# Taxes and other determinants of hedging: evidence from Portuguese privately held companies

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## Abstract

This paper analyses the determinants of corporations to engage in hedging activity. First, we present a review of tax and non tax related theoretical arguments to hedge. Then, measuring corporate hedging by derivatives usage, we present empirical evidence on how these factors affect the risk management decision at firm level based on a sample of Portuguese companies.

The analysis of survey data on the use of derivatives combined with data on firm's financial characteristics suggests that corporate taxation does not affect firms´ hedging decisions. Nevertheless, our results are consistent with other theories that have been advanced to explain corporate hedging, such as the expected costs of financial distress and firm size.

## Resumo

Este artigo analisa, em primeiro lugar, os determinantes económicos das decisões de cobertura do risco financeiro empresarial. Dá-se particular relevo ao factor fiscal.

Posteriormente, e com base numa análise estatística, averigua-se quais os factores relevantes que influenciam tais decisões.

**Keywords**: corporate taxation; derivatives; risk management

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## 1. Introduction

Companies face financial risks in their daily activities. These risks are typically understood as foreign exchange risk, interest rate risk and commodity price risk. The successful management of financial risks can be a crucial competitive advantage.

Survey evidence indicates that firms actively manage financial risks using a combination of internal and external (derivatives) hedging instruments. Among the hedging instruments, derivative usage is the most popular tool of corporate risk management, and therefore a measurable proxy of these activities.

Despite the current popularity of risk management, there is a generalized debate in the academic literature concerning the contribution of risk management to firm value. It was triggered by the apparent contradiction between corporate practice and economic theories stating that risk management was generally redundant.

Hedging will be of no consequence in the classical model proposed by Modigliani and Miller (1958). Applying the logic of MM, Smith and Stulz (1985) discussed the irrelevance of corporate risk management. Corporate risk management would not increase shareholders' value, since firm owners could perform the management of financial risks better than managers, due to the effect of portfolio diversification.

However, the assumptions of MM do not hold in financial markets. In reality, firms face a variety of frictions, such as taxes, financial distress costs, costly external financing, agency costs and asymmetric information. Risk management can thus add value to a firm by (1) reducing expected corporate taxes; (2) reducing the probability of financial distress; (3) reducing cash-flow uncertainty, thereby decreasing underinvestment costs; (4) reducing the effects of information asymmetry between managers and investors; and (5) helping to offset agency costs in cases where shareholder and managerial interests are misaligned.

Most empirical studies on risk management focused on the determinants of hedging and whether the firm's hedging profile fitted one theory or another. Nevertheless, empirical results are mixed, mostly when it comes to the tax argument.

The tax argument for risk management was presented by Smith and Stulz (1985). They argue that, when corporate income is subjected to a convex tax function, the volatility of pre-tax income can be reduced by risk management, decreasing corporate expected taxes and increasing firm value. Empirical studies do not present a consensus supporting the value relationship between corporate risk management and tax structure. For example, Nance, Smith and Smithson (1993) concluded that the larger the probability of a progressive tax function existence and the larger the investment tax credit, the higher the probability of firms to hedge, but Graham e Rogers (2002) concluded that firms do not hedge in response to tax convexity because the incentive is too small when compared to other hedging incentives.

This paper presents a review of tax and non tax factors that can lead to corporate hedging being valuable. Additionally, by combining survey information with financial data and by making use of a logistic model, we regress corporate derivative usage on a proxy for tax convexity and other non-tax variables.

By focusing primarily on samples of large public firms, studies in other countries typically measure risk management activities by derivatives usage and find an extensive use of theses instruments. Evidence on the usage of these products for risk management in Portuguese private firms is very scarce. It is therefore of interest to analize risk management practices within Portuguese private non-financial firms. The purpose of this paper is to provide a description of tax and other non-tax rationale for derivative usage by privately held non-financial firms, located in the Portuguese Central Region.

This paper is organised as follows. Section 2 examines the basis of corporate risk management by emphasising tax arguments. Section 3 identifies data sources and establishes the hypotheses and the empirical methods used. Section 4 provides the results. Section 5 offers conclusions.

## 1. Theoretical framework on corporate risk management

According to classical propositions proposed by MM (1958)[1] the capital structure of a firm has no impact on its value, since shareholders can replicate corporate financing policies by themselves, with their own transactions on capital markets. Smith and Stulz (1985) apply the logic of Modigliani and Miller to corporate risk management and suggest the extension of irrelevance proposition of capital

[1] MM (1958) considered complete capital markets without information asymmetries, taxes and transactions costs.

structure through corporate risk management. Corporate risk management as a financial activity would not increase shareholder value, since the firm's owners could perform the management of financial risks better than managers due to the effect of portfolio diversification.

A closer inspection, however, reveals that the assumptions of MM do not hold in reality, because of the existence of capital market imperfections, such as financial distress costs, taxes, costly external financing, asymmetric information or agency costs. Stulz (1984), Smith and Stulz (1985), Froot, Scharfstein and Stein (1993), Nance et al. (1993), Breeden and Viswanathan (1998), among others, demonstrated that the existence of capital market imperfections can create higher market values for firms that engage in hedging activities.

Some theories have been suggested supporting corporate risk management in terms of its impact in firm value. Tufano (1996) classified these theories under two main classes: shareholder value-maximizing theories and managerial utility-maximizing theories. The first one focuses on hedging as a means to maximize shareholder value. Hedging is therefore beneficial to shareholders because it can mitigate costs associated with market imperfections. In this case, hedging is used to reducing expected tax costs, the probability of financial distress and to avoid underinvestment. In the second group of theories, firms engage in hedging activities for managerial reasons, such as alleviating manager's personal risk, signalling managerial ability and avoiding capital market disciplining. The remainder of this section briefly reviews both theories.

## 1.1. Shareholder value-maximizing theories

### 1.1.1. Tax based theory

Smith and Stulz (1985) provide an analysis of the determinants of corporate risk management policies among large widely-held firms. They suggested that if pre-tax income is subjected to a convex tax function, then the volatility of pre-tax income is costly to the firm. In this case, hedging taxable income by reducing the variability of pre-tax income reduces the firm's expected tax liability, and consequently increases expected post tax value of the firm, as long as hedging costs do not exceed its benefits.

On this subject, existing empirical studies are mainly based on tax structure of the United States (US). Under the US current tax law, a firm must calculate its taxes under two different ways and then pay the higher of both. First, the firm calculates taxes due using net income and the deductions and credits available under the "regular" tax. Then, it must do a separate calculation, requiring a different set of records – this alternative calculation is called *Alternative Minimum Tax* (AMT). The original idea behind this alternative taxation was to tax firms that had substantial economic income but paid little or no "regular" tax, because of tax preferences or because of net operating losses or credit carryforwards. [2]

Concerning the structure of corporate tax income, the dominant feature in the US is progressivity of tax rates. In contrast, in other OECD countries the proportionality of corporate tax rates is predominant. Finally, on the treatment of net operating losses (NOLs), US tax laws allow corporations that have NOLs to carry them back up to 5 years[3] and forward them up to 20 years. [4]

To analyse the effects of hedging on expected corporate tax liability, we start from the value of a firm without hedging. Considering the existence of only two states of the world, $j$ and $k$, and associating a subjective probability of 50 percent to each sate, then, in the absence of leverage, the firm pre-tax value can be either $V_j$, if state of the world $j$ occurs, or $V_k$, if state $k$ occurs. In this case, the expected pre-tax value of the firm is given by the average value $E(V)$, the expected corporate tax liability is given by the average value $E[T(V)]$[5] and the expected post-tax value of the firm is given by $V(0)$.[6]

Under these suppositions, if the firm hedges, and thereby eliminates uncertainty in taxable income, then the firm's pre-tax value is fixed at its expected value $E(V)$ and the corporate tax liability will

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[2] Essentially, a two-track system for computing tax liabilities has been created by the enactment of the AMT. Generally, the AMT is imposed at a rate of 20 percent of alternative minimum taxable income (AMTI) minus an exemption amount (up to $40.000). AMTI is determined by starting with taxable income before NOLs and then adding or subtracting certain preferences and adjustments. Further, NOL carryforwards can offset a maximum of 90% of AMTI. Therefore, even firms with large NOLs may be subject to AMT.

[3] *Tax loss carryback* is a technique that permits losses to be carried back and applied to previous pre-tax earnings the present net amount of losses, i.e., the term "carrying back" a loss means that you refigure the old year's taxable income and taxes. As a result, you may obtain a refund, partially or completely, of taxes you paid in that earlier year.

[4] *Tax loss carryforward* is a technique that permits losses to be carried forward and applied to future earnings the present net amount of losses, i.e., a *carryforward* can be used to reduce future income, thereby reducing future tax payments.

[5] If we consider $T_j[T_k]$ the corporate tax rate when state of the world $j[k]$ occurs, it follows that:

$$E[T(V)] = p_j \cdot T_j \cdot V_j + p_k \cdot T_k \cdot V_k.$$

[6] $V(0) = p_j \cdot (V_j - T_j \cdot V_j) + p_k \cdot (V_k - T_k \cdot V_k)$.

decrease until $T[E(V)]$.[7] It follows that decreases in the corporate tax liability increase the post-tax value of the firm. The value of an hedged firm increases with a reduction in the present value of expected corporate tax liability which assumes the value $\{E[T(V)] - T[E(V)]\}$. This analysis holds when firm hedges completely and when hedging is costless.

A simple numeric example can illustrate the risk management argument proposed above. Let us consider a progressive tax function similar to the one applied in the US. Suppose, additionaly, that without hedging the pre-tax taxable income is either € 20.000,00 or € 70.000,00 with equally probability of occurrence. It follows that the expected pre-tax value of the firm assumes the average value of € 45.000,00 $\left(0,50 \cdot 20.000 + 0,50 \cdot 70.000\right)$, the expected corporate tax liability is € 7.750,00 $\left[0,50 \cdot 0,15 \cdot 20.000 + 0,50 \cdot \left(0,15 \cdot 50.000 + 0,25 \cdot 20.000\right)\right]$ and the expected post-tax firm value is € 37.750,00.[8]

On the other hand, if the firm hedges completely, the equally probability of getting a pre-tax income of either € 20.000,00 or € 70.000,00 is replaced by its expected value (€ 45.000,00) so that pre-tax income is not volatile. Hence, the corporate tax liability will decrease until € 6.750 $\left[0,15 \cdot \left(0,50 \cdot 20.000 + 0,50 \cdot 70.000\right)\right]$ and therefore the firm post-tax value will be € 38.250,00. This analysis implies that complete costless hedging increases the firm's value in the amount of € 1.000,00 $\left(7.750 - 6.750\right)$.

The previous analysis must be modified if hedging is costly. However, if hedging costs do not exceed the benefits, i.e., the value of tax saving, hedging is still valuable. In the example presented above the cost of hedging can not be higher than €1.176,47.[9]

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[7] $T\left[E(V)\right] = T \cdot \left(V_j \cdot p_j + V_k \cdot p_k\right)$.

[8] We suppose that the first 50 000 USD of profit is taxed at a 15% rate and the next 20 000 USD at a marginal tax rate of 25%. We also suppose that the cash flow that occurs at the end of the year is a liquidation cash flow (i.e., the life of the firm is limited only to one year). We considered the state-preference model of firm value proposed by Smith and Stulz (1985). They considered that investors are risk-neutral. As a consequence we can establish a correspondence between state prices and risk-neutral probabilities, thereby the value of firm can be calculated as follows, i.e. such as an expected value:

$$V(0) = \sum_{i=1}^{s} p_i \cdot \left(V_i - T(V_i) \cdot V_i\right) \Leftrightarrow V(0) = 0,50 \cdot \left(20.000 - 0,15 \cdot 20.000\right) + 0,50 \cdot \left[70.000 - \left(0,15 \cdot 50.000 + 0,25 \cdot 20.000\right)\right]$$

[9] At first look, it seems that hedging transactions cost can not exceed €1.000,00 (i.e., tax saving), however, the transactions costs will be diminished to pre-tax income, not to post-tax income, so we must account the maximum value for hedging transactions costs as follow:

In summary, the argument for the impact of risk management on taxes is simple and can be established by means of tax planning: if the effective tax function is convex, in years when taxable income is low, the effective tax rate will be low; conversely, in years when taxable income is high, the tax rate will be high. Hence, if taxable income is hedged, the tax decrease in good years will be larger than the tax increase in bad years so that the firm's expected tax liability will be lower.

Smith (1995) considered three general sources of firm's effective tax function convexity: tax rate progressivity; the existence of a minimum tax, like the *Alternative Minimum Tax* (AMT), and limitations on the use of tax credits, the so-called tax preference items, such as limitations on carrying losses backward or forward and on investment tax credits.

### 2.1.2 Empirical evidence

Nance et al. (1993) provide an empirical analyses of motivations for corporate hedging. They use a sample of 169 nonfinancial firms in order to test the following hypothesis concerning tax convexity and the benefits of hedging: (1) the higher the probability of the firm's pre-tax income is in the progressive region of the tax schedule, (2) the greater the firm's tax loss carry forwards and (3) the greater the firm's tax credits, the greater the benefits of hedging. Their results are consistent with the tax convexity argument, namely, that firms with more of their income in the progressive region of the tax schedule and that have more tax credits, have greater use hedging instruments.

Mian (1996) tested the same hypothesis under the tax-based rationale for hedging, and found statistical evidence only for the third hypothesis. He concludes that hedgers are more likely to have foreign tax credits than nonhedgers.

Rather than using a variable based on net operating losses (NOLs),[10] Graham and Smith (1999) propose a simulation procedure that quantifies the tax savings resulting from a decrease in the volatility of the taxable income when the firms use risk management, i.e., they propose a precise measure of tax

$$Hedging\ transactions\ \text{costs} \times (1 - tax\ rate) \leq 7.750 - 6.750 \Leftrightarrow Hedging\ transactions\ \text{costs} \leq \frac{7.750 - 6.750}{1 - 0{,}15}.$$

[10] Many empirical papers measure tax function convexity by using variables based on the existence of net operating losses (NOLs), namely tax losses carryforwards (for instance, Berkman and Bradbury, 1996; Mardsen and Prevost, 2005; Mian, 1996; Nance et al., 1993; Tufano, 1996; among others). These variables are easy to construct. However, variables based on NOLs suppose implicitly that firms with such tax shields face a convex tax function, which is not always true. Graham e Rogers (2002) conjecture that variables based on this tax shields are probably better proxies for financial distress costs than for the tax convexity.

incentive to hedge. This technique explicitly maps out effective tax functions, assimilating, all together, the features of tax code (such as progressivity of tax schedule, alternative minimum tax and tax losses carrying backwards or forwards), in order to determine the extent of its convexity and the extent to which hedging changes a firm's expected tax liability.

The authors find that in approximately 50 percent of the cases, corporations face convex effective tax functions and, thus, have tax-based incentives to hedge. In approximately 25 percent of the cases firms face linear tax functions. The remaining firms face concave effective tax functions. Of the cases with convex tax functions, roughly one quarter of the firms have material potential tax savings from hedging. For the remaining firms, the tax savings are fairly small. Hence, the considered tax provisions have only a modest effect on the convexity of the tax function.

Through the technique described above, Graham e Smith decompose the basic structure of the effective tax function and conclude that: (1) much of the convexity is induced by the asymmetric treatment of profits and losses in the tax code; (2) losses carryback and carryforward effectively allow firms to smooth losses, thereby reducing tax function curvature at its most convex points, while making the function moderately convex over a broader range of taxable income; and (3) in contrast, the alternative minimum tax and investment tax credits have only a modest effect on the convexity of the tax function. Furthermore they characterize firms with higher probability of facing convex tax function: (1) small firms with their expected taxable incomes near zero; (2) firms with volatiles incomes; and (3) firms where incomes shift between profits and losses.

Using an identical approach Graham and Rogers (2002) do not find evidence that firms hedge to reduce expected tax liability when their tax functions are convex. They consider that firms do not hedge in response to convexity, because the incentive is smaller when compared with other hedging incentives.

To summarize, there is no general consensus regarding the validity of corporate tax hedging theory. On one hand, there is evidence in support of a positive correlation between tax system features and valuable risk management. On the other hand, the results of empirical studies do not give a clear picture regarding the role of tax motive. Potential explanations for these results can rely on the fact that

variables used to capture the tax convexity proxy for more than one argument, that's why in many studies we find no, or weak, statistical significance of tax variables[11] .

## 2.2 Non-tax theories: financial distress and agency costs

The larger the debt relative to firm value and the variability of cash flows, the higher the probability of financial distress. Under this assumption, hedging can contribute to maximize firm's value by reducing the volatility of cash-flows, and thus lower the likelihood of financial distress and the expected associated costs.

In general, empirical investigations on the determinants of hedging support the arguments on financial distress costs (Géczy et al., 1997; Guay, 1999; Haushalter, 2000; Nance et al., 1993). Most of these studies have established a positive empirical relationship between corporate hedging and the likelihood of financial distress. The commonly used variables for proxy in this relation are leverage ratio and interest coverage ratio.

Since the financial distress costs are related to firm size (Warner, 1977) and the risk of financial distress is higher the more volatile are the cash-flows, smaller firms have a greater likelihood of financial distress situations, and thereby of engaging in risk management activities. On the other hand, large firms may exhibit informational economies and economies of scale in risk management activities. In this sense, larger firms are more likely to have the necessary resources and potential trading capacity to permit the use of derivatives. Usually, the existing literature proxies firm size with total assets, market value of equity or total sales.

In firms with significant fixed claims, a conflict of interest between bondholders and stockholders leads to agency costs of debt. These costs can be reduced by means of debt covenants which, however, can limit the degree of freedom for future investment. In the presence of financial risks causing volatility of corporate cash-flows and, by consequence, inducing volatility to the investment programs, corporate hedging can create value to the shareholders. Since hedging can reduce cash-flows volatility, it enables the firm to adequate the need for and the availability of internal funds, thus avoiding underinvestment

[11] See Tufano (1996), Géczy, Minton and Schrand (1997), Gay and Nam (1998), Graham and Smith (1999), Mota (2000) and Graham and Rogers (2002).

(Froot et al., 1993). In addition, hedging can reduce the probability of the existence of restrictive bond covenants, therefore reducing agency costs of debt (Smith and Stulz, 1985).

Froot et al. (1993) venture that firms with planned investment programs (those with growth opportunities) and with more costly external funds would be more likely to benefit from risk management activities. To empirically address this question the existing literature uses the following variables: (1) market-to-book ratio (Graham and Rogers, 2002; Gay and Nam, 1998; Mian, 1996) or research and development (Géczy et al. 1997) are used to proxy for the investment opportunities available to the firm; (2) liquidity (Berkman and Bradbury, 1996; Nance et al., 1993; Tufano, 1996), measured by the quick ratio, the current ratio or the dividend payout ratio, is used to proxy for liquidity constraints. The empirical evidence suggests that hedging can increase the likelihood of internal financing for investment and reduces its dependence on external financing.

To the shareholder value maximizing theories, and assuming the absence of agency conflicts, hedge is always in the interest of shareholders. However, when there is a conflict of interests between shareholders and managers, risk management activities can significantly differ.

Stutz (1984) and Smith and Stutz (1985) focus on managerial risk aversion as a justification for risk management. They argue that risk adverse managers tend to use hedging if they have relatively undiversified financial and human capital and if it is costly to hedge it on their own account. In this case, corporate hedging is driven by managerial personal preferences towards risk.

Commonly, proxies for managerial risk aversion are: the value of common shares held by the firms' directors and officers or incentives related to compensation based stock (Géczy et al., 1997; Gay and Nam, 1998; Haushalter, 2000; Tufano, 1996).

Divergent risk preferences between managers and shareholders may not, at all times, have a negative impact on firm value. Demarzo and Duffie (1995) and Breeden and Viswanathan (1998) link corporate hedging to managerial career and reputation concerns. Hedging can reduce noise associated with performance measures by reducing the firm's cash flow volatility. In this sense, managers with superior abilities may promote hedging activities to better communicate their abilities to the market. Therefore, hedging can also be viewed as a tool to reduce the degree of informational asymmetry between managers and shareholders.

Finally, risk management activities can potentially exacerbate the agency conflicts between managers and shareholders, so leading firms to poorer investment decisions. By easing the protection of managers "preferred" projects, risk management can reduce shareholder value. That is the case when projects that managers look for are negative NPV investments to the firm, and managers only support them because of some personal benefit. Through reduction in cash-flow volatility, risk management provides enough internal funds to engage in those projects, so avoiding capital market discipline imposed by external financing.

## 3 Data, empirical methodology and hypotheses

### 3.1 Data and sample construction

In some countries, qualitative and quantitative information on corporate derivative usage can be obtained from financial statements. In Portugal, however, accurate disclosure of derivative usage in financial statements is scarce.[12] Thus, our study combines both survey information and financial information, this last one obtained from annual reports.

To assess the practices of derivatives usage on surveyed non-financial firms, we have used the 2002 ranking of the "250 largest firms in the Leira district" published annually by the newspaper "Jornal de Leiria". Firms were ranked according to their sales, and we surveyed 145 corporations.

The questionnaire (with a postage-paid return envelope), was very similar to the one used in the well known Wharton Survey on derivative usage. The questionnaire, and a covering letter requiring the balance sheets and income statements of surveyed firms for the years 2001 and 2002, were mailed in July 2004. A total of 50 firms responded, representing a response rate of 34,5%. However, financial data was incomplete for 3 firms. The final sample contains 47 firms.

[12] In Portugal there are accounting rules for non-financial firms that define measurement, recognition and disclosure requirements for exchange-traded futures – Accounting directive nº 17. Directive nº 17 does not cover the other type of financial instruments, but according to Accounting directive nº 18, non-financial firms are obliged to comply with the rules of *International Accounting Standards Board* (IASB). In these terms, since 2001, the year that *IAS 39* from *IASB* (*International Accounting Standards 39 – Financial Instruments: Recognition and measurement.*) became effective in Portugal, all financial assets and liabilities, including derivatives, should be recognised in the balance sheet. Nevertheless, empirical studies on this matter, such as Lopes and Rodrigues (2003) conclude that the accounting practices for financial instruments by Portuguese firms are very far from what IAS 32 and 39 requires, especially, in the measurement and recognition criteria applied to the categories of financial instruments. Additionally, they report that quality of disclosure is less than satisfactory.

A firm is classified as a "derivative user" (hereafter referred to as a "user") if it discloses the use of any of the following derivatives instruments – swaps, futures, forwards, options, structured derivatives and/or hybrid debt. Of the 47 firms in our sample, 11 firms (23,4%) used hedging instruments in fiscal year 2002, while 36 did not. (Some firms may use internal hedging techniques, like on-balance-sheet transactions, such as matching positive and negative exposures, and these techniques will possibly lessen the need to use derivatives).

For each hedger in the sample, data was obtained on whether the firm hedged currency-price risk, interest-rate risk, and/or commodity-price risk; at the same time we collected information on the type of instruments used to hedge these exposures. It is observed that 58,3% of the derivative users hedge interest rate exposure, followed by currency-price exposure (33,3%), while only 16,7% of the firms hedge commodity-price exposure. Forwards and swaps are the two most popular instruments.

One of the firms' specific characteristics that have been emphasizing in existing literature is firm size. Virtually, the majority of the extant empirical studies report a positive relation between firm size and derivatives use. To analyse the differences in terms of firm size we have divided the sample into three groups (assessed by sales) of different sizes (similar to Bodnar, Hayt and Marston, 1998). Thus, firms with sales of less than 9,6 million of euros were considered small and we have 14 firms in our sample; of more than 9,6 million but less than 15,7 million were considered medium and we have 14 firms in our sample; and of more than 15,7 million of euros were considered large and we have 19 firms in our sample.

This breakdown results in that the percentage of responding firms was higher (40%) in group of firms considered larger. Note that the difference between the number of firms lying in this group and the number of the firms lying in the rest of the groups is irrelevant. This is due to the fact that the majority of the responding firms are classified as "medium" firms under the European Community standards.

Finally, 63% of the respondent firms are classified as industrials, and all of them are closely held.

### 3.2 Empirical methodology and hypotheses

To assess external and firm-specific factors that may influence a firm's decision to use derivatives for hedging purposes, we consider 10 individual proxies variables: (1) effective tax rate and tax-losses carry forward proxies for the convexity of the tax function; (2) debt ratio, long term debt ratio, return

on assets and interest coverage ratio, measuring the probability of financial distress; (3) firm's annual sales and total assets represent size of the firm; and finally, (4) the ratio of the fixed asset expenditures on the book value of assets and asset growth measures the firm's growth options.

We apply the Mann-Whitney nonparametric approach to test the difference between the means of variables for users and nonusers. In addition, we estimate a Logit regression to test the combined influence of explanatory variables on the decision to use derivatives and model the binary yes/no decision to use derivatives.

The model has the following specification:

$$p_i = Pr\left[Y_i = 1 \middle| X = X_i\right] = \frac{e^{Y_i}}{1+e^{Y_i}}$$ [13]

where,

- $p_i = p(Y\_DERIV_i)$ - is the conditional probability of derivative usage;

- $Y\_DERIV_i$ - is the dependent variable which has a value of 1 when the firm is a derivative user and 0 otherwise. It is supposed that $Y\_DERIV_i$ is a linear function of several idependent variables. Thus:

$$Y\_DERIV_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + \beta_4 X_{4i} + \beta_5 X_{5i} + \beta_6 X_{6i} + \beta_7 X_{7i} + \beta_8 X_{8i} + \beta_9 X_{9i} + \\ + \beta_{10} X_{10i} + \beta_{11} X_{11i} + \mu_i$$

$\beta_i$ - regression coefficients

$X_i$ - independent variables

$X_{2i}$ – ETR – effective tax rate

$X_{3i}$ – NOLS - net losses to be carried forward

$X_{4i}$ – DEBT - debt ratio

$X_{5i}$ – LTDEBT - long term debt ratio

$X_{6i}$ – COVERAGE - coverage ratio

[13] A probabilidade $q_i = (1 - p_i)$ de que a empresa *i* não utiliza instrumentos derivados, tendo em conta as variáveis $X_i$, é dada por: $q_i = Pr\left[Y_i = 0 \middle| X = X_i\right] = \frac{1}{1+e^{Y_i}}$, de forma que $p_i + q_i = 1$.

$X_{7i}$ – ROA - return on assets

$X_{8i}$ – SALES – sales

$X_{9i}$ – ASSETS – assets

$X_{10i}$ – INV- investment in fixed assets

$X_{11i}$ – ASSETG – asset growth

$\mu_i$ - random variable (error term)

Similar to Francis and Stephan (1990), Nance et al. (1993), Mian (1996), Géczy et al. (1997) and Mota (2000), in our model derivatives usage (dependent variable) is measured by a binary variable that indicates whether the firm uses derivatives. The variable takes the value of 1 those firms that have used derivatives to hedge their exposures to risk, and 0 for those that have not. We collected this information from the survey.

We describe below the proxy's variables included in our model. We do not consider any variable to proxy for extent of managerial risk aversion because of our company's structure sample.[14]

**a) Taxes**

Three sources of firm's effective tax function convexity are usually proposed: (1) tax rate schedule progressivity, (2) the existence of a minimum tax and (3) limitations on the use of tax credits, such as limitations on carrying losses backward or forward and on investment tax credits.

In Portugal the progressivity of tax rates is only valid for the individual income tax. Hence, if convexity exists in firms' tax function it will only be induced by the tax-loss carry backs or forwards or by the investment tax credits.

The Portuguese fiscal system contemplates the tax-loss carryforwards, but the possibility of deduction is up to a maximum of six years, the annual deduction being limited to the value of taxable profit.[15]

[14] The firms in our sample are closely-widely firms. In most cases holders are also managers.

[15] According to what is prescribed in nº 1 of art.47º of Corporate Income Tax Code (CITC).

Concerning tax-incentives, especially those which operate by tax liability deduction, tax-incentives to investment were available in 2002. This is the case of *tax incentives to investment*[16] and of *tax-credits to research and development*.[17] On both situations the expenses that, due to tax liability insufficiency, are not deducted when incurred can be deducted latter, but restricted to a maximum number of years for the deduction.

Until 2001, and due to the then existing accounting rules in Portugal, it was not possible to isolate and quantify in the financial statements the effect of tax-loss carryforwards and of investment tax credit. However, from the year 2002 on this recognition is required. This will be the case when certain firms are forced to present the most complete models of reporting, indicated in the Portuguese Accounting Act (POC – "Plano Oficial de Contabilidade).[18] To these firms it will be applied what is disposed in the accounting directive nº 28 – "*Income tax*".

Concerning this accounting directive, the existence of tax-loss carryforwards, as well as the existence of fiscal credits, determine the recognition of a "credit" upon the State, although only likely to happen in the presence of ulterior taxable profits. According to the directive, that credit is recognized as a deferred tax asset.[19]

Regarding the empirical investigation, many variables have been used to test the relation between taxes and derivatives usage. The great majority of the variables that are used is based in the existence of net operating losses (NOLs) and, with exception to Mota (2000), authors admit a positive relation between the existence of convexity sources of tax function and derivatives usage. Overall, the hypothesis usually tested is as follows: the higher the probability of the firm's pre-tax income is in the progressive region of the tax schedule (or the higher the tax corporate income), the greater the firm's probability of incurrence in tax loss which will be carried forwards (or the greater the firm's tax loss

[16] This kind of incentive can come from *projects of major economic and social impact* or from *projects in the framework of foreign investment* provided, respectably, in nº1 and nº 4 of art.39 of Tax Benefits Code.

[17] Regulated by Decree-Law nº 292/97, 22nd October.

[18] This engagement imposes itself to individual companies regulated by the Commercial Company Act, to the individual stakeholder companies, to the private limited companies, to corporations and to cooperative societies that until the closing date of accounts had overtaken two or tree of the limits referred to in article nº 262 of Portuguese Commercial Company Act, as established in art. 3 of Decree-Law nº 410/89, 21st November.

[19] In any way, the credit should only be booked if there is whether a superior or equal quantity to be recognized as deferred income tax liabilities, or if there is any reasonable expectations from which taxable profits will be verified, an therefore allow in both cases to use that credit.

carryforwards) and the greater the firm's probability of tax credits existence, the greater should be the probability of firm's engagement in hedging.

Following Mota (2000), we consider that a lower tax rate can result from the existence of tax-loss carryforwards in periods prior to the analysis,[20] i.e., there is a major probability of the company's results alternate between profits and losses,[21] which can be prone to the implementation of risk management. From this analysis, a negative relation between variables is anticipated.

Base on this reasoning, the first hypothesis will be that firms that face lower income taxes will have a higher probability to alternate their results between profits and losses, hence the higher the probability of derivatives usage.

The variable proposed will be "effective tax rate", and will be constructed as the ratio of the income tax paid to the pre tax income.

It is likely that from the ratio's "effective tax rate" calculation can result negative values. If this is the case, the ratio should assume a zero value.

Another tax related factor is the influence of NOL in hedging decision. We thus use tax-losses carry forwards "NOLS" – which assumes the value 1 when the pre-tax income has negative values. In contrast, when pre-tax income has positive values this variable assumes the value 0. This variable is proposed to test that firms that experimented tax-losses carry forwards will have a greater likelihood to make use of derivatives instruments.

**b) Financial distress costs**

[20] At first sight it seems that the tax-loss value to carryforward concerning the former period of the analysis can be obtained by the difference between the retained earnings of the actual year and the retained earnings of the former year. If this difference is negative, the value of this difference can be interpreted as the tax-value loss to carryforward. On the other and, if the difference is positive it means that tax-value loss to carryforward didn't exist. However if we analyse the description of the retained earnings account proposed in the Accounting Act we verify, only for the purpose of our analysis (where the difference between retained earnings of two consecutive years is negative), that this account can be booked in debit; (1) by the tax-loss determined in the former exercise; (2) by the difference between attributed profits to affiliate and associated companies participations and inherent profits; (3) and, specially, it can also register "*non frequent and of major significance regularizations*" which should affect shareholders' equity in a negative way, instead of affects the net profit of the year. In this last case, the Accounting Directive nº 8 refers that the expression of "*non frequent and of major significance regularizations*" should only include fundamental errors, i.e., those which are detected in the actual period with such an extent that financial statements of one or more former periods are no longer considered as credible. From this analysis we conclude that the difference between retained earnings of the actual year and those of the former year will not be a good approximation of the existing tax losses to carry forward.

[21] These firms will have major probabilities of having convex tax functions.

We collect data on firm's leverage, interest coverage ratio and profitability to measure financial distress costs.

Measuring financial distress costs by leverage levels relies on the implicit assumption that firms with important gearing in their capital structure have greater probability of facing financial distress. Leverage is measured by debt ratio (Berkman and Bradbury, 1996; Gay and Nam, 1998; Graham and Rogers, 1999) and long term debt ratio (Géczy et al., 1997; Mota, 2000; Tufano, 1998). Debt ratio is here defined as the book value of debt divided by book value of total assets, and long term debt ratio is defined as book value of long term debt scaled by book value of total assets.

Firms with a low interest coverage ratio are less likely to honour the promised payments on debt because they do not generate enough cash from their activities (Nance et al., 1993). We define interest coverage ratio as earnings before interest and taxes plus financial revenue divided by interest expense (Mota, 2000).

Graham and Rogers (2002) considered that firms with low profitability are more prone to experience situations of financial distress. Profitability is measured by return on assets, where return on assets equals the earnings before interest and taxes divided by book value of total assets.

Theory predicts a positive relationship between derivatives use and leverage, and a negative relationship between derivatives´ use and the interest coverage ratio and return on assets.

**c) Firm size**

Two arguments are ususally presented concerning firm size and its impact on hedging. On one side, smaller firms should have a higher hedging ratio because the reduction in financial distress costs is more important in their case. On the other side, if the hedging costs are fixed, larger firms should engage more actively in risk management because it corresponds to an expensive activity that smaller firms cannot afford. Large firms exhibit informational economies and economies of scale in risk management activities. Theoretically, the expected signal of the relationship between derivatives use and firm size is not clear.

The majority of empirical studies report a positive relation between firm size and derivatives use (Berkman and Bradbury, 1996; Mardsen and Prevost, 2005; Mian, 1996; Nance et al., 1993; among others).

We used two variables to proxy's firm size: firm's total assets represented by the logarithm of book value of total assets, and firm's annual sales represented by the logarithm of annual sales.

**d) Agency cost of debt**

Indications of the agency costs of debt can be based on the measurement of firm's investment opportunities. As a proxy for investment opportunity we use the ratio of the firm's fixed assets expenditures defined as firm's fixed assets expenditures, divided by the book value of total assets (Géczy et al., 1997; Mota, 2000).

Moreover, we use the variable asset growth to proxy's for investment opportunities. This variable is defined as the logarithm of tangible assets growth plus amortization/depreciation of the year divided by net profit plus amortization/depreciation of the year (Berkman e Bradbury ,1996).

If risk management is used to protect the continued funding of futures investment programs, theory predicts a positive relationship between derivatives usage and both variables - ratio of the fixed asset expenditures and asset growth.

## 4 Results

### 4.1 Univariate Analysis

In column A of table 1 we report results of an univariate analysis for the independent variables used in the model. To evaluate if there are any differences between the means of variables for users and nonusers, we make use of Mann-Whitney nonparametric approach, because the dependent variable follows a binomial distribution.

Table 1 – Results of Univariate Nonparametric Tests and of Logit Regression

| Variable | Predicted sign | Univariate Tests (A) | Multivariate Tests (B) |
|---|---|---|---|
| | | Z-statistic | Coefficient Estimate |
| Effective tax rate | - | 0,075 | -0,284 |
| Tax-losses carry forwards | + | -0,979 | -19,929 |
| Debt ratio | + | 1,106 | 8,215 (10) |
| Long term debt ratio | + | 0,754 | -6,160 (25) |
| Interest coverage ratio | - | -1,583 (25) | -0,011 |
| Return on assets | - | 0,905 | 29,795 (10) |
| Annual turnover | + | 2,286 (5) | 0,444 |
| Total assets | + | 1,884 (10) | 6,097 (10) |
| Ratio of the fixed asset expenditures | + | 0,578 | 0,438 |
| Asset growth | + | -0,303 | -0,478 |

Notes: (5), (10) and (25) means significance at .05 level, .10 level and .25 level, respectively.

On both tax variables we observe contrary relations of those predicted. Nevertheless, none of the variables shows statistically significant differences between both groups of firms.

Concerning the attribute of financial distress cost, results presented in column A of table 1 show that firms using derivatives have higher debt ratio, higher return on assets and lower interest coverage ratio. Also in this case, none of the variables exhibits a significant statistic difference between users and non users.

To capture firm size effect when using derivatives, two variables were used: annual turnover (log of sales) and total assets (log of total assets). Both variables confirm the expected relation. However, the annual turnover variable is the only one to show significant differences between both groups of firms, at a 5% level. Concerning total assets, the statistic significance is at a level of 10%. These conclusions are in accordance with the results of most empirical studies, which confirm the importance of scale economies in transaction costs and risk management strategies.

Finally, and concerning growth options, we have analysed asset growth variable and ratio of the fixed asset expenditures variable. As in Berkman and Bradbury (1996), the relation between asset growth and derivatives usage was the opposite of the one proposed by the theory. Besides, the difference between the averages of the two groups – users and nonusers - is not statistically significant.

In summary, the univariate analysis highlights that derivatives usage is mainly related to the firm's size. However, given the multivariate aspect of the firm's characteristics, these univariate tests should be interpreted with caution.

### 4.2 Multivariate analysis

Results obtained with the Logit model are reported in column B of table 1.We observe that four of the variables, independently of their statistic significance, do not present the expected coefficients. These variables are: tax-losses carrying forward, the long term debt ratio, the return on assets and the asset growth.

Only the debt ratio, the return on assets and the total of assets variables show statistical significance, but at 10% level. There is also the long term debt ratio variable, whose coefficient has a significance level of 25%.

We first used a model with all the variables (hereafter referred to as "original regression"). To verify more accurately the obtained results, we then used a second model that considers only the variables that reveal statistic significance in the original regression. The results presented in column B of table 1 end up by being confirmed and even improved with this second regression: the return on assets and the total assets become statistically significant at a level of 5% and both debt ratios maintain the same level of significance of the original regression.

To sum up, the results of the multivariate analysis show that:

(1) the tax variables representatives do not present statistical significance, which confirms the conclusions of other mentioned studies;

(2) concerning financial distress costs, only the debt ratio shows significance at a level of 5%. Regarding the return on assets, results obtained suggest the reformulation of the subjacent hypothesis. From our results we can conclude that firms with high profitability are more prone to use derivatives; this will only be verified if growth figures in the firm's aims. In this case, firms will choose bulky investments projects and will more intensely resort to external financing;

(3) we confirm the importance of scale economies in risk management activities;

(4) concerning the theoretical formulation proposed by Froot et al. (1993) stating that firms hedge to minimize underinvestment problems when they have growing options, a statistic significant relation was not found between analysed variables and derivatives usage.

To summarize, multivariate analysis provide support for the importance of scale economies. In addition, the results of this analysis also suggest that firms which hedge are more leveraged, have high profitability and are larger. We do not find evidence that corporate taxation affects corporate hedging policy.

## 5 Conclusion

This paper offers a review of factors that can lead to corporate hedging being valuable. Taxes are particularly discussed.

A sample of 47 Portuguese privately held non-financial firms, located in the Portuguese Central Region is used to assess if taxes and other factors are relevant firms decision to hedge. Combining survey information with financial data and making use of a logistic specification, we provide empirical analysis of the impact of different factors in firms' decisions to use derivatives for hedging purposes.

The theory provides support of a positive correlation between tax system features and valuable risk management. Nevertheless, we find no empirical evidence that firms hedge to reduce expected tax liability. In addition, the results of our analysis suggest that firms which hedge are more leveraged, have high profitability and are larger firms, which support the importance of scale economies.

We are aware of some limitations of our study, namely because sample dimension and firms' disclosures of losses carryforwards and tax credits. This could lead to the use of inappropriate measures of tax convexity, or to the interpretation that firms do not hedge in response to convexity of tax function because the incentive is smaller when compared to other hedging incentives.

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