms[49]) and firms that are diversified and, therefore, bear commodity risk as secondary. They find a 15% hedging discount for undiversified firms, and a 30% positive hedging premium for diversified firms. Once agency conflicts and managerial skills proxies are considered, hedging primary risk is a proxy for bad management and/or high agency conflicts, whilst hedging secondary risk is a proxy for good management and/or low agency conflicts.

[48] This is the infamous case for the gold mining firm Ashanti Goldfields. During September 1999 the gold price rose US$86 and turned Ashanti Goldfields' futures position against the firm. This event forced the firm to implement deep changes in its financial management and systems, along with an issue of equity warrants over 15% of the firm's shares in order to comply with the US$ 270 million collateral required by hedging counterparties in exchange for three years of marging free trading. (With information form Ashanti Goldfields' Financial Reports, http://www.ashantigold.com/Reports/Financial/Archive.htm)

[49] Firms that derive at least 80% of their revenues from exploration and production. (Lookman, 2004)

* Jin and Jorion (2006), based on 119 US oil and gas producers from 1998 to 2001, verify that hedging reduces the firm's stock price sensitivity to oil and gas prices, but finds no evidence of effect on firm's market value. The authors compare their results to those of Allayannis and Weston (2001) and conclude that their result may arise from the fact that individual investors may easily identify and hedge commodity risk exposure for this type of firms on their own[50], thus vanishing the hedging premium. Consequently, Jin and Jorion assert that the existence of a hedging premium depends on the type of risk the firm is exposed to.

* Allayanis *et al.* (2007), using a 39 countries database between 1990 and 1999[51], find that the foreign exchange hedging premium is statistically significant and economically large for firms with strong corporate governance[52], and positive but insignificant for firms with weak governance. Authors find that on average there is a 14.5% hedging premium for firms with foreign currency exposure.

* Nguyen and Faff (2007), based on the 428 largest non-financial Australian firms listed on the Australian Stock Exchange over the 1999-2000 period, find that the use of derivatives in general, and the use of interest rate derivatives in particular, are negatively related to firm value, whilst currency and commodities derivatives have no discernable impact on firm value. They blame poor reporting Australian standards on underlying exposures and derivatives positions for avoiding investors to make an informed judgment of the motives for derivatives usage, therefore, a case for information asymmetry.

* Aretz and Bartram (2009) assert that the literature on directly analyzing the value impact of corporate hedging is fairly mixed and inconclusive to date, whilst the individual analysis of theories of value creation via risk management has serious caveats and limitations. The authors warn about challenges such as endogeneity[53] and identification[54] problems; the choice of appropriate proxy variables for corporate hedging beyond derivatives; modeling of structural relations; the existence of other factors that may motivate risk management, such as earnings smoothing, speculation, or industry competition; and the existence of other hedging mechanisms[55], which may have misguided previous results on the subject.

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[50] Meanwhile, foreign currency exposure is not easily identifiable by individual investors, thus making corporate hedging more valuable for them.

[51] The authors measure value based on exchange-traded ADRs, which provides advantages such as their local liquidity and homogeneous accounting and reporting standards.

[52] Bartram *et al.* (2006) supports this finding: in countries that afford shareholders significant rights, managers may wish to undertake risk management with derivatives to avoid being replaced because of poor firm performance attributable to financial risks.

[53] i.e. firm value determines the hedging choice, rather than hedging determining value. (Aretz and Bartram, 2009)

[54] As asserted by Aretz and Bartram (2009), it is challenging to find empirical proxies of determinants of corporate hedging that are not at the same time also determinants of other corporate finance dimensions such as leverage, compensation or payout policy, and vice versa.

[55] Such as pass-through, operational hedging and foreign debt contracting to manage financial risk, with derivatives possibly playing mostly a fine-tune role. (Aretz and Bartram, 2009)

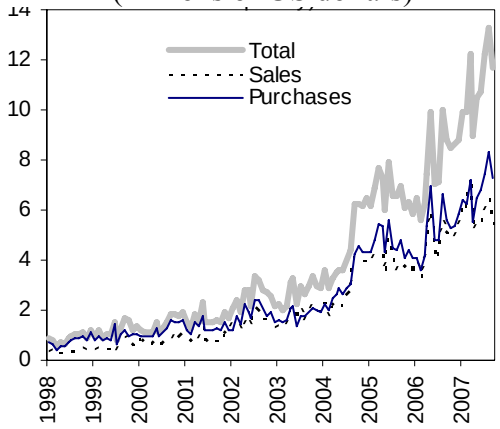
- Bartram et al. (2009), based on a 6,888 non-financial firms from 47 different countries, find strong evidence that the use of financial derivatives reduces both total risk and systematic risk. Derivative use is associated with a positive value premium, although statistically weak and sensitive to endogeneity and omitted variable concerns. Controlling for firms' likelihood to hedge, the authors find that hedging firms have 10% to 25% lower cashflow volatility, 3% to 10% lower standard deviation of returns, 6% to 22% lower sensitivity to market returns (i.e. lower market beta), and 1% to 7% value premium.

3. The Colombian derivatives market: a brief survey[56]

The Colombian derivatives market is composed, fundamentally, of exchange rate derivatives. Particularly, interest rate derivates are almost inexistent, except for sell-buy-backs contracted among banks. Therefore, in this section we will focus in describing the domestic exchange rate derivative market, and in the empirical analysis of this paper we will refer to exchange rate hedging exclusively[57].

During the last few years the market for foreign exchange derivatives has developed importantly in Colombia, favored by the growth in financial integration with the rest of the world. December 1998's US$1.2 billion turnover grew steadily during the next ten years reaching a total of US$13.2 billion in December 2008 (Graph No. 5). Coherent with this expansion the ratio of volume traded in the forward market to volume traded in the spot market has increased substantially in the last few years, from less than 25% in 1998 to almost 100% currently.

Graph No. 5
Total turnover in forward exchange rate market in Colombia
(Billions of US dollars)

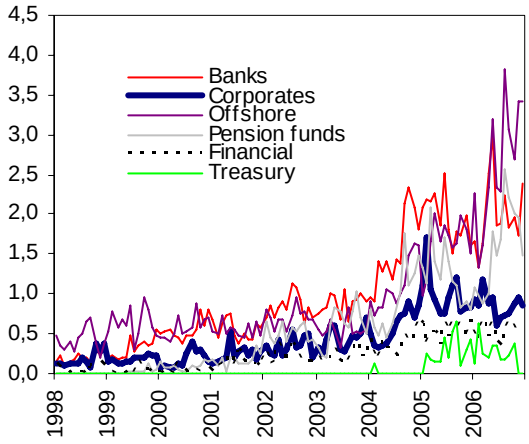


Source: Kamil *et al.* (2008)

Most of the forward contracts are undertaken by banks and pension funds. The participation of the corporate sector is relatively low. Indeed, total turnover of forward transactions by the corporate sector account for approximately 10% of the total (Graph No. 6).

[56] This section is based on Kamil *et al.* (2008).
[57] Almost all of the contracts traded in the Colombian exchange derivate market are Colombian Peso – US Dollar contracts. The vast majority is forwards; swaps account for less than 10% of the total.

Graph No. 6
Turnover of forward transactions by sector
(Billions of US dollars)



Source: Kamil et al (2008)

However, although the on-shore foreign exchange derivatives market has grown remarkably in Colombia, when compared to international standards this market is still underdeveloped. For example, according to calculations of Kamil *et al.* (2008), in 2003 total trading volume accounted for 34.5% of GDP in Colombia, while the percentage for Mexico was 53.2% and for Chile 225.0%. Similarly, in the same year total trading volume accounted for 101.2% of total foreign trade in Colombia, while the percentage for Mexico was 156.5% and for Chile 418.2%.

In Colombia most foreign exchange hedging instruments are non-deliverable contracts traded over the counter, and most of them are short-run contracts (from one week up to one month). Recently the Central Bank of Colombia authorized the participation of a Central Clearing Counterparty (CCC). The CCC will offer a futures contract, Colombian Peso – US Dollar. However, up to date this contract has not been launched in the market yet.

4. Empirical methodology and estimation results

In this section we provide a brief description of the empirical methodology followed in the paper, and discuss the main results and their implications.

4.1. Empirical methodology

The data used in this paper consists of a panel of eight large firms for which quarterly financial information was collected, for the period March 1995 – December 2008. Thus, the number of cross-sectional units is relatively small, while the number of time periods is relatively large. In this context, contrary to traditional panel data settings, it appears reasonable to specify a common conditional mean function across the units, with heterogeneity taking the form of different variances rather than shifts in the means. The asymptotic theory here is respect to time going to infinity, while the number of cross-sectional units is fixed.

Another difference with a traditional panel data set is that units in the context of this study are quite large. Therefore, correlations across units becomes important in the specification, while in a traditional panel data setting these correlations are always assumed to be zero.

The framework for analysis is the generalized regression model

$$y_{it} = x'_{it} + \varepsilon_{it},$$

where y_{it} represents the logarithmic growth rate of Tobin´s Q for firm *i* at time *t*, x_{it} is a vector of explanatory variables for firm *i* at time *t*, and ε_{it} is the error term[58].

The model can be written as

$$\begin{bmatrix} y_1 \\ . \\ . \\ . \\ y_m \end{bmatrix} = \begin{bmatrix} x_1 \\ . \\ . \\ . \\ x_m \end{bmatrix} \beta + \begin{bmatrix} \varepsilon_1 \\ . \\ . \\ . \\ \varepsilon_m \end{bmatrix}$$

The variance-covariance matrix of the perturbation terms can be written as

$$E[\varepsilon\varepsilon'] = \Omega = \begin{bmatrix} \sigma 1_1 \Omega_{1m} & \cdots & \sigma_{1m}\Omega_{1m} \\ \vdots & \ddots & \vdots \\ \sigma_{m1}\Omega_{m1} & \cdots & \sigma_{mm}\Omega_{mm} \end{bmatrix}$$

In order to parameterize the Ω_{ij} matrices in order to model the cross-sectional correlation, these matrices must be squared. Thus, the panels must be balanced. The variance structure of the disturbance terms was specified to account for heteroskedasticity across panels (the variance of each panel differs), and to account for correlation across panels and autocorrelation of order one specific to each panel.

In this specification, we assume β, the coefficients vector, is the same for all panels. The model was estimated by feasible GLS.

4.2. Definition of variables

Tobin´s Q, which proxies for the firm´s value[59], is defined as the ratio of the market value to the replacement value of assets, measured as the book value of assets, following Ji and Jorion

[58] The subscript *i* indexes panels, and *i*=1,…,m; The subindex *t* indexes time, and *t*=1,… T_1.

[59] The rationale for the measure is simple. Firms that earn negative excess returns and do not utilize their assets efficiently will have a Tobin's Q that is less than one. Firms that utilize their assets more efficiently will trade at a Tobin's Q that exceeds one. See Damodaran (2002).

(2006). Specifically, this simple Tobin's Q measure is calculated as the sum of total liabilities and market value of equity divided by total book assets. In undertaking this exercise we assume that the market value of liabilities is equal to the book value.

We chose to use a simple Tobin's Q as opposed to a more complex Tobin's Q[60] for two main reasons. First, this simple Tobin's Q has been shown to be highly correlated with more complex Tobin's Q proxies, which require an estimation of the replacement costs of assets. Allayannis and Weston (2001), for example, report that the correlation coefficient between simple Tobin's Q and complex Tobin's Q is 0.93, while Daines (2001) suggests that similar results are obtained using a simple Tobin's Q and one constructed using the more complex Perfect and Wiles (1994) approach. Second, this simple Tobin's Q does not require a large data input and has been used widely as an effective measure of firm value. Moreover, as is the case for the Australian market (Nguyen and Faff, 2007), the replacement cost data is not available for Colombian firms, making the calculation of a complex Tobin's Q measure impossible.

4.2.1. Explanatory variables included in the regression

The following set of explanatory variables was included in the specification of the Tobin´s Q equation:

a) Hedging variable

This variable, which is of central interest for the study, is defined as the value of the forward contracts of the firm. It is computed as the sum of the short and long forward contracts firm *i* holds at time *t*. In the empirical specification we included up to four lags (quarters) of this variable.

b) Firm´s size

This is a scale variable used to control for the firm´s size. It is computed as the natural logarithm of firm´s *i* total assets at time *t*.

c) Financial constraints

Following Allayannis and Weston (2001) we included a dummy variable to proxy for potential financial constraints faced by firm *i*. The idea of controlling for possible financial constraints is that in an imperfect financial environment financial constraints may have an impact over firm´s value.

The financial constraints variable was constructed as a dummy that takes the value one at time *t* if the firm distributed dividends on that period and zero otherwise. A firm that does not distribute dividends at time *t* might be associated with a firm that is presenting a higher degree of financial constraints at time *t* than an otherwise similar firm that is distributing dividends during the same period.

[60] For example, as measured by Lewellen and Badrinath (1997) or Perfect and Wiles (1994).

d) Leverage

As documented in many empirical papers explaining firm´s value, leverage may have a significant impact. We included a proxy for the degree of leverage of firm *i*, calculated as the ratio of long-term debt to total equity.

e) Profitability

Profitability of firm *i* was calculated as the ratio of gross profits to total assets of firm *i*. More profitable firms use to have a higher value than otherwise identical less profitable firms.

f) Firm´s age

The time a firm has spent in the market might have a positive impact on its market value. The age of the firm can be a proxy for tradition, especially in a country in which only a limited number of firms is traded in the stock market. Thus, we included the variable AGE, calculated as the number of years, up to time *t*, after the firm was created.

Variables firm´s age and firm´s size showed to be highly correlated (0.68). Therefore, in order to avoid possible multicolinearity problems in the regressions we excluded firm´s age from the empirical analysis.

4.2.2. Sample description

For the purpose of this study the sample of firms included in the empirical analysis should meet a number of important requirements: our interest focuses on private, non-financial firms, which export part of their production, and are traded in the stock exchange. These requirements impose an important restriction in the number of firms included in the empirical analysis. First of all, in Colombia only a limited number of firms are traded in the stock market. In 2009, only 100 firms are listed in this market.

After excluding public and financial firms, as well as firms that do not export part of their production, only 10 industrial firms are left. Finally, two of those firms were not listed in the stock market for the whole period covered by this study (March 1995 – December 2008). We required a balanced panel, as imposed by the econometrical methodology used here; therefore we excluded them from the sample. As a result the model was left with eight private, non-financial firms, which met all the requirements described above.

The information for the empirical analysis presented here comes from three different sources: information on the firms´ market value was obtained from the Colombian stock exchange (Bolsa de Valores de Colombia); information on the firms´ balances was obtained from the Colombian Banking Superintendency (Superintendencia Financiera de Colombia); finally, information on derivatives positions and the firms ´exports was obtained from the Central Bank of Colombia (Banco de la República).

4.3. Empirical results

Table No. 1 presents the main results obtained from the regressions ran following the methodology described in section 3.1.

Table No. 1
Dependent variable is growth rate of Tobin´s Q

Variable	Coefficient	Standard Error
Constant	0.0142	0.2731
Hedging t-1	0.0468*	0.0232
Hedging t-2	-0.0748	0.0425
Hedging t-3	0.0539	0.0306
Hedging t-4	-0.0149	0.0078
Size	0.1149*	0.0205
Profitability	-0.0844	0.0939
Leverage	-0.0329	0.0326

* Significantly different from zero at the 5% level.

Table No. 1 shows that hedging matters after controlling for important variables widely used in the literature to explain the growth rate in the value of the firm. However, only the first lag of this variable seems to matter. In order to test whether hedging is an important determinant of firms´ value in the log-run, we computed the long term coefficient of this variable as a linear combination of the coefficients of the first four lags, and the corresponding standard error of the linear combination using the delta-method. Table No. 2 shows the results.

Table No. 2
Empirical results. Dependent varible is growth rate of Tobin´s Q

Variable	Coefficient	Standard Error
Constant	0.0142	0.2731
Hedging (long-run)	0.0111*	0.0048
Size	0.1149*	0.0205
Profitability	-0.0844	0.0939
Leverage	-0.0329	0.0326

* Significantly different from zero at the 5% level.

As Table No. 2 shows, hedging is an important determinant of the firms´ growth rate of Tobin´s Q in the long run. Moreover, the impact of hedging on the firm´s value is the expected one: increases in hedging lead to increases in firm´s value.

Size also seems to matter: larger firms tend to have a higher growth rate of Tobin´s Q than otherwise smaller firms. This result is consistent with similar empirical analyses conducted for other countries. Meanwhile, the level of leverage and profitability does not seem to matter, at least for the sample of firms considered in this empirical study.

5. **Conclusions**

There is a remarkable volume of literature which tests the effects of risk management and hedging decisions for the value of the firm, mainly for the US corporate market. However, there is little effort on this subject for markets which work even farther from absolute perfection.

This document undertakes such task for the Colombian market. Focused on non-financial firms and the local's most liquid derivatives market, we find that for a panel of eight large Colombian corporations the growth rate of Tobin´s Q depends significantly on firm´s size and hedging. Our results suggests that, after controlling for relevant financial variables such as firm´s profitability and leverage, and other variables such as firm´s age, an increase in hedging leads to a higher growth in the firm´s value.

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