
THE IMPACT OF R&D ON M&A VALUE CREATION

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Abstract

As global competition intensifies, innovation has been a means increasingly used by firms to reach and sustain a competitive position. In this sense, Mergers and Acquisitions (M&A) is a strategy even more followed by them to get access to innovation, since thus they acquire firms that achieve outcomes from their R&D activities. Therefore, it becomes a substitute strategy for conducting R&D in-house.

The current dissertation pretends to examine whether there is value creation for shareholders of the acquiring firm resulting from the deal, which is going to be evaluated by performing an event study. Nevertheless, our main purpose is to analyse the effect of R&D intensity of the acquirer and the target on the abnormal returns generated for the shareholders of the acquiring firm resulting from the M&A's announcement and on the M&A premium paid by acquiring firm. To do this analysis, two multiple linear regression model are going to be constructed in which the central independent variables are the R&D intensity of the acquirer and the target firms.

Our findings indicate that firms who invest more in R&D, despite paying more for the acquisition of other firms (higher M&A premium), can create more value because the CAR is higher. In contrast, firms investing less in R&D cannot compensate for this less effort by acquiring other firms that have made such investments. This way, the results suggest that the acquisition of other firms is a complementary strategy to investment in R&D, and not a substitute.

Key-words: M&A, Innovation, R&D, Premium, Abnormal returns.

JEL-Codes: G14, G34, O32, O34.

Resumo

À medida que a concorrência a nível global se intensifica, a inovação tem sido cada vez mais um meio utilizado pelas empresas para alcançar e sustentar uma posição competitiva. Nesse sentido, as fusões e aquisições são uma estratégia progressivamente seguida por estas para conseguirem obter inovação, pois, desta forma, adquirem empresas que alcançam resultados frutíferos decorrentes das suas atividades de R&D.

O presente estudo pretende avaliar se há criação de valor para os acionistas da empresa adquirente como resultado do anúncio da M&A. Esta análise será realizada através da aplicação da metodologia de um *event study*. Todavia, o principal objetivo desta dissertação é analisar qual é o efeito da intensidade do investimento em R&D exibida pela empresa adquirente e pela empresa adquirida nos retornos anormais auferidos pelos acionistas da empresa adquirente resultantes do anúncio da transação, bem como o seu impacto na magnitude do prémio pago pela empresa adquirente. A fim de efetuar este estudo, serão construídas dois modelos de regressão linear múltipla, os quais terão como variáveis-chave independentes a intensidade de investimento da empresa adquirente e da empresa alvo de aquisição.

Os resultados obtidos indicam que as empresas que mais investem em R&D, apesar de pagarem mais pela aquisição de outras empresas, o que está refletido no pagamento do prémio mais elevado, conseguem criar mais valor, pois os retornos anormais auferidos pelos seus acionistas são superiores. Por outro lado, as empresas que menos investem em R&D não conseguem compensar esse menor esforço com a aquisição de outras empresas que realizam esses investimentos. Deste modo, os resultados sugerem que a aquisição de empresas é uma estratégia complementar ao investimento em R&D e não substituta.

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1. Introduction

According to Cordeiro (2014), the business environment is increasingly volatile and the companies are realizing that this fickle world is the new standard, so innovation has been a means used by companies to reach and sustain a competitive position. However, it may not be enough to rely only on internal development since it may be a slow process and competitors may respond quickly and take market share (Gaughan, 2015).

In this sense, Mergers and Acquisitions (M&A) is a strategy even more used by companies to obtain knowledge and new technology (Cefis and Marsili, 2015). Although firms have their own R&D activities, they are restricted by the time efficiency and the ability to make it internally (Ma and Xiao, 2017). Consequently, M&A becomes a means to obtain innovation instead of developing R&D activities in-house.

The present study pretends to examine whether there is value creation for shareholders of the acquiring firm resulting from the M&A's announcement. To do this analysis, it is going to be conducted an event study to evaluate the abnormal returns of shareholders of the acquiring firm around the announcement date of the transaction.

Most importantly, the dissertation aims to evaluate the impact of R&D intensity of the acquirer and the target on both the acquirer's abnormal returns generated with the announcement of the M&A and on the premium paid by the acquiring firm. To perform this analysis, two multiple linear regression models are going to be constructed in which the key independent variables are the R&D intensity of both firms involved in the deal. In addition, we will also control the influence of other relevant characteristics of the deal, the acquirer and the target firms.

Using a sample of 69 completed M&A deals between 2008 and 2017 for both acquirer and target listed in EU enlarged, the study will contribute to fill the gap in the literature regarding the impact of the R&D intensity of the acquirer and the target firm on the wealth of the acquirer's shareholders and on the formation of the M&A premium, since the existing studies mostly study its impact on the innovative performance of the firms. In addition, given the controversy among empirical studies over the impact of an M&A on the wealth of shareholders after the transaction, the study will contribute empirically to this subject.

In the following section, it is presented the literature review related to the subject of the dissertation. Section 3 describes the methodology employed and section 4 comprises the procedure followed in the sample selection and the description of the sample used in the study. Lastly, the results and the conclusions are presented in section 5 and 6, respectively.

2. Literature review

In this section, the literature review regarding mergers and acquisitions and its relation to innovation is presented. It contains the description of the key concepts that are important to be clarified from the beginning and the motives behind M&A. In addition, it comprises the innovation measures, the dilemma of ‘make or buy’ R&D and the impact of M&A on innovation. Furthermore, the factors that affect abnormal returns earned by shareholders of the acquiring firm resulting from the M&A’s announcement and the determinants of M&A premium are exposed. Lastly, similar studies that provide empirical evidence of the subject of the dissertation are addressed, which are followed by the exposition of the research hypotheses.

2.1. Key definitions

Merger and Acquisition (M&A) is turning out to be an important phenomenon to corporate restructuring and to face global competition (Vyas and Narayanan, 2016), usually being a faster way of company expansion than organic growth (Gaughan, 2015).

According to Sherman (2010), there are three typical strategic growth options: organic, inorganic and external. *Organic growth* is carried out by building on and developing the organization’s own capabilities (Johnson et al., 2008). It results from employing extra salespeople, working out new products and processes, and growing geographically, for instance. In contrast, *inorganic growth* involves acquiring another firm (M&A) or strategic assets rather than building these assets internally, in order to reach others product lines, segments of clients or geographical areas. As an alternative to M&A, in *external growth* companies also share resources and activities to pursue a common strategy, but without sharing the ownership of the parent companies (Angwin, 2014). These strategies are not mutually exclusive, so firms may consider them as complementary rather than substitutes (Luypaert and Huyghebaert, 2008).

Merger and acquisition are terms often confused or used interchangeably to refer to any kind of corporate combination or takeover (Brealey et al., 2001). According to Ross et al. (2010), M&A follows one of the three basic forms: merger or consolidation, acquisition of stock or acquisition of assets.

A *merger* is a combination of two or more companies in which the assets and liabilities of the selling firm(s) are absorbed by the buying firm. A *consolidation* is similar to a merger but, while

in a consolidation both the acquiring firm and the acquired firm terminate their previous legal existence and become part of the new firm (Ross et al., 2010), in a merger the acquiring firm retains its original identity and the acquired firm ceases to exist as a separate business entity. In both cases, there is usually a process of negotiation involved between the companies prior to the combination taking place.

In contrast to what happens with the previous category, in an acquisition, the negotiation process does not necessarily take place (Roberts et al., 2003). *Acquisition of stock* corresponds to the purchase of at least 50% of the target firm's stock in exchange for cash, shares or other securities. The acquired firm may continue to exist as a separate entity, but it is now owned by the acquirer. In case the target firm's managers resist the acquisition, the acquiring firm can bypass the target's firm management altogether by offering to buy shares directly to shareholders. This offer to purchase stock is known as a tender offer. *Acquisition of assets* occurs when a firm acquires another by buying a considerable part or all its assets. In this case, the selling firm continues to exist as an independent entity, but it becomes an empty shell (Brealey et al., 2001). Despite the differences presented, the term M&A will be used broadly, which means that we will consider the various types indistinctly throughout the dissertation.

M&A can be classified according to various criteria. Brealey et al. (2001) state that mergers can be categorized as horizontal, vertical, or conglomerate. Mergers are considered horizontal when the acquiring and target firms are in the same line of business. In contrast, a vertical merger occurs when two firms operating at different stages of production merge operations. A conglomerate merger is taken place between firms in unrelated lines of business. Furthermore, M&A can be classified as domestic or cross-border. A domestic M&A is concluded between companies that are based on the same country, whereas in a cross-border M&A the parties involved are from different countries. In addition, the classification can be also done based on the deal attitude. A hostile deal occurs when the acquiring firm acquires the target firm without the agreement of the target's board of directors. In a friendly M&A, the boards of directors of both the acquiring and the target firm approve the transaction.

According to Cefis and Marsili (2015), firms are relying increasingly on external sourcing strategies (including M&A) to meet the demands of globalization and technological development. M&A offer firms the opportunity to access new markets or to obtain the transfer of technology and innovation to keep pace with the globalization of business (Hitt et al., 2006).

Urabe (1988) states:

“Innovation consists of the generation of a new idea and its implementation into a new product, process, or service, leading to the dynamic growth of the national economy and the increase of employment as well as to a creation of pure profit for the innovative business enterprise. Innovation is never a one-time phenomenon, but a long and cumulative process of a great number of organizational decision-making processes, ranging from the phase of generation of a new idea to its implementation phase. New idea refers to the perception of a new customer need or a new way to produce. It is generated in the cumulative process of information-gathering, coupled with an ever-challenging entrepreneurial vision. Through the implementation process, the new idea is developed and commercialized into a new marketable product or a new process with attendant cost reduction and increased productivity”. (pp. 3-4)

OECD suggests that the ratio between R&D expenditures and turnover can be an innovation measure (Mortensen, 2005).

OECD (2015) defines *Research and Development* as: “creative and systematic work undertaken in order to increase the stock of knowledge - including knowledge of humankind, culture, and society - and to devise new applications of available knowledge”. The term R&D covers three activities: basic research, applied research and experimental development. The latter is directed to producing new materials, products or devices, to installing new processes, systems, and services, or to improving substantially those already produced or installed.

2.2. Motives behind M&A

Numerous reasons why companies decide to participate in M&A are advanced in the literature. In today’s globalized business environment, M&A is a strategy used around the world for improving the competitiveness of companies by achieving greater market share, accessing to new markets and new products, acquiring complementary strengths and competencies, attaining economies of scale and correcting internal inefficiencies.

Motis (2007) affirms that the motives behind an M&A can be divided into two groups according to the effective claimant of the M&A gains. In the first group are included the drivers that lead to a rise in the actual or future profits and consequently to an increase in the value of the firms participating in the M&A. This way, the effective claimants are the owners of the firms,

i.e., the shareholders. The motives included in the second group serve the interests of the managers of the firm and not necessarily the interests of the firm. The rationale behind these M&A is to increase the wealth of the managers of the acquiring firm even though they may result in a decrease of the firm's value. The importance of these motives varies over time and one motive is not exclusive to another.

Underneath, some of the more prominent reasons for M&A happen are exposed.

1) Efficiency gains

Economies of scale occur when the average cost of production falls as the level of production increases (Ross et al, 2010). It happens due to the opportunity to spread fixed costs across a larger volume of output. After an M&A, firms may share central services such as accounting, marketing, distribution, financial control, top-level management and computer systems, allowing to get rid of double fixed costs and cut down overlapping R&D which enables the obtainment of scale economies (Brealey et al., 2001).

Economies of scope occur when it is cheaper to produce two or more product or services in one firm than to produce them in separate firms. In other words, they are reached when a firm produce different goods at a lower average marginal cost than it would cost separate firms to produce the goods separately. It is a result of the opportunity to share indivisible resources and to use the firm-specific skills and assets to produce other related products and services (DePamphilis, 2010). This way, an M&A may lead merging firms to produce goods cheaper than before M&A.

Economies of vertical integration are reached when the sum of the cost of the production stages performed by separate firms falls when a single firm performs the two stages of production. It may happen because due to the existence of a technical relationship between the two stages of production or due to the market transaction costs (distribution costs) (Brealey et al., 2001; Ross et al., 2010).

2) Synergy gains

According to Ross et al. (2010), synergy occurs if the value of the combined firm after the M&A is greater than the sum of the value of both acquiring and acquired firm before the M&A. There are three types of synergies: operational, financial and managerial.

Operational synergy results from combining the operations of the acquiring and acquired firms, which is translated in efficiency gains (economies of scale and scope, elimination of duplicate activities and vertical integration). These gains were presented earlier. Furthermore, operational synergy arises through the transference of intangible assets. If acquirer and target firms have different and unique technology capabilities, knowledge, human skills, patents and R&D activities and they are complementary, putting them together, they will most probably achieve a technological progress (Roller et al., 2006). R&D is a very valuable non-tradable asset for a company since it contributes to the development of innovations that enable it to cope with fierce competition. According to Roller et al. (2006), acquire an intensive R&D target may be a quicker way to invest in R&D than conducting it in-house.

These synergies may lead to a lower production and distribution costs or may enable the company to offer unique products and services. They are more usually to arise when the acquiring and acquired firms are in the same or related industries (Martynova et al., 2006).

According to DePamphilis (2010), **financial synergy** is translated into higher cash flows and a lower cost of capital of the acquiring firm or the newly formed firm. After an M&A, the firms may seize higher debt capacity to face investment opportunities due to the higher stability of the earnings level and consequently lower bankruptcy probability. If this greater debt capacity is utilized, the firms will take advantage of a larger tax shield which leads to a higher value of the firm. Furthermore, if the merged firms have uncorrelated cash flows, the losses in one division may offset the incomes in the other, leading to lower taxes. Additionally, an M&A may be gathered to access unrelated businesses. This diversification will lead to a decrease of the risk of company's portfolio and consequently the cost of capital.

Managerial synergy result from eliminate inefficient management through the replacement of the managers that are not acting in the best interests of the owners (Ross et al., 2010). As managers of both firms want to have the right to manage corporate activities, M&A contributes to discipline management. In addition, M&A is a way to reinforce the management

team filling the possible deficit in its expertise with the capabilities and skills of the managers of the other company (Roberts et al., 2003).

3) Growth and diversification

M&A is a strategy used by companies that seek **rapid growth**, which they cannot achieve with organic development. Acquiring an existing firm enables to leap several stages in the process of expansion since the target firm is an organization already in place, with established offices and facilities, management, and other resources (Gaughan, 2015). If the market is saturated, it is desirable to resort to M&A than creating additional capacities through organic growth.

After an M&A, the competitive position of the merged firm is improved since it can command a **greater market share**. With the decrease of the competition within the industry, merged firm increase its market power and consequently its control over prices (Motis, 2007). Although more associated with horizontal mergers, market power motive is not exclusive to them.

Diversification is a drive to M&A since they allow firms to access new markets and products. If a firm is facing slow growth in its current business, it may enter into new product lines and new markets that have higher growth prospects (DePamphilis, 2010; Roberts et al., 2003).

4) Strategic Realignment

M&A can be undertaken as an answer to external environmental changes. According to Gort (1969), economic disturbances make the future less predictable and cause changes in the expectations of individuals. These variations provide opportunities for M&A since they may lead entities to be interested in acquiring or merging others in which they were not interested before the changes. Technological innovation and regulatory and political changes are the macroeconomic forces that have most encouraged the M&A.

Acquiring technology assets represent an important driver for M&A. Given the constantly changing world and the acceleration of **technological changes**, many acquirers are looking for technology companies to position themselves for the future. The technological

advances lead to new products and new processes of production which enables to face the fierce competition (DePamphilis, 2010).

Regulatory changes may influence the timing of merger activity. Deregulation removes artificial constraints to trade and incites new firms to enter. This way, M&A activity is higher in deregulated industries than in regulated ones (DePamphilis, 2010).

5) Managerialism

According to *managerialism hypothesis*, M&A is undertaken by managers who want to maximize their own utility rather than maximizing shareholders value (Rani et al., 2016). Jensen (1986) states that managers have incentives to make their firms grow beyond optimal size because in that way they increase the resources under their control and consequently their compensation. Thus, managers are motivated to rely on M&A because it is a way to reach fast growth.

6) Hubris

According to Roller (1986), the **hubris** or excessive self-confidence of managers drives them to incur in M&A because they believe they can manage target firm more efficiently than the current management. This way, managers of the acquiring firm tends to overpay for the target because, although they are overestimating the synergy value, they undertake the M&A assuming that their valuations are correct (Rani et al., 2016).

7) Market timing

Managers of the acquiring firm exploit the inefficiencies of the market to acquire assets of undervalued targets through M&A using their private overvalued shares (Shleifer and Vishny, 2003; DePamphilis, 2010).

Annex 1 contains a summary table with the reasons listed above.

Various motives were presented to explain the occurrence of M&A, but we will focus on operational synergies, namely on the acquisition of the intellectual property of the target firm, given the increasingly importance associated to this asset.

2.3. M&A and innovation

Nowadays, M&A are used by companies to get the knowledge, technology, patents and R & D activities of the target, and thereby enhancing innovation that enables them to remain competitive. As these intangible assets contribute to the development of new or improved goods, services or production processes, they are considered valuable resources. This way, we want to find out if the targets investing more in R&D are perceived as representing more value.

2.3.1. Innovation measures

Innovation has been a means increasingly used by companies to achieve and maintain a competitive advantage (Cassiman et al., 2005). Cohen and Levinthal (1989) discuss the effect of R&D on innovation and learning, arguing that R&D obviously generates innovation, but also develops the firm's ability to identify, assimilate and exploit knowledge from the environment.

Various measures have been used to capture the innovative performance of companies, namely R&D inputs, patents counts, patent citations and counts of new product announcements. Hagedoorn and Cloudt (2003, p. 1366) state:

“R&D inputs could be a reasonable indicator of innovative effort, patents could be a more than an acceptable indicator of innovative output, patent citations could be used to measure the quality of innovative output and new product announcements could indicate the level of product innovation.”

Alternatively, according to Wagner (2011), R&D activities can be proxied by three variables: R&D intensity (calculated by the ratio between R&D expenditures and sales) that measures innovation effort and input, patenting intensity (obtained dividing the firm's patent generated by the size of the firm) which measure R&D output and, lastly, the patent stock accumulated over time that is a measure of a firm's own accumulated technological knowledge.

Since there is a high correlation between some of these measures, certain researchers propose that these indicators can be considered as a fractional or global measurement of performance (Hagedoorn and Cloudt, 2003). Pakes and Griliches (1984) evidence a strong association between R&D and the number of patents across firms and industries. Ahuja and

Katila (2001) also demonstrate a correlation equal to 0.89 between R&D inputs and R&D output in their research for the chemical industry.

This way, innovation is usually measured by R&D intensity. R&D intensity can be measured by the ratio between R&D expenditures and total assets (Desyllas and Hughes, 2010). Mortensen (2005) suggests that the ratio between R&D expenditures and turnover is also an innovation measure. Total assets and sales are proxies of the firm size and they capture its growth, so by using them to normalize R&D expenditures, it is ensured that the measure is comparable for companies with different sizes and that it takes into account changes in their size (Desyllas and Hughes, 2010).

2.3.2. R&D: 'Make or buy' dilemma

According to Cordeiro (2014), the business environment is increasingly volatile and the companies are realizing that this fickle world is the new standard. Therefore, it may not be enough to rely only on organic growth and cost-cutting to deliver consistent financial results and it may be easier to buy growth than build it.

In this context, corporate innovation has become an important factor in the company's development and even survival. As a result, firms frequently face make-or-buy dilemma. M&A is a means for external technology sourcing which can be complementary, substitute or both to in-house R&D (Wagner, 2011). Although firms have their own research and development activities, they are restricted by the time efficiency and the ability of corporate it internally. Therefore, firms are frequently resorting to mergers and acquisitions (M&A) to bridge the gap between their current point and the point they want to reach regarding innovation and performance (Cassiman and Veugelers, 1999, 2002; Cefis, 2010) (*Apud* Cefis and Marsili, 2015).

Although the make-strategy is more expensive and the results are less predictable, it allows addressing the specific needs of the company. Veugelers and Cassiman (2006) showed that companies following only one of the "Make" or "Buy" strategies obtained poorer results in terms of the introduction of new or improved products when compared to the results obtained by companies that used the make-buy strategy.

Phillips and Zhdanov (2012) examine in their study what is the impact of the M&A market in the choice to develop R&D and innovate. They consider that a dynamic M&A market

can lead large firms decrease its R&D activities, while small firms increase them. Instead of conducting R&D in-house, bigger firms may optimally opt to wait that smaller ones invest on R&D and then acquire those that fruitfully innovate. As successful innovation makes firms attractive acquisition targets, the small firms are encouraged to conduct R&D in order to increase the likelihood of achieving innovative outcomes and being bought by another firm. This way, bigger firms may consider that it is not beneficial to conduct R&D because they can get innovation through the acquisition of firms that fruitfully achieve outcomes from their R&D activities.

Ma and Xiao (2017) state that a company with a high level of R&D investment before M&A is often considered an attractive target for a larger company. This way, if a company wants to be acquired, it should increase their R&D input and increase its appeal.

2.3.3. Impact of M&A on innovative performance

Given the role that M&A and innovation play in the development of competitive strategies, it is essential to appreciate the relation between M&A and innovative performance of companies. Before moving forward, it is important to clarify what is the innovative performance in order to truly understand what is being analysed. Only then we are able to realize how M&A has influence over it.

In the broad sense, innovative performance refers to inventive, technological and innovative performance, i.e., it includes the path from the devise of an idea to the introduction of an invention into the market, but then excluding the possible financial hit of such innovations. In a stricter sense, innovative performance refers to the degree to which companies actually introduce inventions into the market, in other words, the rate of introduction of new products, new process systems or new devices (Freeman and Soete, 1997) (*Apud* Hagedoorn and Cloudt, 2003).

There is no consensus about the impact of M&A on innovative performance of acquiring and target firms. The existing literature proposes different points of view regarding whether M&A create, destroy or reallocate value related to innovation among them. (Cefis and Marsili, 2015).

Since acquiring and target firms have different motivations to participate in an M&A, the analysis of the relation between innovation and M&A will be divided into two parts: one for acquiring firms and the other for target firms. Besides analysing the change in the level of innovation after M&A, there are studies that analyse whether the level of innovation before M&A has an impact on the likelihood of a company to participate in M&A. This way, the referred analysis will address the variations in the level of innovation before and after M&A.

Regarding the effects of M&A in acquiring firms, as previously referred, Phillips and Zhdanov (2012) affirm that large firms may consider disadvantageous to engage in R&D because they can get access to innovation through the acquisition of a smaller firm that achieve fruitful results from their R&D activities. This way, the investment in R&D by large firms might decrease before M&A. In addition, M&A requires limited resources, namely management attention in the preparation process and financial resources in the financing of the transaction, which could be devoted to other activities than those related to R&D, such as identification and investment in innovation opportunities (Hitt et al, 1996).

After M&A, the competition will decrease because the number of competitors in the industry will be reduced. It can lead firms to reduce their investment in R&D and consequently their level of innovation (Granstrand and Sjolander, 1990). Hitt et al. (1996) state that post-M&A's integration process also absorbs much managerial time and energy which may lead to a lower managerial commitment to internal innovation. They defend that firms following an active acquisition strategy may resort to debt to financing themselves, which can lead firms to reduce R&D in order to support the costs incurred.

In contrast, other authors argue that the level of innovation of acquiring firms improve after M&A. Cassiman et al. (2005) affirm that R&D input may decrease due to the elimination of duplicated R&D, but M&A may create economies of scale and/or scope in R&D encouraging firms to increase their R&D investments. Ma and Xiao (2017) refer that external knowledge can be used to supplement the internal knowledge which helps to develop new products and services. However, it does not happen with substitute companies. According to Desyllas and Hughes (2010), firms with complementary technologies increase their R&D level after the acquisition, whereas substitute firms decrease it.

In the case of target firms, the possibility to exit through strategic M&A represents a motivation to invest in R&D. As mentioned earlier, successful innovation makes firms attractive

targets, so the small firms are encouraged to conduct R&D in order to rise the likelihood of achieving innovative outcomes and being acquired by another firm. (Phillips and Zhdanov, 2012). However, executives of target firms also devote much energy and attention during the negotiation process. Before M&A, activities of target firms continue, but decisions requiring long-term commitments such as heavy investments in R&D are often postponed (Hitt et al., 1996).

After M&A, the organizational structural inertia of target firm can be broken because the acquiring firm usually sends new managers to the target firm, which can lead it to innovate (Hanman and Freeman, 1984; Jeffrey, 2012) (*Apud* Ma and Xiao, 2017). At this point, acquiring and target firms share resources, technology, and knowledge which can promote innovation.

According to Berchicci (2013), the challenge is to find a balance between internal and external R&D activities in order to capture the benefit from external technology sources.

2.4. Impact of M&A on shareholders' wealth

Although M&A is an increasingly frequent phenomenon in the business environment, the debate about whether it creates or destroys value remains open. There is value creation if the real value created resulting from the M&A is higher than the cost of pursue it (Shah and Arora, 2014).

Some studies provide evidence that conducting an M&A leads to the destruction of value for shareholders of the bidding firm (Mulherin and Boone, 2000; Shukla and Gekara, 2010), others found a positive effect, even it is small (Goergen and Renneboog, 2004; Martynova and Renneboog, 2006), while others defend that its effect is null or not significant (Capon and Pistre, 2002; Shah and Arora, 2014). The payment of a too high M&A premium is frequently pointed out as an explanation for M&A does not create value for acquirer's shareholders in the period surrounding the announcement day (Kim and Canina, 2013).

Empirical research evidences that some characteristics of the deal, acquirer and target firms may influence the gains of the shareholders. According to Hitt et al. (2012), the most commonly cited factors are the relative size of the acquirer and target firm, the relatedness between the industries of the acquirer and target firm, the method of payment, the performance of the acquiring firm prior M&A and the acquisition experience of the bidder. Besides these

factors, we present others variables mentioned in the literature that have an impact on the wealth of the shareholders of the acquiring firm.

1) R&D intensity of target

King et al. (2008) refers the more the R&D resources of the target firm, the more the number of possible resource combinations between the acquirer and the target firm. Firms investing more in R&D increase their odds of successful innovation and, thus, increase their attractiveness (Phillips and Zhdanov, 2012). Since acquiring R&D-intensive targets increases the chances to reach innovation, the shareholders may react positively to the announcement of their acquisition.

However, investing in R&D, by itself, it is not a guarantee of the achievement of innovation. The investment in R&D has inherently the uncertainty of attaining fruitful outcomes.

2) Relative size between target and acquirer firm

The impact of the relative size between the target firm and acquirer firm is often associated with the effectiveness of the integration process (Hittl et al., 2012). According to Martynova et al. (2011), since it is required a more compound management to maintain the effectiveness in larger firms, the integration of the target firms with higher dimension is a more complex process, which can lead to poorer performance. This way, in case of high target's size relative to acquirer, investors may fear that these higher integration costs are reflected in the value of the wealth generated for the shareholders of the company and, therefore, they revise their estimates downwards. However, the size of the target needs to be large enough to have an impact on the acquirer firm (King et al., 2008).

Moeller et al. (2004) state that the incentives of managers and shareholders are more aligned in small than in large firms. This way, the managers are not so prone to undertake a transaction by hubris reasons.

3) Relatedness between industries of the acquirer and target firm

The influence of the relatedness between industries of the acquirer and target firm on the shareholders' reaction to the M&A is not obvious.

According to the results found by Martynova and Renneboog (2006), M&A between firms of unrelated-industries destroy value to acquirer's shareholders since they are often motivated by personal gains of managers. Goergen and Renneboog (2004) state that managers should not try to diversify the company to reduce the risk for shareholders since a diversified portfolio can be better constructed by the shareholders themselves. However, unrelated M&A may be used as a strategy by firms operating in less attractive industries.

Regarding the related M&A, acquirers may prefer targets with related-products and related-markets due to less information asymmetry, market control incentives, economies of scale and easier integration progress. This way, to acquire a target of a related industry may be a more likely way to improve the post-M&A performance (Shelton, 1988; King et al., 2008). However, it is not certain that this happens since it depends on how the acquirer takes in and adapts the resources coming from the target firm (Cheng and Yang, 2017)

There are other authors (Fowler and Schmidt 1989; Singh and Montgomery 1987) defending the existence of no relationship between industries and the acquisition performance. Capron and Pistre (2002) argue that the relatedness between industries is not enough to guarantee that acquirer's shareholders will benefit by entering into this deal. They defend that there is value creation to acquirer when it holds inimitable assets or skills to be exploited in the target's framework since the competitors cannot reach the same advantage.

4) Technological motivation for pursuing the M&A

In the actual context of constant change, technological M&A are an increasingly frequent phenomenon since they constitute a mean used by the acquirer to gain access to external technology rapidly. In addition to enabling a firm to be at the forefront of technology within its area, it also allows it to broaden its scope by acquiring technology from other areas (Huang et al., 2015). Technology is a valuable asset representing a higher growth potential since it is a way to reach innovation.

However, the market reaction to M&A announcement could be not positive. On the one hand, shareholders may fear that the higher premium usually paid in this type of M&A erode the synergies arising from it (Chira and Volkov, 2017). On the other hand, the uncertainty regarding the success of the challenging integration of the firms in technological M&A, can lead to a negative reaction by the investors.

5) Domestic or cross-border M&A

Some researchers found evidence that the share price of the acquirer in case of cross-border deal significantly underperforms that of acquirers participating in a domestic deal (Goergen and Renneboog, 2004; Schoop, 2013). The regulatory differences and the cultural distance underlying cross-border deals are reasons commonly pointed out to explain these results. The difficulties to communicate and to conciliate the distinctive values and practices, especially in the integration phase, becomes the management of the post-merger process more complex and more costly (Cheng and Yang, 2017). Thus, as the market may anticipate these issues, usually it reacts better to the announcement of domestic M&A (Martynova and Renneboog, 2006).

6) Method of payment

An acquiring firm can pay an M&A through 3 different methods: all-cash, all-stock or a combination of both. Some studies show that all-stock payments generate lower abnormal returns for acquirer's shareholders than in the case of all-cash (Abhyankar et al., 2005; Martynova and Renneboog, 2006).

Usually, all-cash method is used when the shares of the acquiring are undervalued, and all-stock method is used when they are overvalued (Martynova and Renneboog, 2006; Hitt et al., 2012). Thus, according to the payment method offered by acquiring firm, the market adjusts the value of their shares. If the method used is all-cash, the market positively revises the value of the shares. In the case of the all-stock method, the market decreases the value of the shares (Martynova and Renneboog, 2006).

In addition, an all-cash offer suggests that acquiring firm expects to improve performance because, when using this method, it does not have to share the future results

obtained with the target firm, contrary to what would happen if the payment were all-stock. Ismail (2011) has found evidence that when there is certainty in achieving synergies through the M&A, bidders are more likely to pay the transaction with cash, whereas, in case of uncertainty, they finance the transaction with stock.

7) Deal attitude

As referred earlier, the deal's attitude corresponds to the atmosphere under which the deal is celebrated, and it assumes one of the two options: hostile or friendly. Previous studies evidence that a hostile bid triggers negative abnormal returns for the shareholders of the bidding firm (Goergen and Renneboog, 2004; Shaheen, 2006). A possible explanation is that the shareholders are concerned that the premium offered is too high in the case of opposition to the bid or in the case of a direct offer to the shareholders of the target firm. Since the higher the premium paid, the lower the synergy value accruing to the bidder, the reaction of investors to hostile bids is negative (Martynova and Renneboog, 2006).

8) First stake of the acquirer in the target

During the M&A process, one of the most uncertain issues is the target firm's stand-alone value. In this way, if the acquirer firm owns a stake in the target firm before the celebration of the deal, the acquirer has easier access to relevant information of the target firm, allowing it to evaluate the value of the target firm and the potential synergies more reliably and accurately (Schoop, 2013).

9) Performance of the acquiring firm prior M&A

According to Hitt et al. (2012), the pre-merger performance of the acquiring firm may be a predictor of the quality of management. This way, a higher performance of the acquirer prior to the deal suggests that its managers are capable to efficiently manage the M&A process, properly integrate the businesses of the parties and thus create value to the shareholders.

10) Liquidity of the acquiring firm

An acquirer firm with a higher level of liquidity is more tendentious to destroy value by overbidding (Martynova and Renneboog, 2006; Schoop, 2013). If it happens, the shareholders of the acquiring firm perceive the payment of an excess value and react negatively.

In addition, Jensen (1986) states that cash holdings aside from profitable investment opportunities are often used for managerial empire building purposes.

11) Acquisition experience of the bidder prior M&A

Bidders with prior-experience in M&A activity are more skilled to give higher efficiency to the integration process. This process requires time and attention by managers, so if they already conducted a similar process before, they are more likely to avoid inefficiencies and manage the process faster (Schoop, 2013). This way, the existence of prior experience of acquirer influence the cost of the M&A. If the costs are lower, it is expected higher returns from M&A in those that bidder has experience.

However, Halebian and Finkelstein (1999) and Schoop (2013) evidence that it is not entirely true. These authors suggest a U-shaped relation between the acquisition experience of the bidder and acquirer performance. Over the first deals held, new challenges are constantly arising, and the firm is not yet able to handle them efficiently. After overtaking some M&A, the firm has already developed its know-how and its ability to manage certain issues and thus it can instil more efficiency in the process and improve the post-merger performance of the companies involved (Schoop, 2013).

12) Performance of the target firm prior M&A

The target firm's profitability prior to the M&A influences the perception of the acquirer's shareholders in relation to the increase in value that the acquisition will provide.

However, Hitt et al. (2012) refer that prior researches evidence that some acquirers select target firms regardless of their profitability before the deal and that the consideration of this factor in the selection of the target may depend on the industry concerned since profitable firms are more frequently targeted in growing industries. Other authors suggest that the acquirers are

enticed by distressed firms because they believe to be capable to recover the firm by applying better management practices.

13) Future growth opportunities of the target firm

Firms presenting more growth opportunities are more attractive to acquirer firms, especially for those that have exhausted their growth options. Thus, the acquisition of a target in these conditions provides it with access to alternatives of development.

However, Goergen and Renneboog (2004) state that it is expected that the acquirer firm pays a higher premium for a target firm with more growth opportunities which may lead to a negative share price reaction by the shareholders of the acquirer. One possible explanation is that they fear that the target firm's growth opportunities do not compensate for the higher premium paid by the acquirer.

2.5. Determinants of the M&A premium

M&A premium is one of the most critical aspects in M&A deal because it has an impact on the outcomes of the M&A, but it cannot be determined exactly due to the uncertainty about the true value of the target firm and the synergies provided by such M&A. Furthermore, the price paid in an M&A deal is always a bilateral decision: the payment of a higher price benefits the shareholders of the target and damage the shareholders of the acquiring firm, and vice-versa. Thus, the price is one of the most critical points of negotiation in M&A deals (Ruslan, 2016).

M&A premium corresponds to the difference between the value paid by the acquirer to obtain a stake in the target firm and the pre-acquisition market value of that stake (Ismail, 2011). According to Kim and Canina (2013), it is defined as the final offer price as a percentage of the target's share price one day prior to the announcement of the M&A.

The acquirer firm is open to pay the premium because it expects to obtain synergies resulting from the M&A, so it attributes more value to target firm's assets than the one to which they are traded in the market (Stellner, 2015). However, the price paid must be smaller than the value of the acquired firm and potential synergies because otherwise the M&A is destroying value for the shareholders of the acquiring firm (Hitt et al., 2009). This way, the price paid should be between the stand-alone value of the target and the value of the target for the acquirer in that

this latter corresponds to the sum of the stand-alone value of the target and the expected synergies caused by the M&A (Ruslan, 2016).

Although the expected synergies are pointed as the main motivation for the payment of a premium, there are other reasons that can motivate it. These reasons include agency factors, managerial hubris, the presence of other competing bidders, and desire to acquire a specific firm due their unique resources and knowledge, among others (Hitt et al., 2012).

To evaluate the impact of the R&D intensity of the acquirer and the target on M&A premium, it is important to identify other factors indicated in the literature that influence the size of the premium paid. As in the case of abnormal returns, the premium is affected by various characteristics of the deal, acquirer firm and target firm. They are presented and explained below.

1) R&D intensity of target firm

The acquirer can get innovation through the acquisition of firms that fruitfully achieve outcomes from their R&D activities. The higher the R&D investment of the target before M&A, the higher the odds of it achieve innovative outcomes and being acquired. The opportunity to acquire valuable R&D and to attain significantly higher profits increase the premium that acquirer is willing to pay (Roller et al., 2006; Hitt et al., 2012; Ma and Xiao, 2017).

2) Relative size between target and acquiring firm

Acquiring firms are more likely to pay higher premiums when the target is larger because there is more probability to achieve considerable operating and financial synergies, namely economies of scale, than in the case of smaller targets (Ismail, 2011; Faulkner, 2012; Ruslan, 2016).

3) Domestic or cross-border M&A

Studies related to the foreign direct investment predict that foreign bidders should be able to take advantage of imperfections in factor and capital markets and thereby generate more gains. Consequently, bidders in cross-border transactions were expected to pay higher premiums (Goergen and Renneboog, 2004).

4) Method of payment

Payment can be made by cash, stock or a combination of both. Acquiring firm prefer to pay with cash when shares are undervalued and with equity when they are overvalued. In the latter case, shareholders of the target continue to have ownership in the newly formed firm and to be subject to the risk of the evolution of the cash flows of it. This way, the higher the percentage of the payment made in cash, the lower the risk to the shareholders of the target firm, so the lower the premium that the acquirer is willing to pay (Myers and Majluf, 1984; Shleifer and Vishny, 2003; Martynova and Renneboog, 2006; Ismail, 2011).

5) Deal attitude

Premiums are often higher in hostile because target firm's management opposes the M&A, so acquiring firm has to offer a high premium in order to convince shareholders of the target to undertake the deal (Martynova and Renneboog, 2006; DePamphilis, 2010).

6) First stake of the acquirer in the target

The ownership of target equity provides the acquirer with a better access to the information of the target firm. This way, it is easier to judge if it is a good acquisition or not and make a more accurate evaluation of the target firm. Thus, the odds of overbid are lower (Martynova and Renneboog, 2006).

7) Liquidity of the acquiring firm

Firms presenting higher liquidity are able to get easier access to financing. Therefore, they are more freely to overbid. In addition, the acquiring firms with excess cash are more exposed to the risk of overbidding by their managers due to managerial empire building motives (Martynova and Renneboog, 2006).

8) Acquirer's prior experience in M&A

It is expected that firms with higher M&A experiences are more capable to negotiate with the target and more efficient at managing the integration process of the new firm (Hitt et al., 2009; Schoop, 2013).

9) Performance of target firm prior to the M&A

It is expected that a positive financial condition of the target is associated with higher M&A premiums. The higher pre-merger operational performance of the target, the more likely to acquirer pay a larger premium because that target is a good investment opportunity for the acquirer (Ismail, 2011; Hitt et al., 2012).

10) Future growth opportunities of the target firm

Target firms with higher market-to-book ratio are perceived to be a better investment since they provide the acquirer with more opportunities to grow. This way, a high market-to-book ratio of the target firm leads to a higher bid premium (Goergen and Renneboog, 2004).

2.6. Similar studies

In this subsection, the contributions given by other empirical studies are exposed, describing the characteristics of those researches and their main findings.

Shah and Arora (2014) examine the effect of M&A announcements on return to shareholders, assessing their influence on the stock price of the acquiring and the target firms. They conduct an event study methodology, proceeding to the calculation of the Cumulative Average Abnormal Returns (CAAR) for different event windows and for both acquirer and target firm. Their results show that CAAR are statistically insignificantly different from zero at all levels of significance for bidding firms, leading to the conclusion that the announcement of the M&A does not carry informational content by their shareholders since they do not earn abnormal returns. A reasoned point by them is the mistrust of the bidding's shareholders regarding the creation of value since they incur in a high risk if the acquiring firm decides to conduct an M&A without an adequate due diligence of the target.

The study of Cassiman et al. (2005) analyze deeply 31 M&A deals occurred between 1990 and 2005 and settled by firms of medium- and high-tech industries in order to investigate the impact of technological- and market-relatedness on the R&D process. Conducting a univariate analysis due to their limited sample, they find that firms with ex-ante complementary technologies become more active performers after the M&A. However, when acquiring firm

and target firm are technology substitutive, they significantly decrease their R&D levels. In addition, they suggest that firms with the same technology and in related-market before M&A capture little technology gains, pointing out a more pronounced reduction of R&D than non-related-market firms. Their results evidence that rival firms exhibit poorer performance after the transaction in terms of both R&D outputs and productivity.

The study of Cloudt et al. (2006) examines the effect of M&A on innovative performance of the acquiring firm after the transaction using a Poisson regression model applied to a sample that contains companies from North America, Europe and Asia which covers four high-tech industries for deals between 1985 and 1994. Their study is similar to the one of Ahuja and Katila (2001) since both have common goals and methodology, although the latter is carried out only to the chemicals industry and cover the period between 1980-1991. Both studies distinguish technological and non-technological M&As. While Ahuja and Katila (2001) did not find statistical significance of the impact of non-technological M&A on subsequent innovation output, Cloudt et al. (2006) suggest that this type of M&A has a negative impact on the post-M&A innovative performance of the acquiring firm. Regarding to technological M&A, both studies agree in the point that the relative size of the acquired knowledge base reduces the innovative performance of the acquiring firm. However, while Ahuja and Katila's (2001) findings point out that absolute size of acquired knowledge base enhances innovation output, Cloudt et al. (2006) evidence that it happens just during the first few years after M&A and then the effect becomes negative. In addition, both studies found a non-linear impact of the connection of acquiring and target knowledge bases on the innovative performance of the acquirer. This way, a curvilinear impact proposed by Cloudt et al. (2006) suggests that acquirers should look at targets that are neither too much similar nor too much unrelated in terms of their knowledge bases.

Ismail (2011) has a research developed for 336 M&A deals between acquiring and target firms listed in US, which are nonfinancial institutions that aims to assess the impact of managers' estimate synergy on the premium paid and on the payment method. His study reveals evidence that synergy does not explain the M&A premium, so he believes that it may be announced to induce shareholders to approve the deal. In addition, his findings show that when acquiring firms have low growth potential and target firms are large, has higher operating performance before the M&A and their growth potential are higher, it is more likely that acquiring firms overpay

(Ismail, 2011). Regarding the payment method, Ismail (2011) evidence that the probability of the acquirer offers more shares is higher when it is overvalued relative to the target.

2.7. Research questions

There is no consensus about the significance of the returns earned by acquirer's shareholders resulting from an M&A's announcement. This way, we want to evaluate if the M&A's announcement creates value ($CAAR > 0$) or destroys value ($CAAR < 0$) or if it has a null impact the wealth of the shareholders of the acquiring firm, i.e., if the generated returns are no significantly different from 0 ($CAAR = 0$). Thus, the hypothesis to be tested is defined as:

H1: The announcement of the M&A has an impact on wealth of the shareholders of the acquiring firm, i.e., it generate abnormal returns ($CAAR \neq 0$).

If this hypothesis is rejected, we conclude that the abnormal returns resulting from the M&A's announcement are not significantly different from 0. If the hypothesis is accepted, according to the value obtained for CAAR, we know whether there is creation or destruction of value for the shareholders of the acquiring firm. This way, we will contribute to the empirical evidence of M&A effect on the wealth of shareholders of the acquiring firm.

Thereafter, we want to assess whether the R&D intensity of the acquirer and the target has impact on the magnitude of the abnormal returns produced with the announcement of the M&A. This way, we want to test the following hypotheses:

H2: The R&D intensity of the acquiring firm has impact on the abnormal returns of acquirer's shareholders resulting from the M&A's announcement.

H3: The R&D intensity of the target firm has impact on the abnormal returns of acquirer's shareholders resulting from the M&A's announcement.

Lastly, we want to assess what is the influence of the R&D intensity of the acquirer and the target on the size of the M&A premium.

As mentioned earlier, the M&A premium affects the creation of value because the synergies gained with the transaction must compensate the value paid to acquire the target firm. Since R&D is considered a valuable asset in the actual fast-changing context and seek for

constant innovation, we want to determine if the R&D intensity of the parties involved in the transaction has an impact on the size of the premium paid by the acquirers. Thus, the hypotheses to be tested are:

H4: The R&D intensity of the acquiring firm influences the size of the M&A premium paid by the acquiring firm.

H5: The R&D intensity of the target firm influences the size of the M&A premium paid by the acquiring firm.

3. Methodology

In order to answer the question of whether M&A create value or not, we will carry out an event study methodology whose characteristics will be presented in section 3.1.1. In section 3.1.2., the abnormal returns calculation process is presented. Lastly, in order to understand the influence of the factors presented in the literature on the returns, namely the R&D intensity of acquirer and target, the linear regression model developed is exposed.

Thereafter, to analyse if the premium paid is higher as higher the R&D intensity of the acquirers and targets, we will undertake a multiple linear regression model which is presented in section 3.2.

3.1. Abnormal Returns

3.1.1. Event study

An event study methodology is conducted to evaluating the impact of a corporate event on the value of a firm. The effect on the wealth of the firm's shareholders is measured examining the firm's stock price reaction to the notice of the event (Khotari and Warner, 2006). In the current dissertation, the event considered is the M&A's announcement.

Event study relies on the assumption that markets are efficient. According to the Efficient Market Hypothesis developed by Fama (1970), in these markets, the security prices fully reflect all available information. This way, when additional information is disclosed, the market reacts favourably or unfavourably according to the perception of the market participants about the event.

Consequently, the change in the shareholders' expectations about the future profitability of the firm made in accordance with the information released on the announcement of the M&A will be instantly reflected in the current stock price. Thereby, analysing the behaviour of merging firms' stock prices around the deal announcement day and comparing it with the market's performance, it is possible to perceive whether the announcement has an abnormal impact on the stock returns of firms involved. The abnormal returns arising from the M&A notice corresponds to the excess return with respect to what would be obtained in case the announcement did not happen (Motis, 2007).

However, the abnormal returns of the day of the announcement may not reflect the true value created by M&A for the shareholders of the acquiring firm. Due to market anticipation resulting from insider information, information leakages and rumours, the stock price of the acquiring firm in the days before to the announcement of the M&A may already have incorporated the information of a probable M&A. In contrast, a slow information processing after the event may lead to a delay in incorporating the M&A announcement into the stock price of the acquiring firm (Peterson, 1989).

Thus, in order to capture these effects, it must be set an event window over which the abnormal returns will be analysed. Its length should not be too small to not mistakenly exclude the effect of information released before the event and to consider the lag of speed of adjustments, but it should not be too long to avoid capturing other effects than those resulting from the event (Peterson, 1989). In this study, it was considered a 21-day event window [-10; 10] as a main event windows, where 0 corresponds to the event day. It comprises the period from 10 days before the event until 10 days after it. The event day corresponds either the announcement day or the first trading day following the announcement in case the announcement is made on a non-trading day. However, as there is no consensus about the event window that should be used due to potential differences in information leakage or/and in the speed of adjustment of prices to news, we have decided to do the calculations for other event windows ([-5; 5], [-10; 2], [-2; 0], [-1; 1], [0; 10] and [2; 10]) in order to decrease biases and thus better assess the M&A impact.

3.1.2. Abnormal returns calculation

The M&A announcement effect on shareholders' wealth is measured by computing the abnormal returns of stocks surrounding the announcement day. Abnormal return (AR) corresponds to the difference between the actual return (R) and the expected return (E(R)):

$$AR = R - E(R) \quad (3.1)$$

There are various models used to modeling the normal returns, namely Market Model (MM) and Market-Adjusted Model (MAM) which are further explained.

The market model method is widely used since it considers both risks associated with the mean returns and the market (MacKinlay, 1997). According to this model, the expected (or normal) return of the stock is given by:

$$E(R_{i,t}) = \alpha_i + \beta_i * R_{m,t} + \varepsilon_{i,t} \quad (3.2)$$

where,

$E(R_{i,t})$ - expected return of the share of firm i on day t ;

α_i - measure of average return of shares of firm i that is not explained by the market;

β_i - measure of the sensibility of shares of firm i towards the market volatility;

$R_{m,t}$ - return of the market index on day t ;

$\varepsilon_{i,t}$ - random error term.

If the event had not occurred, the difference between the actual return and the expected return would be zero. Therefore, in case the daily abnormal returns and the cumulative abnormal returns do not fluctuate around zero, it is concluded that the M&A announcement had impact on the stock market and, consequently, influenced the wealth of shareholders (Peterson, 1989; MacKinlay, 1997) Thus, the daily abnormal return of the firm i on day t is obtained as follows:

$$\varepsilon_{i,t} = AR_{i,t} = R_{i,t} - E(R_{i,t}) = R_{i,t} - (\alpha_i + \beta_i * R_{m,t}) \quad (3.3)$$

where,

$AR_{i,t}$ - abnormal return of the share of firm i on day t ;

$R_{i,t}$ - actual return of the share of firm i on day t .

The cumulative abnormal return (CAR) for the share of the firm i is defined as the sum of daily abnormal return over the event window.

$$CAR_i = \sum_{t=k}^l AR_{i,t} \quad (3.4)$$

where k represents the first day of the event window and l represents the last day of the event window.

The average abnormal return (AAR) for each day in the event windows is calculated following the equation, and assuming N as the number of acquiring firms:

$$AAR_t = \frac{1}{N} \sum_{i=1}^N AR_{i,t} \quad (3.5)$$

Lastly, to obtain the abnormal performance of all acquiring firms composing the sample, the cumulative average abnormal returns (CAAR) for acquiring firms are calculated:

$$CAAR = \frac{\sum_{i=1}^N CAR_i}{N} \quad (3.6)$$

As mentioned in the previous subsection, the choice of an event window should attend to some issues. There is no unanimity in relation to the one that must be used. According to Peterson (1989), it is left to the researcher who must balance the benefits of a longer period (an improved prediction model) and the cost of a longer period (model parameter instability). The event windows used in the current dissertation are $[-10; 10]$, $[-5; 5]$, $[-10; 2]$, $[-2; 0]$, $[-1; 1]$, $[0; 10]$ and $[2; 10]$. The abnormal returns are calculated over these periods.

In order to obtain the normal returns, the Ordinary Least Squares (hence OLS) method is used to estimate the parameters of the market model to each firm. The parameters α_i and β_i are obtained using the real returns and the market returns calculated during the estimation window. It is imperative that the estimation window and event window do not overlap to avoid the estimates of normal returns model are influenced by the event-related returns (Rani et al., 2016).

Since our sample is composed of acquiring and target firms listed in an EU country, we employ the S&P Europe 350 index as a proxy for the market. Then, the index is used to determine the market return.

The OLS regression uses the estimators $\hat{R}_{i,t}$ and $\hat{R}_{m,t}$ over the estimation window. The estimators are obtained using a logarithm transformation to approximate the returns form to normality (Henderson, 1990):

$$\hat{R}_{i,t} = \ln\left(\frac{P_t}{P_{t-1}}\right) \quad (3.7)$$

$$\hat{R}_{m,t} = \ln\left(\frac{I_t}{I_{t-1}}\right) \quad (3.8)$$

where,

P_t – market price of the share of firm i on day t ;

P_{t-1} – market price of the share of firm i on the day before day t ;

I_t – Index value on day t ;

I_{t-1} – Index value on the day before day t .

Thus, the expected return according to the MM can be obtained as:

$$E(R_{i,t}) = \hat{\alpha}_i + \hat{\beta}_i * R_{m,t} \quad (3.9)$$

The Market-Adjusted Model (MAM) can be viewed as a restricted market model (MacKinlay, 1997), where it is assumed $\alpha_i=0$ and $\beta_i=1$. As the model parameters are pre-specified, there is no requirement to set an estimation window.

This method does not consider the company risk since it assumes that the impact of the market across securities is similar. This way, the expected return is equal to the market return:

$$E(R_{i,t}) = R_{m,t} \quad (3.10)$$

According to Brown and Warner (1985), these two methodologies have similar power with daily data. They concluded that simple models are comparable to more complex models in

terms of capacity to identify abnormal performance. This way, due to data restrictions, the expected returns are estimated using the Market-Adjusted Model.

Thereafter, it is necessary to test whether the abnormal returns (if any) generated by the announcements are statistically significant or not. In this sense, a parametric test is going to be carried out. The rejection of the null hypothesis ($H_0: CAAR=0$) verifies if the M&A announcement affects the wealth of the acquiring firm's shareholders. Assuming the cumulative average abnormal returns (CAARs) have a normal distribution and are independently and identically distributed over time, the test statistics for the null hypothesis has a t-Student distribution (Brown and Warner, 1985).

$$CAAR \sim N(0; \sigma) \quad (3.11)$$

$$t_{stat} = \frac{CAAR_t}{\hat{S}(CAR)} \quad (3.12)$$

$$\hat{S}(CAR) = \sqrt{\frac{1}{N-1} \sum_{i=1}^N (CAR_i - CAAR)^2} \quad (3.13)$$

where,

t_{stat} – t-student test statistic;

$CAAR$ – cumulative average abnormal returns;

CAR_i – cumulative abnormal return of firm i , $i=1, \dots, N$;

N – total number of acquiring firms with available abnormal returns;

$\hat{S}(CAR)$ – standard deviation of CAR , an unbiased estimator of the standard deviation of the population (σ).

Additionally, the non-parametric test Wilcoxon signed-rank test is going to be performed. The non-parametric test is less demanding since it is a distribution-free test, but it is not affected by outliers, so it produces robust results. The Wilcoxon signed-rank test considers

both the sign and the magnitude of the abnormal returns are important. This test uses the absolute value of abnormal return. The rejection of the null hypothesis (H_0 : median = 0) verifies in the case of unequally likely positive or negative abnormal returns (Serra, 2004). When the number of observations is large, the distribution of the statistic is approximately a normal distribution:

$$z \sim N(0; \sigma) \quad (3.14)$$

$$z = \sum_i r_i^+ \quad (3.15)$$

$$E(z) = \frac{N(N+1)}{4} \quad (3.16)$$

$$\sigma^2(z) = \frac{N(N+1)(2N+1)}{24} \quad (3.17)$$

where,

z – test statistics for Wilcoxon signed-rank test;

r_i^+ - rank of the observation i with a positive absolute value of abnormal return;

N – number of observations in a certain event windows.

3.1.3. Abnormal returns - Multiple linear regression model

The magnitude of abnormal returns performance at the time of the event is a measure of the impact of such an event on the wealth of the shareholders. This way, evaluating the relationship between the abnormal returns and some characteristics of the deal, the acquirer and the target firm, in particular, R&D intensity of the acquirer and target, it is possible to realize how these factors impact the wealth of shareholders on the announcement. In this sense, a multiple linear regression model (MLRM) is going to be created.

The regression model for the current dissertation is defined as:

$$\begin{aligned}
CAR_i = & \beta_0 + \beta_1.RDINT_ACQ_i + \beta_2.RDINT_TARG_i + \beta_3.RELSIZE_i \\
& + \beta_4.RELINDUSTRIES_i + \beta_5.TECHDEAL_i + \beta_6.CROSSBORDER_i \\
& + \beta_7.CASHONLY_i + \beta_8.HOSTILE_i + \beta_9.FIRSTSTAKE_i \\
& + \beta_{10}.PERF_ACQ_i + \beta_{11}.LIQUID_ACQ_i + \beta_{12}.PRIOREXP_ACQ_i \\
& + \beta_{13}.PERF_TARG_i + \beta_{14}.GROWOP_TARG_i + \varepsilon_i
\end{aligned} \tag{3.18}$$

The dependent variable CAR_i is the Cumulative Abnormal Returns of the acquiring firm for the event windows $[-10; 10]$, the main event window previously defined. The cumulative abnormal returns for the share of the acquiring firm i , CAR_i , is defined as the sum of abnormal returns of the acquiring firm i over the event window, expressed in percentage. It measures the stock price reaction associated with the announcement of the M&A, since on that day it is released new information in the market that is reflected quickly on the stock returns. The higher the magnitude of abnormal returns performance at the time of the M&A's announcement the higher the impact of that event on the wealth of the shareholders.

Regarding the predictor variables, the R&D intensity of the acquirer and target are the key independent variables of our model since our purpose is to understand if they influence the abnormal returns resulting from M&A's announcement. In addition, the remaining factors mentioned in the literature that have influence over the abnormal returns are also considered. All independent variables and the respective measures considered are exposed in the section 3.3. In that section is also presented the expected relationship between the dependent variable and each one of the independent variables. Annex 2 contains an overview of all these aspects.

3.2. Premium - Multiple linear regression model

According to Kim and Canina (2013), the underperformance of the acquirer stock return around the announcement is often attributed to the payment of an excessive premium. This way, since M&A premium is determinant for the creation or destruction of value for the shareholders of the acquiring firm, a model to determine which factors affect the M&A premium is going to be developed. The specification of the MLRM for the current study is given as:

$$\begin{aligned}
PREMIUM_i = & \beta_0 + \beta_1.RDINT_ACQ_i + \beta_2.RDINT_TARG_i + \beta_3.RELSIZE_i \\
& + \beta_4.RELINDUSTRIES_i + \beta_5.TECHDEAL_i + \beta_6.CROSSBORDER_i \\
& + \beta_7.CASHONLY_i + \beta_8.HOSTILE_i + \beta_{10}.FIRSTSTAKE_i \\
& + \beta_{11}.PERF_ACQ_i + \beta_{13}.DEBTCAP_ACQ_i + \beta_9.PRIOREXP_ACQ_i \\
& + \beta_{12}.PERF_TARG_i + \beta_{14}.MB_TARG_i + \varepsilon_i
\end{aligned} \tag{3.19}$$

In the current study, the dependent variable PREMIUM corresponds to M&A premium paid by the acquirer firm in order to gain control over the target firm. The premium is the value in excess of the pre-acquisition market value of a company that is paid for the right to control and proportionately enjoy the profits of the business (Hitt et al., 2012; Gaughan, 2015). Since the pre-acquisition market value of the target may be affected by information released before the announcement, the premium is often calculated using a longer period of time. Although they may introduce some noise, longer periods are used to reduce the market anticipation effect (Laamanen, 2007). In this sense, the premium paid by the acquiring firm i , $PREMIUM_i$, is given by the excess of the offer price over the target closing stock price 4 weeks prior to the M&A announcement, expressed as a percentage.

The independent variables represent the characteristics of the deal, the acquirer and the target firm that may explain the M&A premium. They were selected based on the literature analysed. Since the focus is to evaluate the impact of the R&D intensity of the acquirer and the target firm on the M&A premium, these are the key independent variables of the model. All independent variables and their associated measures, as well as the expected relationship between the dependent variable and each one of them, are exposed in the next section. Annex 2 contains a summary of these aspects.

3.3. Independent variables and measures

The independent variables considered in both linear regression models previously described, as well as their measures and the expected relationship of each one with the two dependent variables, are exposed below.

$RDINT_ACQ$ and $RDINT_TARG$ =R&D intensity of the acquiring firm and the target firm, respectively. They are measured by the mean of the ratio between net intangible assets and

total assets of the acquirer and target firm, respectively, in the last 5 years before the deal. The R&D intensity is used as a proxy to the degree of innovation of a company. Due to lack of data on patents and R&D expenditures, in this study, the R&D intensity of the acquirer and the target are measured by the mean of the respective ratio between the value of “Intangible Assets, Net” and the value of “Total Assets” for the 5 years before the announcement. “Intangible Assets, Net” represents “Intangible, Gross” reduced by “Accumulated Intangible Amortization”. This account excludes the value of “Goodwill” and includes the value of patents, copyrights, franchises, trademarks, trade names, secret processes, and organization costs. For instance, it includes the capitalized software/website development costs (not specific to certain machinery), the prepayments for licenses and the capitalized research and development costs if classified as intangibles.

According to the Quixant’s report (2017), the research and development costs are classified as intangible assets if the company can demonstrate the following criteria: 1) The technical feasibility of completing the intangible asset so that it will be available for use or sale; 2) The intention to complete the intangible asset and use or sell it; 3) The ability to use or sell the intangible asset; 4) The probability that the asset created will generate future economic benefits; 5) The availability of adequate technical, financial and other resources to complete the development; and 6) The ability to measure reliably the expenditure attributable to the intangible asset during its development. The cost of an internally generated development costs comprises all directly attributable costs necessary to create, produce, and prepare the asset to be capable of operating in the manner intended by management. Directly attributable costs include the cost of materials, employee costs incurred on project development along with an appropriate portion of relevant overheads. Capitalised development costs are amortised on a straight line basis over their expected useful economic lives. Development costs not meeting these criteria are expensed in the statement of comprehensive income as incurred.

RELSIZE=relative size between the target and the acquirer. As considered by Chira and Volkov (2017), it is measured by the ratio of the natural logarithm (ln) of total assets of the target firm at the end of the year prior to announcement over the natural logarithm (ln) of total assets of the acquirer firm at the end of the year prior to the announcement.

RELINDUSTRIES=relatedness of the industries of the acquirer and the target firm. It is a dummy variable that takes the value one if the industries of acquirer and target firm are

related, i.e., if the first two digits of SIC code of acquirer and target coincide, and zero otherwise. This measure was previously considered by Martynova and Renneboog (2006) and Ismail (2011).

TECHDEAL=technological related deal. It is a dummy variable that takes the value one if the deal was carried out for a technological purpose, and zero otherwise. Its value was defined based on the revealed information about the deal and on news.

CROSSBORDER=geography of the deal is cross-border. It is a dummy variable that takes the value one if the deal is cross-border, and zero otherwise, as considered in the studies of Martynova et al. (2011) and Schoop (2013). This variable analyses if the home-countries of the acquirer and the target coincide, i.e., if the deal is domestic, or if it entered by firms from different countries.

CASHONLY=the method payment is cash-only. It is a dummy variable that takes the value one if the method of payment is only cash, and zero otherwise. This variable was considered by Goergen and Renneboog (2004) and Martynova et al. (2011).

HOSTILE= the deal attitude is hostile. The deal attitude is taken into account through this dummy variable that takes the value one if the deal attitude is hostile, and zero otherwise. This variable was considered in the studies of Ismail (2011) and Schoop (2013).

FIRSTSTAKE=the acquirer had no stake in the target firm before the deal. It is a dummy variable that takes the value one if the acquirer had no stake in the target before the deal, and zero otherwise. It is considered to analyse the facility of access to information about the target by the acquirer. If it takes the value 0, it means that the acquirer had access to more information, allowing it to evaluate the transaction more accurately. This measure was previously considered by Schoop (2013).

PERF_ACQ and PERF_TARG=performance of the acquirer and the target prior to the M&A, respectively. It is given by the mean of the ratio between EBIT and total assets of the acquirer and the target, respectively, in the last 5 years before the deal. This measure was considered in the study of Schoop (2013).

LIQUID_ACQ=liquidity of the acquirer firm. It is measured by the mean of the ratio between total current assets and total current liabilities of the acquirer in the last 5 years before the deal.

PRIOREXP_ACQ=acquirer's prior experience in an M&A process. It corresponds to a dummy variable that takes the value one if the acquirer has already participated in an M&A, and zero otherwise. This variable was considered in the study of Schoop (2013).

GROWTHOP_TARG=future growth opportunities of the target firm. It is given by the market-to-book ratio of the target firm at the end of the year prior to the announcement. This measure was considered by Ruslan (2016) and Chira and Volkov (2017).

4. Data

In section 4.1, the selection process and the composition of the sample used to carry out this study are described. The descriptive statistics of the variables considered in the study, as well as the analysis of the correlation between them, are exposed in section 4.2.

4.1. Data selection

The list of M&A deals composing our sample and respective information, as well as the financial data about both the acquirer and the target firm, were collected from Eikon database of Thomson Reuters.

The sample contains the deals that meet the following criteria: (1) deal type is *Acquisition* or *Merger*; (2) the deal was “completed-confirmed” or “completed-assumed” between January 2008 and December 2017; (3) both the acquirer and the target firms were listed at the time of the deal in a country belonging to EU enlarged; (4) the firms involved are non-financial. The last restriction was imposed to avoid dealing with the special regulatory environment and accounting issues related to financial institutions. We decided to confine the study to EU countries because macroeconomic factors are more stable since countries share certain economic, political and social laws and policies.

Moreover, we retained only the deals where the M&A led to a change in ownership positions, i.e., those where the initial stake of the acquirer in the target was less than 50% and the final stake was more than 50% in order to exclude deals seeking for just a minority participation. Additionally, the deals made for the same acquirer that do not present a difference of at least 280 trading days between the announcement days were excluded. After applying all these filters, we have obtained an initial sample of 153 M&A deals.

Thereafter, we collected the financial data with respect to acquiring firm and target firm. Due to lack of data, the study was conducted using a final sample composed by 69 deals.

We present the sample distribution in table 1.

Table 1 - Sample Distribution

This table exhibits the sample distribution of the sample used in our study.

Panel A - Distribution by Year			Panel C - Distribution by Sector				
Year	No. of deals	Percent	Industry	No. of acquirers	Percent	No. of targets	Percent
2008	3	4.35	Basic Materials	5	7.25	5	7.25
2009	5	7.25	Cyclical Consumer Goods / Services	10	14.49	11	15.94
2010	6	8.70	Energy	4	5.80	2	2.90
2011	11	15.94	Healthcare	11	15.94	12	17.39
2012	4	5.80	Industrials	21	30.43	19	27.54
2013	10	14.49	Non-Cyclical Consumer Goods / Services	6	8.70	6	8.70
2014	6	8.70	Technology	12	17.39	12	17.39
2015	11	15.94	Telecommunications Services	0	0	1	1.45
2016	6	8.70	Utilities	0	0	1	1.45
2017	7	10.14	Total	69	100	69	100
Total	69	100					

Panel B - Distribution of Deal Characteristics			Panel D - Distribution by Country				
Characteristics	No. of deals	Percent	Home Country	No. of acquirers	Percent	No. of targets	Percent
Related industries	39	56.52	Austria	0	0	1	1.45
Technological deal	34	49.28	Belgium	1	1.45	1	1.45
Cross-border	17	24.64	Denmark	0	0	1	1.45
Cash Only	26	37.68	Finland	4	5.80	4	5.80
Hostile	1	1.45	France	13	18.84	10	14.49
Experienced acquirer	59	85.51	Germany	1	1.45	0	0
First Stake	62	89.86	Italy	4	5.80	2	2.90
Total	-	-	Netherlands	3	4.35	3	4.35
			Poland	0	0	1	1.45
			Republic of Ireland	1	1.45	0	0
			Spain	1	1.45	2	2.90
			Sweden	10	14.49	6	8.70
			United Kingdom	31	44.93	38	55.07
			Total	69	100	69	100

For our sample, it is observed that the years with more announcements are 2011 and 2015 (representing each about 15.94%), followed by 2013 (14.49%).

Regarding the characteristics of the deal, more than half (56.52%) of the M&A occurred between companies belonging to related industries and approximately one half (49.28%) happened for technological reasons. In addition, approximately a quarter (24.64%) of the deals were entered into between firms based in different countries, i.e., cross-border deals. The cash-only payment method was implemented in 26 out of 69 bids of the sample. Most acquirers of our sample deals had already participated in an M&A (about 85.51% of the acquirers) and 89.86% had no stake in the target firm before the bid.

Concerning the economic sectors of the parties involved, acquirers mainly belong to the industrials sector (30.43% of the acquirers), followed by the technology and healthcare sectors (representing 17.39% and 15.94% of the acquirers, respectively). In the same way, these are the sectors with more targets belonging to, representing 27.54%, 17.39% and 17.39% of the targets, respectively.

As displayed in Panel D, United Kingdom is the country to which most acquirers and targets belong (44.93% and 55.07%, respectively), followed by France representing 18.84% of the acquirers and 14.49% of the targets, and Sweden representing 14.49% and 8.70%, respectively.

As observable in the table, the hostile attitude is adopted only in one of the deals of our sample, so the variable HOSTILE will be discarded. Hereafter, the variable HOSTILE is no longer analysed.

4.2. Data description

In order to describe the deals and the firms composing our sample, the descriptive statistics of the variables used in the study are displayed in table 2. We present the descriptive statistics for all analysed event windows.

Table 2 - Descriptive Statistics

This table shows the descriptive statistics of the variables incorporated in the current study. CAR is defined as the sum of abnormal returns of the firm over the event window, expressed in percentage. PREMIUM is the ratio of price paid by acquirer per target share minus the target closing share price 4 weeks prior to the announcement day to the target closing share price 4 weeks prior to the announcement day, expressed in percentage. RDINT_ACQ is measured by the mean of the ratio between net intangible assets and total assets of the acquirer in the last 5 years before the deal, expressed in percentage. RDINT_TARG is measured by the mean of the ratio between net intangible assets and total assets of the target in the last 5 years before the deal, expressed in percentage. RELSIZE is the ratio of natural logarithm (ln) of the total assets of target firm at the end of the year prior to announcement over the natural logarithm (ln) of the total assets of acquirer at the end of the year prior to announcement. RELINDUSTRIES is a dummy variable that takes the value one if the industries of acquirer and target firm are related, i.e., if the first two digits of SIC code of acquirer and target coincide, and zero otherwise. TECHDEAL is a dummy variable that takes the value one if the deal was carried out for a technological purpose, and zero otherwise. CROSSBORDER is a dummy variable that takes the value one if the deal is cross-border, and zero otherwise. CASHONLY is a dummy variable that takes the value one if the method of payment is only cash, and zero otherwise. FIRSTSTAKE is a dummy variable that takes the value one if the acquirer had no stake in the target before the deal, and zero otherwise. PERF_ACQ is defined as the mean of the ratio between EBIT and total assets of the acquirer in the last 5 years before the deal, expressed in percentage. LIQUID_ACQ is the mean of the ratio between total current assets and total current liabilities of the acquirer in the last 5 years before the deal, expressed in percentage. PRIOREXP_ACQ is a dummy variable that takes the value one if the acquirer has already participated in an M&A, and zero otherwise. PERF_TARG is defined as the mean of the ratio between EBIT and total assets of the target in the last 5 years before the deal, expressed in percentage. GROWTHOP_TARG is the market-to-book ratio of the target firm at the end of the year prior to the announcement.

	Mean	Median	Maximum	Minimum	Std. Dev.	N
CAR [-10; 10] (%)	-1.35	-0.69	25.04	-38.77	10.35	69
CAR [-10; 2] (%)	-0.04	0.31	28.78	-25.94	9.01	69
CAR [-5; 5] (%)	0.13	-0.74	24.44	-26.49	8.59	69
CAR [-2; 0] (%)	1.45	0.77	19.50	-8.63	6.01	69
CAR [-1; 1] (%)	1.50	1.16	19.73	-10.48	5.82	69
CAR [0; 10] (%)	-1.07	-1.09	21.01	-35.50	7.92	69
CAR [2; 10] (%)	-1.89	-1.66	13.10	-23.22	6.25	69
PREMIUM (%)	35.64	29.41	177.78	-50.51 ¹	36.20	69
RDINT_ACQ (%)	12.01	6.67	56.85	0.00	13.45	69
RDINT_TARG (%)	14.84	10.91	112.09	0.00	19.06	69
RELSIZE (%)	75.42	76.25	129.86	32.11	20.70	69
RELINDUSTRIES	0.57				0.50	69
TECHDEAL	0.49				0.50	69
CROSSBORDER	0.25				0.43	69
CASHONLY	0.38				0.49	69
FIRSTSTAKE	0.90				0.30	69
PERF_ACQ (%)	4.74	7.19	30.50	-49.14	13.87	69
LIQUID_ACQ (%)	162.41	129.95	630.22	49.58	105.40	69

¹ This value is associated to the deal entered between Parkmead Group PLC and Lochard Energy Group PLC. In the years before the announcement, Parkmead Group PLC had seen a decline in Net Sales and Total Current Assets, as well as an increase in Total Current Liabilities.

PRIOREXP_ACQ	0.86				0.35	69
PERF_TARG (%)	2.08	5.11	38.74	-49.77	15.40	69
GROWTHOP_TARG (ratio)	3.27	1.83	59.10 ²	0.32	7.05	69

According to the results exhibited, the mean of the CAR obtained by the acquirers of our sample varies across the different event windows considered. For the event windows [-10; 10], [-10; 2] [0; 10] and [2; 10] the average of the CAR is negative, which means that, on average, M&A's announcement destroyed value considering the effect in the entire extent of these windows. In contrast, for the other event windows the average is positive, remarking the higher values for the event windows [-2; 0] and [-1; 1]. The aggregated effect of the announcement along with these windows is positive, i.e., there is a creation of value. However, their high standard deviation suggests the presence of a wide range of CAR values.

Regarding M&A premium, its mean value is 35.64% for our sample. However, it assumes values between -50.51% and 177.78%, where, in cases of its value is negative, the acquirer purchases the target firm for a discount, i.e., less than its market value.

The R&D intensity of acquirer ranges between 0 and 56.85 and the mean value is 12.01. Comparing it with the R&D intensity of target that varies between 0 and 112.09 and presents a mean value equal to 14.84. The average of the R&D intensity of the target is higher than that of the acquirer for our sample.

The mean and the median of the relative size between acquirer and target are 75.42 e 76.25, respectively. It varies between 32.11 and 129.86. Its standard deviation is equal to 20.70.

With regard to performance, the mean of the performance for the acquirer equals 4.74, meaning that, on average, the EBIT value corresponds to 4.74% of the value of the Total Assets, while the mean of the target is equal to 2.08. The acquirer firm presents values between -49.14 and 30.50 and a standard deviation of 13.87, while the target firm has values between -49.77 and 38.74 and a standard deviation of 15.40. The latter value suggests the existence of outliers regarding the performance of the target.

The liquidity of the acquirer is, on average, equal to 162.41. It ranges between 49.58 and 630.22 its standard deviation is equal to 105.40.

² This value corresponds to the market-to-book ratio presented by Betfair Group PLC associated to the deal established with Paddy Power PLC.

The growth opportunities variable range lies between 0.32 and 59.10 and its mean value is 3.27. Its standard deviation is equal to 7.05, suggesting the existence of outliers with respect to this variable.

Prior to estimating, we will analyse the correlation coefficients between the variables used in our study in order to trace possible signs of multicollinearity. The coefficient matrix is shown in the annex 3.

In general, there is no strong correlation between variables, with the highest coefficient being 0.44.

In consideration of the nature of the variables and the values obtained in the descriptive statistics for the maximum and the minimum and for the standard deviations, it is possible to identify evidence of the existence of outliers. This way, the observed outliers were handled using the winsorization method. This corrective measure was applied to variables that are measures by a ratio or a growth rate since they are more tendentious to present outliers. This way, the variables submitted to the winsorization method were CAR, PREMIUM, RDINT_ACQ, RDINT_TARG, RELSIZE, PERF_ACQ, LIQUID_ACQ, PERF_TARG and GROWTHOP_TARG

Applying this method for the percentiles 5% and 95%, all the observations with values greater than the percentile 95% took the value of the percentile 95% and all observations with values lower than the percentile 5% took the value of the percentile 5%. This repositioning of extreme values to the percentiles 5% and 95% of the distribution reduces the effect of outliers in the conclusions and brings robustness to the estimators.

Hereafter, the variables referred above are always considered after applying the winsorization method. The descriptive statistics of these winsorized variables are presented in the annex 4.

5. Results

In this section, the results obtained with the implementation of the methodology to our sample are presented. Section 5.1. contains the results regarding the computation of abnormal returns and the analysis of the model constructed to evaluate whether the R&D intensity of the acquirer and the target influence its value. Lastly, the analysis of the impact of these variables on the premium paid by acquirer is presented in section 5.2.

5.1. Abnormal performance

5.1.1. Cumulative average abnormal returns

In order to examine the impact of M&A announcements on stock returns of acquirer's shareholders, it was conducted an event study to the event windows [-10; 10], [-5; 5], [-10; -2], [-2; 0], [-1; 1], [0; 10] and [2; 10]. The results obtained are displayed in table 3.

Besides presenting the CAAR value for each window, we also exhibit the results of the statistic tests carried out to test the hypothesis of no abnormal returns ($H_0: CAAR=0$), i.e., the hypothesis of the announcement has no impact on the wealth of the shareholders of the acquiring firm during the event window.

The average abnormal returns (AAR) for each day, as well as the respective statistics tests were also computed and the results are exposed in annex 5.

As previously referred, the computation of the abnormal returns was performed using the Market-Adjusted Model (MAM) to estimate the normal returns of the shares and using the S&P Europe 350 as a proxy for the market.

According to the results exhibited, the conclusion whether M&A announcement creates or destroys value varies depending on the investment window. This is a pertinent study from the investment perspective to determine the periods for which it is possible to reach gains.

For the event windows [-10, 10], [-5, 5], which are among the most extended periods analysed and comprise an interval before and after the announcement, the value of CAAR is negative (-1.35% and -0.04%, respectively), but it is not significantly different from 0, which means that there are no abnormal returns for the shareholders of the acquiring firm during these entire windows and thus the announcement has no impact on their wealth.

Table 3 - Cumulative Average Abnormal Returns (CAARs) for M&A Announcements across various Event Windows

This table contains the cumulative average abnormal returns (CAAR) and the median of the average abnormal return (AAR) from the event windows considered in the study, the percentage of positive CAARs in each event windows, and the results of the test statistics conducted to evaluate the statistical significance of the returns. ***, **, * indicates significance at 1%, 5% and 10% level, respectively.

Event Window	Average Abnormal Return		% Positive CAAR	Parametric Test	Non-parametric Test	N
	Cumulative (%)	Median (%)		t-value	z	
[-10; 10]	-1.35	-0.69	44.93	-1.09	-1.01	69
[-5; 5]	-0.04	0.31	50.72	0.12	-0.09	69
[-10; 2]	0.13	-0.74	42.03	-0.04	-0.12	69
[-2; 0]	1.45	0.77	52.17	2.00 **	1.44	69
[-1; 1]	1.50	1.16	56.52	2.14 **	1.74 ***	69
[0; 10]	-1.07	-1.09	43.48	-1.13	-1.34	69
[2, 10]	-1.89	-1.66	37.68	-2.51 **	-2.44 **	69

Although the value of CAAR is positive for the event window [-10; 2], which comprises the pre-announcement period and a short period after the announcement, the same conclusion is reached regarding the significance of its value. The announcement of the M&A has no impact to the wealth of the shareholders along this period.

However, when we analyse the event window [-2; 0], the value of CAAR is positive (equal to 1.45%) and statistically significant according to the parametric test. This results from the statistically significant positive AAR generated in the days -1 and 0 (0.68% and 1.19%, respectively), which suggest that, in the day before the announcement, the market anticipates the M&A and perceives it as being value-creating, reinforcing that position on the day of the announcement. This implies that there is information released before the announcement. Thus, an investor purchasing shares of the acquiring firm 2 days prior to the announcement and selling them on the announcement day can have a return of 1.45%.

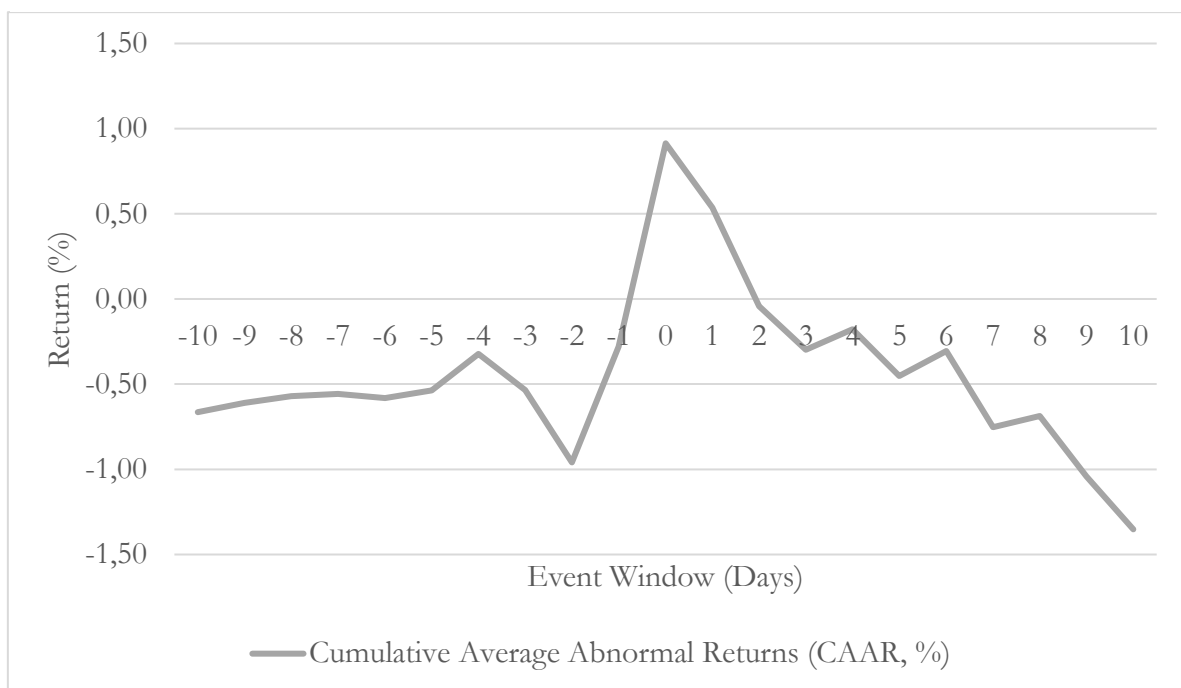
The CAAR for the event window [-1; 1] has positive value (1.50%) and it is statistically significant, which means that, on average, the shareholders earn positive abnormal returns for this event windows as a whole. This is the investment period that provides the highest CAAR value, indicating that the investors who earn the most are those who buy shares of the acquiring company on the day prior to the announcement and sell them one day after the announcement.

When we look to the event window $[0; 10]$, the value of CAAR is negative, but not significantly different from 0. In contrast, the value of CAAR is statistically significant for the event window $[2; 10]$. Thus, we conclude that it is the positive value of ARs of day 0 that compensates for the negative returns registered in the remaining days of the event window $[0; 10]$ and allows the negative CAAR for this event window are not significant. The results of these windows suggests that, after the announcement of the deal, the investors revise their estimates and they no longer expect the deal would create value for the shareholders of the acquirer firm, so they react negatively.

Concluding, in general, the M&A announcement does not generate abnormal returns to the shareholders of the acquiring firm for the event window $[-10; 10]$, and thus the value of their wealth is not influenced. This findings are in line with many results of previous studies, such as Capron and Pistre (2002) and Shah and Arora (2014). However, the gains obtained by investors and its significance depend on both the moment they invest and the period of such investment.

Figure 1 exhibits graphically the evolution of CAAR along the event window $[-10; 10]$.

Figure 1 - Cumulative Average Abnormal Return (CAAR) along Event Window



5.1.2. Abnormal returns - Regression results

To identify the characteristics of the deal, the acquirer and the target influencing the abnormal returns earned by shareholders of the acquiring firm resulting from M&A announcement and, in particular, to assess whether R&D intensity of the acquirer and target have influence on their magnitude, we have performed a multiple linear regression model.

As referred earlier, the dependent variable of this model is the Cumulative Abnormal Returns earned by acquiring firm, CAR. The model was estimated using the values of CAR calculated for the event window [-10; 10], since it is the wider and the main event window used in our study.

The independent variables were introduced into the regression stepwise. In the regression (1), only the key variables of our study which representing the R&D intensity of the acquirer and the target firm (RDINT_ACQ and RDINT_TARG) were considered. In the regression (2), the variables describing the characteristics of the deal (RELSIZE, RELINDUSTRIES, TECHDEAL, CROSSBORDER, CASHONLY and FIRSTSTAKE) were added. Thereon, the remaining variables with respect to the characteristics of the acquirer (PERF_ACQ, LIQUID_ACQ and PRIOREXP_ACQ) were introduced in the regression (3). Lastly, the remaining variables related to the characteristics of the target (PERF_TARG and GROWTHOP_TARG) were included in the regression (4). The results obtained are shown in table 4.

It is expected a positive relationship between the dependent variable CAR and the independent variables RDINT_TARG, CASHONLY and PERF_ACQ. In contrast, it is expected that RELSIZE, CROSSBORDER, FIRSTSTAKE and LIQUID_ACQ have a negative relationship with CAR. The expected relationship between CAR and the remaining variables is ambiguous.

According to the estimation output, there are no variables that are considered to influence significantly the value of CAR simultaneously across all regressions.

The results show that the variable representing the R&D intensity of the acquirer presents a positive coefficient along the 4 regressions but the variable is only significant in regressions (1) and (2) for which the coefficient is equal to 0.18. The positive coefficient indicates

a positive relationship between the level of R&D of the acquirer and CAR which means that an increase in the R&D intensity of the acquirer results in higher CAR to the shareholders of the acquiring firm. This positive correlation may derive by the positive perception of the acquirer's shareholders who consider that, since the acquirer is an R&D-intensive firm, it is entering into a deal aiming to get specific resources that are owned by the target, in order to take advantage of their own R&D activities.

Regarding the variable RDINT_TARG, the coefficient is not significant across all regressions, suggesting that the R&D intensity of the target has no influence on the value of CAR. Moreover, unlike expected, the coefficient of the RDINT_TARG obtained in all regressions are negative. It was expected a positive correlation between variables since firms investing more in R&D are more likely to reach fruitfully innovation outcomes, as referred by Phillips and Zhdanov (2012). These opposite results may be caused by the possible sense of uncertainty of shareholders regarding the capacity to reach future economic benefits using the R&D of the target.

In relation to the characteristics of the deal, the variable RELSIZE is considered significant in regression (2), exhibiting a negative coefficient. Our findings indicate that larger targets are associated to lower abnormal returns, what is in accordance to the relationship predicted. As affirmed by Martynova and Renneboog (2011), larger targets involve a more complex integration process, requiring more resources of the acquiring firm, namely management attention. The variable RELINDUSTRIES is statically significant in regression (4), presenting a negative coefficient. Although the potential lower levels of asymmetric information and higher efficiency gains, the integration process is unique and its success depends on how the information is transmitted between parties and how the acquirer absorb and adapts the resources coming from the target firm (Cheng and Yang, 2017). Since firms have different ways of working operating in the same industry, it may be complicated to manage these differences and coordinate all processes in a single sense.

Table 4 – The effect of characteristics of deal, acquirer and target firm on CAR

This tables exhibit the results of the estimation of the linear regression models. The dependent variable is CAR. It contains the value of the coefficients between each independent variable and the dependent variable. The values of t-statistic are reported in parenthesis under the coefficient. ***, **, * indicate significance at 1%, 5% and 10% level, respectively. W means that the variable is winsorized.

Independent variables	(1)	(2)	(3)	(4)
RDINT_ACQ	0.18 *	0.18 *	1.58	1.40
	(1.87)	(1.92)	(0.16)	(0.13)
RDINT_TARG	-0.12	-0.10	-1.17	-1.25
	(-1.40)	(-1.09)	(-0.10)	(-0.11)
RELSIZE		-1.69 *	-1.46	-0.93
		(-0.10)	(-0.09)	(-0.06)
RELINDUSTRIES		-1.07	-1.09	-1.70 *
		(-2.41)	(-2.50)	(-3.67)
TECHDEAL		-1.03	-0.72	-0.37
		(-2.30)	(-1.71)	(-0.82)
CROSSBORDER		2.00 *	1.81 *	1.31
		(4.83)	(4.60)	(3.13)
CASHONLY		0.12	-0.44	-0.27
		(0.30)	(-1.16)	(-0.69)
FIRSTSTAKE		0.18	0.25	-0.14
		(0.60)	(0.86)	(-0.44)
PERF_ACQ			0.88	-0.33
			(0.09)	(-0.04)
LIQUID_ACQ			-0.22	-0.19
			(0.00)	(0.00)
PRIOREXP_ACQ			-1.13	-1.30
			(-3.49)	(-3.73)
PERF_TARG				2.62 **
				(0.23)
GROWTHOP_TARG				1.67
				1.12 *
C	-1.69	1.09	1.37	0.92
	-1.04	6.39	9.04	5.99
R ²	0.06	0.18	0.21	0.35
Adjusted R ²	0.03	0.07	0.06	0.19
F-statistic	2.05	1.68	1.39	2.24
Prob (F-statistic)	0.14	0.12	0.20	0.02
Observations	69	69	69	69

Lastly, the variable CROSSBORDER is significant in regressions (2) and (3) and it exhibits a positive relationship with CAR, contrary to what was expected. In the actual globalized world, one explanation to this fact is that cross-border M&A may represent an facilitated way to get access to new markets since it simplify the process of ingress and settling on the market, allowing to take advantage of the current position occupied by the target in the market. Although they are not statistically significant, the variables TECHDEAL, CASHONLY and FIRSTSTAKE present coefficients generally in accordance with the expectations.

With the exception of the R&D intensity of the acquirer, the remaining variables characterizing the acquiring firm (PERF_ACQ, LIQUID_ACQ and PRIOREXP_ACQ) are not considered to have a significant influence on the value of CAR. Although that, in general, the results are not contradictory to what is predicted.

Furthermore, the value of CAR is significantly explained by the characteristics of the target firm, represented by the variables PERF_TARG and GROWTHOP_TARG. These variables were introduced in regression (4) and are both significant, exhibiting a positive coefficient equal to 2.62 and 1.67, respectively. The expected signals of the correlations are ambiguous since there are authors defending opposite reasoning as exposed in the literature review. Our results evidence that the higher the performance and the growth opportunities of the target firm, the higher the abnormal returns earned by the shareholders of the acquiring firm. This suggests that the most profitable target firms are seen as better investments for the acquirer since they will presumably continue to present a good performance. In addition, firms presenting more growth opportunities bring new options of development to the acquirer, so the acquisition of this kind of targets also generates a positive reaction in the market.

Concluding, regarding the question whether the R&D intensity of the acquirer and the target has influence on the abnormal returns earned by the shareholders of the acquiring firm, it is concluded that R&D of acquirer has a positive influence on the CAR value, this is., the higher the R&D intensity of the acquirer, the higher the abnormal returns earned by shareholders. In contrast, due to the inherent uncertainty, the R&D intensity of the target firm shows has no impact on the returns earned by shareholders, and consequently on their wealth.

5.2. Premium – Regression results

To examine how the R&D intensity of the acquirer and the target contribute to determine the size of the M&A premium, we developed another linear regression model in which the dependent variable is the premium (PREMIUM) and the mentioned characteristics are again used as independent variables.

Similar to what was done in the previous linear regression, the independent variables were introduced into the regression stepwise. In the regression (1), only the key variables of our study which representing the R&D intensity of the acquirer and the target firm (RDINT_ACQ and RDINT_TARG) were considered. In the regression (2), the variables describing the characteristics of the deal (RELSIZE, RELINDUSTRIES, TECHDEAL, CROSSBORDER, CASHONLY and FIRSTSTAKE) were added. Thereon, the remaining variables with respect to the characteristics of the acquirer (PERF_ACQ, LIQUID_ACQ and PRIOREXP_ACQ) were introduced in the regression (3). Lastly, the remaining variables related to the characteristics of the target (PERF_TARG and GROWTHOP_TARG) were included in the regression (4). The results obtained are shown in table 5.

It is expected a positive relationship between the dependent variable PREMIUM and the independent variables RDINT_TARG, RELSIZE, TECHDEAL, CROSSBORDER, PERF_ACQ, LIQUID_ACQ, PERF_TARG and GROWTHOP_TARG. In contrast, it is expected that RDINT_ACQ, RELINDUSTRIES, CASHONLY, FIRSTSTAKE and PRIOREXP_ACQ have a negative relationship with PREMIUM.

The results evidence that there is one variable (RDINT_ACQ) considered statistically significant in all estimated models, which means that it has a significant impact on the M&A premium.

As referred, the variable RDINT_ACQ is significant for all regressions at 5% significance level, indicating that it influences the size of the premium paid by the acquirer. Contrary to expectations, its positive coefficient indicates that the higher the R&D intensity of the acquirer, the higher the premium it pays in order to gain control over the target firm. This may be justified because often which leads R&D-intensive acquiring firms to enter into a deal is the interest in the specific resources of the target. This way, they are willing to pay more in order to acquire them.

Table 5 - The effect of characteristics of deal, acquirer and target firm on CAR

This tables exhibit the results of the estimation of the linear regression models. The dependent variable is PREMIUM. It contains the value of the coefficients between each independent variable and the dependent variable. The values of t-statistic are reported in parenthesis under the coefficient. ***, **, * indicate significance at 1%, 5% and 10% level, respectively.

Independent Variables	(1)	(2)	(3)	(4)
RDINT_ACQ	0.75 ** (2.60)	0.71 ** (2.35)	0.77 ** (2.55)	0.76 ** (2.43)
RDINT_TARG	-0.53 * (-1.98)	-0.47 -1.67	-0.37 -1.34	-0.33 -1.10
RELSIZE		-0.25 -1.26	-0.32 -1.64	-0.36 -1.66
RELINDUSTRIES		-6.97 -0.97	-8.27 -1.17	-8.02 -1.10
TECHDEAL		4.65 0.65	0.12 0.02	0.25 0.03
CROSSBORDER		-1.83 -0.24	0.46 0.06	0.76 0.09
CASHONLY		4.56 0.60	5.02 0.61	4.29 0.50
FIRSTSTAKE		1.47 0.13	-2.46 -0.23	-2.24 -0.20
PERF_ACQ			0.12 0.35	0.17 0.48
LIQUID_ACQ			0.09 ** (2.37)	0.10 ** (2.29)
PRIOREXP_ACQ			-6.16 -0.65	-5.94 -0.61
PERF_TARG				-0.01 -0.04
GROWTHOP_TARG				-1.02 -0.45
C	33.22 *** (6.57)	50.50 *** (2.69)	49.43 ** (2.45)	52.76 ** (2.41)
R-Squared	0.11	0.18	0.26	0.27
Adjusted R-Squared	0.08	0.07	0.12	0.09
F-statistic	3.99	1.67	1.87	1.55
Prob (F-statistic)	0.02	0.13	0.06	0.13
Observations	69	69	69	69

The results regarding the variable RDINT_TARG show that it is significant in regression (1), while it is not statistically significant in the regressions 2-4. It suggests no strong evidence that R&D intensity of target has influence on the premium paid. In addition, the sign of its coefficient is opposite to the one expected. It may be caused by the possible sense of uncertainty of shareholders regarding the capacity to reach future economic benefits using the R&D of the target. They may prefer to acquire another target for a lower premium or opt to organic development, since this is way they can answer exactly to the needs of the firm.

Apart from these variables, only the variable that represents the liquidity of the acquirer (LIQUID_ACQ) is significant in the regressions 3 and 4. As expected, the coefficient of this variable is positive. This is consistent with the arguments of Martynova and Renneboog (2006) and Schoop (2013) who say that firms presenting a higher level of liquidity are more likely to overbid since they are not so constrained from a financial perspective. This way, in general, the higher the liquidity of the acquirer, the higher the size of the M&A premium.

All the other variables (RELSIZE, RELINDUSTRIES, TECHDEAL, CROSSBORDER, CASHONLY, FIRSTSTAKE, PERF_ACQ, PRIOREXP_ACQ, PERF_TARG and GROWTHOP_TARG) are not considered to have an influence on the value of the M&A premium since they are not statistically significant. Although the insignificance demonstrated, these variables present a negative coefficient, with the exception of the variables TECHDEAL, PERF_ACQ and the CROSSBORDER in the regressions 3 and 4 which presents a positive coefficient. The signal of the coefficients of the variables RELSIZE, CASHONLY, PERF_TARG and GROWTHOP_TARG are not in accordance with the expected.

The negative relationship of the relative size of the target to the acquirer with the M&A premium may be a reflection of the concern of the managers of the acquiring firm in relation to the integration process and the challenges which that engenders. This way, they may be not willing to pay more for larger targets. Regarding the payment method, although the results are contrary to what expected, they are in accordance with the findings of Ismail (2011). He refers that the higher M&A premium when the payment method is made in cash may seek to counterbalance the tax liability applied over the target shareholders' capital gains.

To conclude, regarding the hypothesis whether R&D intensity of the acquirer and target influence the M&A premium, there is evidence that R&D intensity of the acquirer has an impact on its size, while the evidence for R&D intensity of target firm is not strong. These conclusions

are reached considering that the R&D intensity is measured by the mean of the ratio between net intangible assets and total assets in the last 5 years before the deal.

6. Conclusions

Using a sample composed by 69 M&A deals between EU listed firms between 2007 and 2017, the main purpose of the current research was to evaluate whether the M&A's announcement has impact on the wealth of acquirer shareholders, and, most important, to understand what is the influence of the R&D intensity of the acquirer and target on that impact. Furthermore, it was intended to examine how the R&D intensity of the parties contribute to determine the size of the M&A premium.

In order to answer these questions and thus to contribute to the M&A literature regarding the R&D, we conducted an event study to evaluate the CAAR around the announcement day and then we performed two multiple linear regression models with the R&D intensity of the acquirer and the target being the key independent variables, in order to assess their influence on CAR and premium paid.

The results evidence that, in general, the abnormal returns resulting from the announcement of an M&A are not significantly different from 0 and thus the announcement has no impact on the wealth of the shareholders of the acquiring firm. However, this conclusion depends on the investment window of the investors. In the pre-announcement period, the abnormal returns of the acquirer's shareholders are not significant. Only for small windows surrounding the announcement day, the abnormal returns are positive and statistically significant, being a result of the positive reaction by the market in the day before and on the announcement day. In the post-announcement period, the investors adjust their estimates and the abnormal returns become negative and statistically significant.

Regarding the influence of R&D intensity of the acquirer and target firm on the magnitude of the abnormal returns, the results demonstrate that level of R&D of acquirer has a positive influence over the value of CAR, which means that the higher the R&D intensity of the acquirer the higher the CAR earned by shareholders of the acquiring firm. With regard to R&D intensity of the target firm, the insignificance of its coefficient across all the estimated regressions suggests that it has no influence on the wealth of the acquirer's shareholders. This may result from the sense of uncertainty of shareholders regarding the capacity to reach future economic benefits using the R&D of the target.

According to the results, with exception of the R&D intensity, the other variables describing characteristics of the acquirer are not considered to have an influence on the abnormal returns generated. In contrast, the variables characterizing the target are considered to contribute to explain their value. Regarding the deal properties, the relative size and the relatedness between the industries of the parties involved influence negatively the returns generated, contrary to cross-border deals that are considered to contribute positively to their value, since it is a way to facilitate the entry in the new markets.

With respect to the relationship between the M&A premium and the R&D intensity of the acquirer and the target firm, the findings evidences that the level of R&D of the acquirer influences significantly the size of the premium paid by the acquirer. The relationship between these variables is positive meaning that the higher the R&D intensity of the acquirer the higher the value of the premium that it pays. In contrast, the relationship observed between the R&D intensity of target and the size of the M&A premium is negative but there is no strong evidence of such influence. In addition, the results suggest that the level of liquidity of the acquirer influences positively the size of the M&A premium, since firms with more liquidity are more prone to overbidding or entry into deals by empire building.

Concluding, from a broader perspective, the results suggest that firms who invest more in R&D, despite paying more for the acquisition of other firms (higher M&A premium), can create more value because the CAR is higher. In contrast, firms investing less in R&D cannot compensate for this less effort by acquiring other firms that have made such investments. Ultimately, the results suggest that the acquisition of other firms is a complementary strategy to investment in R&D, and not a substitute.

It is important to note that the current dissertation has some limitations that should be taken into account when analysing the results. The lack of data, namely financial data about the acquiring firm and the target firm, as well as the information about the deal, resulted in a small sample size and in the non-application of the Market Model to estimate the normal returns. Furthermore, one of the main limitations of our study is the measure of the company's innovation, proxied by the R&D intensity. As referred, the scarce data on financial data, especially on patents and R&D expenditures, led to R&D intensity of the firms were measured by the mean of the ratio between net intangible assets and total assets in the last 5 years before

the deal. This measure brings some limitations that may bias the results obtained because it includes values that are not related to the innovation and R&D activities of the company.

Lastly, for further research, we suggest the study of a more extensive sample and the application of a multi-component measure for innovation, taking into account the R&D input, the R&D output and the patent stock, in order to obtain more robust results. Furthermore, it could be conducted a similar study for other regions and for specific industries.

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Annexes

Annex 1 - Motives behind M&A

This table summarizes the motivations for an M&A, as well as the authors that mention them.

Motives		Motivation	Authors
<i>Shareholders gains</i>			
Efficiency gains	Economies of scale	Improve operating efficiency, leading to a reduction of production cost.	Brealey et al. (2001)
	Economies of scope		Ross et al. (2010)
	Economies of vertical integration		DePamphilis (2010)
Synergy gains	Operational synergy	The decrease of production and capital costs, increase of R&D and discipline of management.	Roller et al. (2006)
	Financial synergy		Martynova et al. (2006)
	Managerial synergy		Ross et al. (2010)
Growth and diversification	Rapid growth	Increase market share and positions the firm in higher growth markets	DePamphilis (2010)
	Greater market power		Roberts et al. (2003)
	Diversification		Motis (2007)
			DePamphilis (2010)
Strategic realignment	Technological change		Gaughan (2015)
	Regulatory change		Gort (1969)
			DePamphilis (2010)
<i>Managers gains</i>			
Managerialism		Increase the size of the firm under control and consequently managerial power and compensation	Jensen (1986)
			Rani et al. (2016)
Hubris		Excessive self-confidence leads managers to incur in M&A even when they make mistakes in <u>valuating</u> target firm	Roller (1986)
			Rani et al. (2016)
Market timing		Buy assets of undervalued targets through M&A paying with their own overvalued shares	Shleifer and Vishny (2003)
			DePamphilis, 2010

Annex 2 - Variables, measures and predicted relation

This table shows the label used to represent each variable and its respective measure, as well as the predicted relationship between each independent variable and the dependent variables CAR and PREMIUM.

Variable	Label of the variable	Measure	Predicted relation	
			CAR	PREMIUM
<i>Dependent variables</i>				
CAR (%)	CAR	Sum(AR _{i,t}), i =acquirer firm i and t = {-10;10}	-	-
Premium (%)	PREMIUM	(Share price paid by acquirer/Target Share price 4 weeks prior to announcement)-1	-	-
<i>Independent variables</i>				
R&D intensity of acquirer (%)	RDINT_ACQ	Mean(Intangible Assets, Net/Total Assets), last 5Y before the deal	Unknown	Negative
R&D intensity of target (%)	RDINT_TARG	Mean(Intangible Assets, Net/Total Assets), last 5Y before the deal	Positive	Positive
Relative size between target and acquirer (%)	RELSIZE	Ln(Total Assets of target)/Ln(Total Assets of acquirer), at the end of the year prior to announcement	Negative	Positive
Relatedness of the industries of the acquirer and target firms	RELINDUSTRIES	Dummy (1=Related industries=The first two digits of SIC code of acquirer and target coincide; 0=Otherwise)	Ambiguous	Negative
Technological related deal	TECHDEAL	Dummy (1=Yes; 0=Otherwise)	Ambiguous	Positive
Geography of the deal	CROSSBORDER	Dummy (1=Cross-border; 0=otherwise)	Negative	Positive
Payment method	CASHONLY	Dummy (1=Payment method is only cash; 0=Otherwise)	Positive	Negative
First stake of the acquirer in the target	FIRSTSTAKE	Dummy (1=Acquirer has a stake in the target before the deal; 0=otherwise)	Negative	Negative
Performance of acquirer firm prior M&A (%)	PERF_ACQ	Mean(EBIT/Net Sales), last 5Y before the deal	Positive	Positive
Liquidity of the acquirer (%)	LIQUID_ACQ	Mean(Total Current Assets/Total Current Liabilities), last 5Y before the deal	Negative	Positive
Prior experience in M&A of acquirer	PRIOREXP_ACQ	Dummy (1=Prior experience; 0=Otherwise)	Ambiguous	Negative
Performance of target firm prior M&A (%)	PERF_TARG	Mean(EBIT/Net Sales), last 5Y before the deal	Ambiguous	Positive
Growth opportunities of target (Ratio)	GROWTHOP_TARG	Market-to-book ratio of the target firm at the end of the year prior to announcement	Ambiguous	Positive

Annex 3 - Correlation matrix

This table shows the correlation matrix between the variables used in our study. CAR is defined as the sum of abnormal returns of the firm over the event window, expressed in percentage. PREMIUM is the ratio of price paid by acquirer per target share minus the target closing share price 4 weeks prior to the announcement day to the target closing share price 4 weeks prior to the announcement day, expressed in percentage. RDINT_ACQ is measured by the mean of the ratio between net intangible assets and total assets of the acquirer in the last 5 years before the deal, expressed in percentage. RDINT_TARG is measured by the mean of the ratio between net intangible assets and total assets of the target in the last 5 years before the deal, expressed in percentage. RELSIZE is the ratio of natural logarithm (ln) of the total assets of target firm at the end of the year prior to announcement over the natural logarithm (ln) of the total assets of acquirer at the end of the year prior to announcement. RELINDUSTRIES is a dummy variable that takes the value one if the industries of acquirer and target firm are related, i.e., if the first two digits of SIC code of acquirer and target coincide, and zero otherwise. TECHDEAL is a dummy variable that takes the value one if the deal was carried out for a technological purpose, and zero otherwise. CROSSBORDER is a dummy variable that takes the value one if the deal is cross-border, and zero otherwise. CASHONLY is a dummy variable that takes the value one if the method of payment is only cash, and zero otherwise. FIRSTSTAKE is a dummy variable that takes the value one if the acquirer had no stake in the target before the deal, and zero otherwise. PERF_ACQ is defined as the mean of the ratio between EBIT and total assets of the acquirer in the last 5 years before the deal, expressed in percentage. LIQUID_ACQ is the mean of the ratio between total current assets and total current liabilities of the acquirer in the last 5 years before the deal, expressed in percentage. PRIOREXP_ACQ is a dummy variable that takes the value one if the acquirer has already participated in an M&A, and zero otherwise. PERF_TARG is defined as the mean of the ratio between EBIT and total assets of the target in the last 5 years before the deal, expressed in percentage. GROWTHOP_TARG is the market-to-book ratio of the target firm at the end of the year prior to the announcement.

	CAR	PREMIUM	RDINT_ACQ	RDINT_TARG	RELSIZE	RELINDUSTRIES	TECHDEAL	CROSSBORDER	CASHPERC	FIRSTSTAKE	PERF_ACQ	LIQUID_ACQ	PRIOREXP_ACQ	PERF_TARG	GROWTHOP_TARG
CAR (%)	1.00														
PREMIUM (%)	0.15	1.00													
RDINT_ACQ (%)	0.18	0.23	1.00												
RDINT_TARG (%)	-0.06	-0.04	0.44	1.00											
RELSIZE (%)	-0.25	-0.31	-0.13	0.13	1.00										
RELINDUSTRIES	-0.11	-0.01	0.12	-0.06	0.05	1.00									
TECHDEAL	-0.11	0.16	0.09	-0.02	-0.15	0.34	1.00								
CROSSBORDER	0.19	-0.08	-0.09	-0.04	0.14	0.16	0.04	1.00							
CASHONLY	0.09	0.11	-0.11	-0.17	-0.41	-0.04	0.13	-0.03	1.00						
FIRSTSTAKE	-0.03	-0.03	0.06	0.00	0.08	0.00	-0.05	-0.03	0.06	1.00					
PERF_ACQ (%)	0.27	0.04	0.08	0.01	-0.28	-0.13	-0.12	0.11	0.37	-0.01	1.00				
LIQUID_ACQ (%)	-0.21	0.31	-0.12	-0.14	0.20	0.15	0.23	-0.07	-0.14	0.13	-0.37	1.00			
PRIOREXP_ACQ	-0.14	-0.20	-0.20	-0.06	0.20	-0.11	-0.09	0.14	-0.19	0.00	0.02	-0.04	1.00		
PERF_TARG (%)	0.40	-0.09	0.11	-0.05	-0.06	0.07	-0.23	0.21	0.13	0.12	0.30	-0.36	0.00	1.00	
GROWTHOP_TARG	0.34	-0.05	0.03	0.08	0.00	0.11	0.15	0.20	-0.08	0.04	0.24	-0.01	0.04	0.07	1.00

Annex 4 - Descriptive statistics of variables after apply winsorization method

This table shows the descriptive statistics of the variables studied after applying the winsorization method. CAR is defined as the sum of abnormal returns of the firm over the event window, expressed in percentage. PREMIUM is the ratio of price paid by acquirer per target share minus the target closing share price 4 weeks prior to the announcement day to the target closing share price 4 weeks prior to the announcement day, expressed in percentage. RDINT_ACQ is measured by the mean of the ratio between net intangible assets and total assets of the acquirer in the last 5 years before the deal, expressed in percentage. RDINT_TARG is measured by the mean of the ratio between net intangible assets and total assets of the target in the last 5 years before the deal, expressed in percentage. RELSIZE is the ratio of natural logarithm (ln) of the total assets of target firm at the end of the year prior to announcement over the natural logarithm (ln) of the total assets of acquirer at the end of the year prior to announcement. RELINDUSTRIES is a dummy variable that takes the value one if the industries of acquirer and target firm are related, i.e., if the first two digits of SIC code of acquirer and target coincide, and zero otherwise. TECHDEAL is a dummy variable that takes the value one if the deal was carried out for a technological purpose, and zero otherwise. CROSSBORDER is a dummy variable that takes the value one if the deal is cross-border, and zero otherwise. CASHONLY is a dummy variable that takes the value one if the method of payment is only cash, and zero otherwise. FIRSTSTAKE is a dummy variable that takes the value one if the acquirer had no stake in the target before the deal, and zero otherwise. PERF_ACQ is defined as the mean of the ratio between EBIT and total assets of the acquirer in the last 5 years before the deal, expressed in percentage. LIQUID_ACQ is the mean of the ratio between total current assets and total current liabilities of the acquirer in the last 5 years before the deal, expressed in percentage. PRIOREXP_ACQ is a dummy variable that takes the value one if the acquirer has already participated in an M&A, and zero otherwise. PERF_TARG is defined as the mean of the ratio between EBIT and total assets of the target in the last 5 years before the deal, expressed in percentage. GROWTHOP_TARG is the market-to-book ratio of the target firm at the end of the year prior to the announcement. W indicates that the winsorization method was applied to the variable.

	Mean	Median	Maximum	Minimum	Std. Dev.	N
CAR_W [-10; 10] (%)	-1,28	-0,69	14,87	-20,46	8,77	69
CAR_W [-10; 2] (%)	-0,28	0,31	12,06	-14,69	7,29	69
CAR_W [-5; 5] (%)	0,13	-0,74	14,10	-12,47	7,06	69
CAR_W [-2; 0] (%)	1,21	0,77	12,17	-7,46	5,22	69
CAR_W [-1; 1] (%)	1,36	1,16	11,16	-6,92	4,99	69
CAR_W [0; 10] (%)	-0,90	-1,09	10,81	-11,98	6,15	69
CAR_W [2; 10] (%)	-1,65	-1,66	7,15	-11,76	4,91	69
PREMIUM_W (%)	11,54	6,67	42,75	0,26	12,02	69
RDINT_ACQ_W (%)	13,28	10,91	51,64	0,33	12,96	69
RDINT_TARG_W (%)	75,10	76,25	113,49	37,67	19,33	69
RELSIZE_W (%)	0,57				0,50	69
RELINDUSTRIES	0,49				0,50	69
TECHDEAL	0,25				0,43	69
CROSSBORDER	0,38				0,49	69
CASHONLY	0,90				0,30	69
FIRSTSTAKE	5,30	7,19	25,51	-24,71	11,44	69
PERF_ACQ_W (%)	158,82	129,95	382,87	66,53	90,99	69
LIQUID_ACQ_W (%)	0,86				0,35	69
PRIOREXP_ACQ	2,32	5,11	19,09	-33,49	13,20	69
PERF_TARG_W (%)	2,46	1,83	6,87	0,50	1,71	69
GROWTHOP_TARG_W	-1,28	-0,69	14,87	-20,46	8,77	69

Annex 5 - Abnormal Returns and Test Statistics on and around M&A Announcements

This table contains the average abnormal returns (AAR) and CAAR from the day -10 to day 10, the median of ARs, the percentage of positive ARs in each day, and the results of the test statistics conducted to evaluate the statistical significance of the returns. ***, **, * indicates significance at 1%, 5% and 10% level, respectively.

Day	Abnormal Return			% Positive CAAR	Parametric Test	Non-parametric Test	N
	Average (%)	Cumulative average (%)	Median (%)		t-value	z	
-10	-0.66	-0.66	-0.02	47.83	-1.60	-0.92	69
-9	0.05	-0.61	-0.02	49.28	0.15	-0.59	69
-8	0.04	-0.57	-0.07	44.93	0.12	-0.34	69
-7	0.01	-0.56	0.06	50.72	0.05	0.25	69
-6	-0.02	-0.58	0.08	52.17	-0.08	-0.14	69
-5	0.04	-0.54	0.00	50.72	0.12	0.78	69
-4	0.21	-0.32	0.01	50.72	0.96	0.76	69
-3	-0.21	-0.53	-0.11	43.48	-0.67	-0.37	69
-2	-0.43	-0.96	-0.49	37.68	-1.73 *	-2.44 **	69
-1	0.68	-0.28	0.50	62.32	2.34 **	1.86 *	69
0	1.19	0.91	0.59	55.07	1.77 *	1.68 *	69
1	-0.38	0.54	0.02	52.17	-1.15	-0.66	69
2	-0.58	-0.04	-0.32	44.93	-1.47	-1.32	69
3	-0.25	-0.30	-0.26	42.03	-1.08	-1.28	69
4	0.12	-0.18	0.18	53.62	0.50	0.40	69
5	-0.27	-0.45	-0.29	44.93	-1.04	-1.12	69
6	0.15	-0.31	0.29	57.97	0.57	0.77	69
7	-0.45	-0.75	-0.10	42.03	-1.64	-1.42	69
8	0.07	-0.69	0.09	53.62	0.30	0.21	69
9	-0.35	-1.04	-0.17	44.93	-1.59	-1.23	69
10	-0.31	-1.35	-0.12	46.38	-1.36	-1.56	69