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Exploring Risk Management Issues in the Technological Sector: The Effect of the Use of Derivatives Hedging on Technology Firms' Value

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Abstract. Entrepreneurship is synonymous with "bearing risk". In a technological context, the risks are much higher. The implementation of risk management instruments is therefore essential for entrepreneurs in the technological industry. However, how the use of derivatives hedging impacts the market value of technology firms remains unaddressed. To expand upon entrepreneurship literature in terms of risk management, we develop a new multidisciplinary theory that integrates risk management theories with entrepreneurship. By applying various methodologies (fixed-effect, pooled OLS, and system GMM) to our sample of 81 firms — listed between 2007-2020 in the Stoxx Europe 600 and operating in the Telecommunication and Information Technology industries — we reveal that the use of this risk management instrument does not impact upon technology firm value, measured as Tobin's Q. These results offer entrepreneurs a better understanding of the uselessness of using derivatives hedging to increase technology firm value in the technological industry.

Keywords: Derivatives, Hedging, Risk management, Corporate decisions, Entrepreneurship.

1. Introduction

In times of uncertainty and growing environmental instability, entrepreneurs must deal with higher levels of volatility and increased risk. It is not possible —

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especially for entrepreneurs and investors who directly bear the risks when investing their money — to remove external environmental uncertainty, as this is a component of objective reality. It is therefore essential for entrepreneurs to use risk management practices when facing uncertainty in an attempt to increase company value. In this context of instability and growing uncertainty, risk management has become a key strategic issue, as success in facing uncertainty arises as a result of superior risk management practices (Clarke and Varma, 1999).

Satisfying the needs of investors and entrepreneurs is more difficult today than it was in the past. This is because globalization has enabled businesses to deal with clients and suppliers across the globe who are able to provide new opportunities. At the same time, these processes increase degrees of complexity and risk. More and more unplanned events therefore need to be managed by companies. If companies can manage risks better, avoiding the negative effects of bad events (exchange rates, interest rates, commodity prices, etc.), then the company's value will increase.

Of all of the risk management instruments used by companies to face uncertainty, derivatives hedging has received the most academic attention (Smith, 1995). There is still a lot of debate among risk management scholars regarding the impact of the use of derivatives hedging on company value (Bachiller, Boubaker, and Mefteh-Wali, 2021). The first stream of researchers affirmed that the use of derivatives hedging increased company value by reducing profit volatility, lowering financial distress costs, and alleviating information asymmetry (DeMarzo and Duffie, 1995; Leland, 1998; Smith and Stulz, 1985). Another stream of researchers believed that derivatives hedging was detrimental to company value in instances where risk management instruments sought to satisfy managerial self-interest (Knopf, Nam, and Thornton Jr., 2002), or were used for speculative reasons that increased risk exposure (Hagelin and Pramborg, 2004). Prior works reported a positive correlation between derivatives hedging and leverage (Haushalter, 2000), leading firms to increase their debt and thus negatively impact upon firm value. Simultaneously, other pieces of recent research have not found any significant relationship between derivatives hedging and firm value (Belghitar, Clark, and Mefteh, 2013). The status quo of current literature thus implies that discussions related to the effects of derivatives hedging on company value are still unclear, and there is therefore room for deeper analysis.

This debate highlights the importance of sample selection, as prior works have focused on a specific industry (airlines, oil and gas producers, etc.), evidencing a positive effect of derivatives hedging on firm value in some circumstances, and a negative effect in others. With this in mind, the analysis of technology firms is important as, to our best knowledge, there are no prior studies focused on firms of this kind that widely use derivatives hedging instruments. This is because a relevant portion of their revenue comes from foreign countries,

and this increases their degree of exposure to the fluctuations of exchange rates (Sahoo, 2016).

This paper seeks to fill this empirical gap by identifying some characteristics of the firms able to explain the positive/negative/null effect of derivatives hedging on firm value. Despite numerous studies on this topic — often with opposing results — prior analyses have not focused on specific industries, failing to show that these characteristics are able to strongly influence the effect of derivatives hedging on firm value. This is a relevant issue, as academics have explained that the industry in which a company competes is a significant predictor of firm-level performance (Dess, Ireland, and Hitt, 1990). In fact, industry profitability is a statistically significant predictor of firm profitability, as it consistently explains more variance than any of the three business-level strategy variables (market share, debt/equity ratio, firm capital intensity) (Beard and Dess, 1981). Therefore, in our study, we focus on one single industry (the technological sector). To avoid any potential industry effects on the results, we consider a sample of companies with similar characteristics.

However, we do not expect derivatives hedging to significantly impact technology company value for several reasons. First of all, technology companies are affected by high leverage, due to the relevant investments they make. Because there is a positive correlation between derivatives hedging and leverage (Haushalter, 2000), an incremental recourse to debt is not likely to be beneficial for the firm. Secondly, in contexts with inadequate corporate governance practices, like smaller firms or firms with high ownership concentration, the mechanism of using derivatives hedging instruments is weak with regards to the relative inability of managers to use such complex instruments. Thirdly, prior studies have revealed that gains from the use of derivatives hedging could be inadequate in covering the significant costs of the financial, physical, and human resources needed to use a hedging approach (Belghitar, Clark and Mefteh, 2013). Fourthly, the presence of agency costs, which is an issue for most of the companies, can influence top executives to use derivatives hedging to maximize their own utility and not the company value. In the end, an insignificant effect of derivatives hedging on technology company value would be consistent with the classic Modigliani and Miller (1958) paradigm, according to which risk management should be irrelevant to company value.

Given the relevance of the use of derivatives hedging instruments for technology companies, and the fact that, to our knowledge, no studies are able to explain their relationship with firm market value, this study seeks to provide a guide for entrepreneurs, enabling them to understand whether or not the use of those instruments can be beneficial to the market value of technology companies.

The specific research question that we aim to address in this paper pertains to whether or not the use of derivatives hedging by firms in the Telecommunication and Information Technology industries impacts upon company value.

To answer our research question, we empirically analyse the relationship between the use of derivatives hedging instruments and company market value, which is measured as Tobin's Q for a relevant number of technology companies in Europe. The work thus seeks to identify the impact of the use of derivatives hedging instruments on Tobin's Q, proposing suggestions related to entrepreneurship development in order to increase company value. Our paper aims to provide a decision support tool for entrepreneurs and investors in medium-sized enterprises, using a sample of listed European companies as a proxy.

Our analysis was focused on Europe, considering all of the European listed companies which were part of the STOXX Europe 600 Index and were operating in the information technology and telecommunications industries. Europe was chosen as a result of the transparency of its financial statements, this made it possible for us to understand the derivatives hedging instruments used. Europe also has a significant number of companies operating in high technological industries.

Our starting hypothesis was that derivatives hedging instruments, which are used by small, medium, and large companies, do not contribute to increasing or decreasing the market value of technology companies.

This paper will initially provide a summary of the literature that evidences the link between entrepreneurship and risk management, the determinants of the use of derivatives, and their effect on firm value. The second section identifies the hypotheses. The third section outlines the sample and the methodology implemented. The fourth section reveals the results of our models, and the final section of the paper presents our findings.

2. Literature and Hypothesis

2.1. Literature Overview

Entrepreneurship and Risk Management

Firms operate in increasingly complex and uncertain environments. Managing risks is therefore a requirement for survival (McMullen and Shepherd, 2006). Risk management has many implications for business success, as a correct strategy implemented to avoid risks reduces both potential losses and the probability of bankruptcy.

Of the different kinds of firms, medium-sized enterprises have fewer resources in comparison to big companies, and therefore face more difficulties when building reliable mechanisms to support their risk management strategies (Brustbauer, 2016). This often requires significant investment. In fact, in medium-sized enterprises, the risk management function is generally covered by

the entrepreneur and is sometimes supported by an irrelevant number of employees (Watt, 2007). Entrepreneurs are generally labelled as "risk takers" (McGrath, MacMillan, and Scheinberg, 1992), as they are the ultimate owners of the company and they make the final decisions in terms of risk taking. An entrepreneur's perception and willingness to take risks affects their risk management approach.

However, despite risk management remaining an important function for each firm, especially for medium-sized enterprises, which are more vulnerable in comparison to big companies, the matter of exploiting risk management has been insufficiently considered by entrepreneurs. According to scholars, there are several reasons for this lack of interest. First of all, entrepreneurs do not consider uncertainty related to positive consequences as a possible element of risk, but only as a possible negative outcome (MacCrimmon and Wehrung, 1988). Secondly, entrepreneurs struggle to attain precision when assessing risks, but do not demonstrate the volition to diminish it to a measurable degree. Therefore, risk perception and their capacity to manage risks are able to influence an entrepreneur's risk management approach.

Entrepreneurship risk management is considered to be a process designed to identify potentially dangerous events that are able to affect an organization, and to help entrepreneurs to achieve the organization's targets. Risk management is important for entrepreneurs as it supports the firm's strategic development by diminishing potential losses, thus facilitating a competitive advantage (Nocco and Stulz, 2006).

Moreover, risk management is much more relevant for medium-sized enterprises than for big companies when it comes to considering the challenges that these companies face when accessing credit. Medium-sized enterprises (like Small and Medium Enterprises) have more difficulty accessing credit in comparison to big companies. Medium-sized enterprises provide information that is physiologically more opaque than that provided by big companies. This makes the issue of evaluating their creditworthiness a difficult one (Ciampi, Giannozzi, Marzi, and Altman, 2021). Moreover, there is an extensive amount of literature that reveals that imperfections in the credit market stem from the recognized higher levels of risk faced by medium-sized enterprises in comparison to big companies. This is due to higher relative probabilities of failure, greater chances for information asymmetry, and moral hazards (Ennew and Binks, 1995); all of which imply a higher level of risk in terms of a firm's ability to obtain new financial resources. Therefore, in order to assess all of the risks, such as temporal financial resource needs, medium-sized enterprises need to manage risk management tasks more closely.

Many academics who analyse risk management have proposed distinctive frameworks for interpreting the theme, but they principally consider big corporations and not all industries. Manufacturing and the financial sectors are their preferred industries (Verbano and Venturini, 2013). According to past

works, the extent of the risk depends on the type of industry (Aureli and Salvatori, 2013). At the same time, other scholars have shown that risk management does not depend on the kind of industry, nor its organization ownership, but rather can be affected by business know-how, risk comprehension, and the risk aversion of entrepreneurs (Jayathilake, 2012).

As confirmed by a number of academics, few works focus on risk management in medium-sized enterprises. Literature on risk management in medium-sized enterprises is ambiguous, and research on this theme is still scarce (De Araújo Lima, Crema, and Verbano, 2020). The opportunity to implement and sustain risk management in medium-sized enterprises is up for academic debate. Furthermore, there is a lack of guidelines describing how to accept a broad risk management approach in medium-sized enterprises (Crema, 2017), and these practices are rarely shared between organizations. Moreover, risk management could be implemented in different ways depending on the organization's size (Rostami, Sommerville, Wong, and Lee, 2015). For medium-sized enterprises, risk management is generally more analytically developed in bigger organizations, as the characteristics of these companies are very dissimilar in relation to those of smaller companies with regards to management characteristics, financial structure, and risk of default (De Araújo Lima, Crema, and Verbano, 2020).

Few studies seek to offer an indication of the real experiences associated with risk management in medium-sized enterprises (Crema, 2017; De Araújo Lima, Crema, and Verbano, 2020), and it is very difficult to find a synthesis that systematizes the understandings and practices established in this area. Moreover, the divisive outcomes of risk management literature in medium-sized enterprises reveals that the theme is still being discussed and questioned by academics. Therefore, there is a need for an exhaustive comprehension of risk management in medium-sized enterprises and an outline on how it should affect entrepreneurs' decisions in defining firm strategies.

Derivatives Use Determinants

Among the different risk management instruments, the use of derivatives is one of the most heavily exploited by firms.

Literature analyzing companies' use of derivatives is extensive because a company can use these instruments in many ways. A company can exploit derivatives to hedge with the aim of reducing its risk of exposure to a specific price, or it can gamble in an attempt to make a profit. In the Modigliani-Miller paradigm, exploiting derivatives hedging is not relevant for firm performance (Modigliani and Miller, 1958). From this point of view, the frequency of the use of derivatives is confusing because it could be expensive, and investors may exploit these instruments in relation to their inclination to take risks in a more efficient way than a company (DeMarzo and Duffie, 1991).

Risk-management theory justifies the appropriate use of derivatives hedging because of market imperfections that generate high levels of volatility related to rates or prices. This can be very expensive for a company. Prior academics have distinguished between four different kinds of situations in which volatility raises a company's cost of capital (and therefore reduces company value) (Guay and Kothari, 2003): i) financial distress expenses; ii) expensive external funding; iii) asymmetry in tax expenses; and iv) the risk aversion costs of managers. Coherent with all of these elements, there are significant empirical analysis that explore the use of derivatives and explain how the use of derivatives permits companies to stabilize their cash flows and profits, and consequently decrease their relative cost of capital and raise company value.

Other scholars explain that the use of derivatives can raise the levered company value by decreasing the chance of a relevant negative shock to the company's cash flows, thereby diminishing the possibility of bankruptcy (Smith and Stulz, 1985). Thus, the company experiences a cost of capital decrease and, consequently, an increase in company value. Moreover, prior works have found that, in times of financial distress, company owners can sacrifice positive NPV (net present value) investments if the financial issuers increase their gains (Myers, 1977). As such, studies offer proofs that the use of derivatives could increase company value by decreasing the company's likelihood of facing financial distress.

Some scholars analyse the impact of the use of derivatives on company financing costs. If external financing is more expensive than internal financing, the use of derivatives could better pair cash out-flows and cash in-flows, decreasing the likelihood of a company requiring more expensive external finance (Froot, Scharfstein, and Stein, 1993).

Other academics have shown that companies with better growth opportunities and financial constraints exploit with high probability currency derivatives (Géczy, Minton, and Schrand, 1997). Other scholars confirm this, explaining that hedging is connected with greater company value for companies with better growth prospects and those with superior information asymmetry (Choi, Mao, and Upadhyay, 2013).

Companies that obtain flatter profits also have less of a chance of facing bankruptcy. This therefore reduces borrowing expenses (Trueman and Titman, 1988).

Tax laws are asymmetrical and, because companies pay taxes when they generate profits but do not receive money from the State for losses, companies can exploit derivatives to decrease the volatility of their earnings and thus stabilize the tax disbursements due (Smith and Stulz, 1985). Companies that start to use derivatives face a significant decrease in their cash effective tax rates (Donohoe, 2015).

Additionally, analysis has found that reduced cash-flow volatility from the use of derivatives may allow companies to improve their debt capacity and obtain

tax benefits related to the increased financial expenses of the amplified debt (Leland, 1998).

While reducing volatility using derivatives does not directly generate advantages for investors, it could benefit executives and managers with high levels of risk aversion. Academics explain that those executives and managers may exploit derivatives to reduce remuneration uncertainty. Company value therefore rises, as managers with high degrees of risk aversion necessitate inferior remuneration when uncertainty is minor (Smith and Stulz, 1985).

Generally, recognizing the impact of the use of derivatives on company risk is difficult because of the endogenous characteristics of both economic and financial risks, and of the use of derivatives. This is evident in the amount of effort required to detect a company's level of risk, omitting the impact of the use of derivatives. For instance, a positive correlation between the use of derivatives and company risk could imply that companies exploit these instruments to raise the level of risk in an attempt to gain a profit. It could also show that companies with a higher risk inclination make use of derivatives more significantly.

Other researchers, with different results compared to the cited studies, show that some companies exploit derivatives to gain profits (speculation) and to increase company risk. A significant number of financial tragedies that happened in the 1990s were linked to the use of derivatives for speculative reasons. In the years following these tragedies, the use of derivatives for speculative reasons has often been frowned upon by investors and, therefore, most companies have asserted that they exploited derivatives only for hedging reasons. However, there are concerns that companies exploit derivatives to speculate in order to obtain a financial gain. Prior studies explain that companies usually exploit derivatives to take a look or to speculate (Bodnar, Hayt, and Marston, 1998) in order to gain information and cost advantages, as opposed to speculating to increase risk. In other studies, researchers have shown that some companies can benefit from this approach (Adam and Fernando, 2006). Scholars have shown that, in specific industries (e.g., mining), companies regularly obtain relevant positive cash flow, exploiting speculative derivatives without mounting their risk, thus signifying that they benefit from industry-specific knowledge able to permit them to obtain a financial gain from derivatives transactions executed for speculative reasons.

Other academics explain that deciphering a positive correlation between the use of derivatives and the speculative targets is complicated, because the proxies expended in these works may comprise derivatives that are exploited for speculation or for hedging (Chernenko and Faulkender, 2011). Therefore, it is difficult for researchers to understand whether the documented correlations are determined by the use of derivatives for hedging or for speculative reasons. Chernenko and Faulkender (2011) explain that companies concurrently use interest rate swaps for speculation and for hedging, and that companies make use of derivatives to increase profits and to speculate when manager remuneration contracts are linked to company performance.

Derivatives Use and Company Value

The most cited economic theories seem to suggest that company risk management, and therefore also instruments like derivatives hedging, is not able to increase company value. For instance, in line with the Modigliani and Miller (1958) paradigm, a company's financing choices are not able to influence the company's value, because shareholders can simply replicate them. Therefore, because company risk management can be considered to be a financing policy, it is not able to increase company value in a Modigliani and Miller world.

However, a branch of theoretical research explains that company value is positively affected by derivatives hedging. Some scholars affirm that, by decreasing bankruptcy chances, derivatives hedging can increase company value, and that this effect is more relevant for companies that face higher costs when in financial distress (Smith and Stulz, 1985). Among the costs associated with financial distress are those linked to failure to invest in profitable investments because of the deadweight costs of debt (Stulz, 2008). This is explained by the fact that, when there are deadweight costs, companies that require external financing underinvest if the operating cash-flow is low. The use of derivatives hedging generates supplementary cash, avoiding the underinvestment problem (Froot, Scharfstein, and Stein, 1993). Therefore, in their model, derivatives hedging is an instrument used to reduce the underinvestment incentive.

Other scholars develop Froot, Scharfstein, and Stein's (1993) model, showing that, when considering the agency costs linked to the executives-shareholder relationship, derivatives hedging may enable executives to decrease company value (Tufano, 1998). This literature stream assumes that executives have the incentive to misappropriate a relevant part of the value created from an investment. Because financial institutions know that the agency problem exists, they refuse to provide resources to companies for investments of this kind.

Notably, out of all the studies investigated, there is no significant evidence to suggest that derivatives hedging increases company value (Carter, Rogers, and Simkins, 2006). Scholars have examined the correlation between the use of currency derivatives and the company market value, finding a positive link, and interpreting the results as proof of the fact that hedging activities are able to increase company value (Allayannis and Weston, 2001). However, some authors affirm that it is difficult to interpret the results of Allayannis and Weston's work, as the results are affected by endogeneity problems across the sample of the firms used (Jin and Jorion, 2006). Jin and Jorion (2006) tested the effect of derivatives hedging on company market value without finding any correlation. Other scholars had similar results to Jin and Jorion (2006), revealing that the potential gains deriving from the use of derivatives hedging are small in comparison to the variation of equity values (Guay and Kothari, 2003). Guay and Kothari (2003) justify their results by explaining that any increase in company value is either very small or is due to other risk management instruments that are value enhancing and positively correlated with derivatives hedging.

In general, a correlation between the use of derivatives hedging and company value can instead reveal a correlation between two endogenous variables. If the use of derivatives hedging increases company value, why do not all companies operate in the same way and use these kinds of instruments? Relevant works have focused on explaining the endogeneity problem and have shown it can be reduced by only considering companies operating in the same industry (Jin and Jorion, 2006).

Other researchers have published studies in which they have observed a negative impact of derivatives hedging on company value. One of the reasons for this is that derivatives hedging is used by executives and managers only for self-purpose reasons, and is not in the interest of the company (Knopf, Nam, and Thornton Jr., 2002). Another reason examined by academics shows that the use of th3se instruments is encouraged only for speculative reasons, and not for hedging purposes (Adam and Fernando, 2006). A negative correlation can also be determined by the high fixed costs of hedging, which can make hedging very expensive (Haushalter, 2001). A recent contribution explains that the use of derivatives hedging is not strictly exogenous, and that after controlling for the failure of the strict exogeneity assumptions, it does not have an impact on company value (Magee, 2013).

Overall, we have shown that the results of studies inspecting the correlation between the use of derivatives hedging and company value are mixed.

2.2. The Hypothesis

Accordingly, prior studies explain that the use of derivatives hedging can have different impacts on company value. Moreover, these impacts are also dependent on the type of industry considered in the analysis. The reason behind these differences stems from the fact that there are issues linked to endogeneity problems across the samples used for the analysis. Prior scholars suggest focusing the analysis on only one industry in order to avoid endogeneity problems (Jin and Jorion, 2006).

Based on what has been explained in previous sections, the hypothesis of this paper is that the use of derivatives hedging in the Telecommunication and Information Technology industries, whose companies are affected by higher degrees of leverage and therefore have higher financing costs, does not affect company value, given the fact that gains from derivatives hedging could be inadequate in covering the significant costs associated with using a hedging approach.

The hypothesized null impact of derivatives hedging on company value stems from the fact that firms operating in the Telecommunication and Information Technology industries are affected by higher leverage, and therefore by higher financing costs. The costs associated with hedging do not cover the gains from

derivatives hedging activity, and therefore there is not an effect on company value:

H1: The use of derivatives hedging by firms in the Telecommunication and Information Technology industries does not impact upon company value.

3. Sample and Methodology

The sample includes 81 publicly traded stocks of firms that are listed on the Stoxx Europe 600 and are operating in the Telecommunication and Information Technology industries. Our time horizon covers 14 years (from 2007 to 2020) and data was collected using Bloomberg and Datastream Thomson Reuters as databases for a total of 766 observations. We chose 2007 as the starting year, as this was the first year of the application of the IFRS 7, which radically changed the disclosures that companies had to provide with regards to financial instruments (Tron and Colantoni, 2021).

Our paper aims to provide a decision support tool for entrepreneurs and investors in medium-sized enterprises, using a sample of listed companies as a proxy. We believe that our sample is representative for several reasons: i) the European market is mainly characterised by medium-sized companies, as is the case for the listed companies; ii) the European market is characterised by high levels of transparency; iii) a high number of companies operate in technological industries in the European area; iv) this industry has not yet been studied in depth by previous researchers (Allayannis, Lel and Miller, 2012). This choice is justified by several elements. Firstly, a database of private companies would be non-homogeneous, given the differences between the various national accounting standards. Limitations in terms of observations and listed companies make it possible to apply uniform accounting standards (IAS/IFRS), while allowing the sample size to be greatly expanded. Secondly, companies in the technology sector tend to be, especially in recent years, larger than average in size when compared to those in other sectors and, therefore, given the high market valuations, tend to have an incentive to go public (Mazur, Dang and Vega, 2021).

In the empirical models, as a dependent variable for measuring the firm value, we used the natural logarithm transformation of the Tobin's Q ratio. This ratio is less susceptible to accounting practices and it is a forward-looking index (Wernerfelt and Montgomery, 1988) with good statistical properties (Hirsch and Seaks, 1993). Moreover, the reliability of the Tobin's Q ratio in this field has been demonstrated by several authors (Bartram, Brown, and Conrad, 2011; Panaretou, 2013; Tron and Colantoni, 2021; among others). In order to make our results more robust, we applied both of the definitions of Tobin's Q that have been applied in previous literature. Firstly, Tobin's Q ratio is defined as (Panaretou, 2013):

$$1.Tobin's\ Q = (Market\ Value\ of\ Equity + Book\ Value\ of\ Debt + Book\ Value\ of\ Preferred\ Stocks) / Total\ Assets$$

Secondly, Tobin's Q ratio can also be defined as (Panaretou, 2013):

$$2.Tobin's\ Q\ 2 = (Market\ Value\ of\ Equity - Book\ Valure\ of\ Equity\ + Total\ Assets) / Total\ Assets$$

To investigate whether or not the use of derivatives influences the firm's value, we used a dummy variable equal to 1 if a company used derivatives during the financial year. This variable follows the example of Allayannis and Weston (2001).

Based on past research (Jin and Jorion, 2006; Panaretou, 2013), we added several control variables. An overview of the control variables that were used in this paper can be found in Table I.

Table I – Variable Description

Variable	**Description**
Derivative User	A dummy variable that is equal to 1 when a company used a derivative
Size	The natural logarithm of total assets
Roa	Net income divided by total assets
Dividends	A dummy variable that is equal to one if the firm paid a dividend in the current year and 0 otherwise
Leverage	Book value of long-term debt divided by the market value of common equity
Foreign Presence	Foreign sales divided by total sales
Capex	Capital expenditures divided by total sales
Liquidity	Cash and cash equivalents divided by current liabilities

In Table II we report the descriptive statistics of each variable.

Table II - Descriptive Statistics by Status
Notes: Users are companies that used a derivative during the financial year.

	N	**Mean**	**Std. Dev.**	**P1**	**P50**	**P99**
All Firms						
Ln Tobin's Q 1	806	0.48	1.02	-2.63	0.44	3.15
Ln Tobin's Q 2	818	0.70	0.72	-0.85	0.59	4.23
Users						
Ln Tobin's Q 1	585	0.42	0.72	-1.01	0.34	2.63
Ln Tobin's Q 2	586	0.62	0.58	-0.54	0.51	2.44
Size	586	15.88	1.97	11.99	15.87	19.40
Roa	581	7.65	8.76	-10.47	7.22	36.38
Dividends	586	0.82	0.38	0	1	1
Leverage	570	0.33	0.52	0.00	0.15	2.99
Foreign Presence	586	0.60	0.32	0.00	0.68	1
Capex	586	0.08	0.09	0.00	0.39	0.43
Liquidity	584	0.60	0.85	0.02	0.40	4.34
Non Users						
Ln Tobin's Q 1	221	0.64	1.54	-6.43	0.70	4.13
Ln Tobin's Q 2	232	0.89	0.97	-0.95	0.83	4.14
Size	232	13.98	1.63	10.08	13.97	18.25
Roa	219	14.51	34.73	-32.32	8.97	44.56
Dividends	232	0.38	0.49	0	0	1
Leverage	204	0.09	0.19	0.00	0.03	0.83
Foreign Presence	232	0.33	0.39	0.00	0.01	1.00
Capex	232	0.04	0.08	0.00	0.02	0.40
Liquidity	228	0.77	0.84	0.00	0.51	4.17

The VIF test and the correlations between the variables can be seen in Table III and Table IV.

Table III – Correlation analysis

	Ln Tobin's Q 1	Ln Tobin's Q 2	Derivative User	Size	Roa	Dividends	Leverage	Foreign Presence	Capex	Liquidity
Ln Tobin's Q 1	1.00									
Ln Tobin's Q 2	0.8728*	1.00								
	0.0000									
Derivative User	-0.0922*	-0.1690*	1.00							
	0.0088	0.0000								
Size	-0.2405*	-0.3460*	0.4159*	1.00						
	0.0000	0.0000	0.0000							
Roa	0.4879*	0.5219*	-0.1542*	-0.2232*	1.00					
	0.0000	0.0000	0.0000	0.0000						
Dividends	0.1131*	0.0981*	0.4502*	0.3123*	0.1158*	1.00				
	0.0013	0.0050	0.0000	0.0000	0.0010					
Leverage	-0.4396*	-0.4382*	0.2153*	0.4317*	-0.1531*	0.0071	1.00			
	0.0000	0.0000	0.0000	0.0000	0.0000	0.8436				
Foreign Presence	0.1231*	0.1277*	0.3514*	0.1805*	-0.0976*	0.3775*	-0.1847*	1.00		
	0.0005	0.0003	0.0000	0.0000	0.0057	0.0000	0.0000			
Capex	-0.1220*	-0.1710*	0.1770*	0.3685*	-0.1177*	0.0753*	0.3219*	-0.0816*	1.00	
	0.0005	0.0000	0.0000	0.0000	0.0009	0.0312	0.0000	0.0196		
Liquidity	0.1883*	0.1939*	-0.0921*	-0.1731*	0.1448*	-0.0910*	-0.1421*	0.2210*	-0.0013	1.00
	0.0000	0.0000	0.0086	0.0000	0.0000	0.0094	0.0001	0.0000	0.9712	

standard error in parentheses; ***, **, and * indicates statistically significant levels of 1%, 5% and 10%, respectively.

Table IV – VIF Test

Variable	**VIF**	**1/VIF**
Derivative User	1.29	0.776939
Size	1.93	0.518172
Roa	1.15	0.869432
Dividends	1.21	0.827408
Leverage	1.43	0.699274
Foreign Presence	1.25	0.800826
Capex	1.27	0.784609
Liquidity	1.19	0.842625

The correlations between the variables reveal a negative significant correlation between the use of derivatives and the firm value, signalling a possible negative impact for derivative users.

In order to increase the robustness of our results, we applied three methodologies: i) fixed effect OLS model; ii) pooled OLS model; and iii) system GMM estimators.

The fixed effect OLS methodology is the most frequently used in previous research, as it allows researchers to manage both heteroskedasticity and

autocorrelation (Ayturk, Gurbuz, and Yanik, 2016). As a control, we applied the Hausman test, which confirmed the choice of the model. As a second methodology, we performed a pooled OLS model, which can be considered a valid alternative tool (Wooldridge, 2010). However, our analysis could be affected by an endogeneity problem linked to the relationship between the use of derivatives and firm value, as the use of derivatives can impact upon the firm value. However, the opposite could also be true (Magee; 2013). To overcome this issue, we ran a dynamic panel with system GMM estimators as a third methodology (for a complete description of the methodology see Arellano and Bover, 1995, and Blundell and Bond, 1998), as suggested by Magee (2013).

4. Results

We ran every model; initially using the first definition of Tobin's Q, followed by the second definition of Tobin's Q.

The results of the fixed effect model are shown in Table V.

Table V – Fixed Effect Model

Dependent variable	**Ln Tobin's Q 1**	**Ln Tobin's Q 2**
Models	(1)	(2)
Independent variables		
Derivative User	0.031	0.048
	(0.082)	(0.076)
Size	-0.036	-0.041
	(0.073)	(0.063)
Roa	0.009***	0.007***
	(0.003)	(0.002)
Dividends	0.168***	0.146***
	(0.050)	(0.047)
Leverage	-0.481***	-0.395***
	(0.104)	(0.086)
Foreign Presence	0.212*	0.200*
	(0.117)	(0.109)
Capex	-0.716	-0.592
	(0.594)	(0.572)
Liquidity	0.007	-0.008
	(0.051)	(0.045)
Constant	0.927	1224
	(1.102)	(0.958)
Year Dummies	Yes	Yes
Company Dummies	Yes	Yes
Observations	766	766
R Squared	0.440	0.389

***, **, and * indicates statistically significant levels of 1%, 5%, and 10%, respectively.

For both Models 1 and 2, the use of derivatives is not statically significant and does not affect the firm value. In both models, the control variables ROA, Dividends, Leverage, and Foreign Presence are statistically significant.

We then ran the pooled OLS model; initially using the first definition of Tobin's Q (Model 3), followed by the second definition of Tobin's Q (Model 4). The results of the pooled OLS model are shown in Table VI.

Table VI – Pooled OLS Model

Dependent variable	**Ln Tobin's Q 1**	**Ln Tobin's Q 2**
Models	(3)	(4)
Independent variables		
Derivative User	0.004	0.022
	(0.079)	(0.072)
Size	-0.100***	-0.096***
	(0.032)	(0.026)
Roa	0.011***	0.009***
	(0.002)	(0.002)
Dividends	0.116**	0.096**
	(0.051)	(0.047)
Leverage	-0.496***	-0.406***
	(0.108)	(0.087)
Foreign Presence	0.212*	0.189*
	(0.110)	(0.101)
Capex	-0.523	-0.470
	(0.534)	(0.501)
Liquidity	0.016	-0.003
	(0.054)	(0.048)
Constant	1.881***	2.059***
	(0.498)	(0.407)
Year Dummies	Yes	Yes
Company Dummies	Yes	Yes
Observations	766	766
R Squared	0.512	0.518

***, **, and * indicates statistically significant levels of 1%, 5%, and 10%, respectively.

In this instance, previous results are confirmed. In both Models 3 and 4, the use of derivatives is not statically significant and does not affect the firm value.

Finally, we ran the dynamic panel with system GMM estimators; initially using the first definition of Tobin's Q (Model 5), followed by the second definition of Tobin's Q (Model 6). The results are shown in Table VII.

Table VII – GMM Model

Dependent variable	**Ln Tobin's Q 1**	**Ln Tobin's Q 2**
Models	(5)	(6)
Independent variables		
Lag Dependent Variable	0.383***	0.541***
	(0.104)	(0.083)
Derivative User	-0.035	-0.019
	(0.099)	(0.082)
Size	-0.191***	-0.142**
	(0.063)	(0.061)
Roa	0.005**	0.004*
	(0.002)	(0.002)
Dividends	0.028	-0.060
	(0.087)	(0.088)
Leverage	-0.315***	-0.290***
	(0.108)	(0.106)
Foreign Presence	0.461***	0.399**
	(0.160)	(0.152)
Capex	0.149	-0.499
	(0.480)	(0.352)
Liquidity	-0.016	-0.021
	(0.035)	(0.028)
Constant	3.178***	2.460***
	(0.874)	(0.842)
Year Dummies	Yes	Yes
Industry Dummies	Yes	Yes
Observations	700	704
AR (1)	-3.80***	-4.12***
AR (2)	-1.26	-1.34
Hansen's test statistic	45.93	51.18

***, **, and * indicates statistically significant levels of 1%, 5%, and 10%, respectively.

The last models confirmed our previous findings by revealing that the use of derivatives does not have an impact on the firm value.

All of our models imply that the use of derivatives as a risk management tool does not affect the firm value for European companies in the Telecommunication and Information Technology industries. Our results seem to confirm the traditional theory of Modigliani and Miller (1958), according to which risk management tools do not affect firm value.

As previously mentioned, these findings could be explained by various factors. Firstly, as suggested by Belghitar, Clark, and Mefteh (2013): "*Even when hedging programs are appropriate and well executed, gains from hedging may be inadequate to cover the substantial costs in financial, physical and human*

resources required to conceive and implement the hedging strategy". Therefore, the use of derivates as a risk management tool could be ineffective in mitigating the volatility of revenues or costs for a company.

Secondly, as suggested by Aretz and Bartram (2010), derivatives are just one of the available methods for hedging and, normally, their value tends to be insignificant. As such, it is not sufficient to affect a firm value.

Finally, as highlighted by Tufano (1998), risk management tools could be considered a reliable instrument for managers when it comes to avoiding being monitored by external stakeholders. The management team could therefore also consider investing in projects with negative present value, thanks to the use of a hedged capital.

5. Conclusion

Nowadays, companies are facing a series of increasingly unplanned events. It is therefore now necessary for businesses to adopt risk management tools to mitigate the consequences of these events.

With this in mind, derivatives are one of the main instruments that an entrepreneur can use; especially in the technology sector, as a significant portion of the revenue in this sector comes from foreign countries, thus increasing its exposure to the fluctuations of exchange rates (Sahoo, 2016).

We contribute to existing literature on corporate hedging as our results imply that the use of derivatives does not affect firm value in the technology sector in the European market (HP1). Therefore, our findings confirm that the impact of derivatives on firms' values can be strictly linked to the specific industry (technology, airlines, oil and gas producers, etc.), since the derivatives' effects on firms' values are impacted by the characteristics of the specific sector in which they are applied.

These findings have various managerial implications:

i) The risk management activities conducted within a company may not be properly disclosed by managers, as suggested by Bean and Irvine (2015). This could lead investors to not incorporate this data in their analysis. Managers should therefore better disclose to the market the type and nature of the risks that are mitigated by the use of derivatives, expressing how these could be advantageous for a company.

ii) Our results suggest no rationale for hedging with derivatives at the firm level. Our findings show little support for the impact of risk management activities on firm value, with the subsequent implications for managers. However, derivatives are just one of the available risk management instruments that managers can use. Therefore, managers could also use other risk management tools, which may impact upon the firm value.

However, our paper has some limitations. Firstly, it considers only European companies. Future researchers should consider an larger sample in order to better generalize the results. Secondly, we considered only listed companies. As such, future studies should expand their samples to discover whether or not our findings are also true of non-listed companies.

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