Innovative and competition effects of M&A in Large European firms

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Abstract:

In this paper we explore the effects of M&A in innovation and competition levels in European firms. Using the information of a unique micro-longitudinal database of top European R&D investors and EC Merger Control Organism, the analysis is based on dynamic panel estimations using random and fixed-effects models at the firm-level. Our results show that mergers and acquisitions influence positively the R&D intensity of top companies in the European Union over the period 2004-2012. The inclusion of 562 M&A authorized in the phase-1 investigation by the Competition Authority allows us to state a positive relationship between innovation and M&A processes. On the other hand, empirical evidence shows that mergers increase the profitability of these companies in the following years. Using profit as a valid proxy of competition level, we confirm that authorized M&As enhance technological capabilities of European large companies but they also harm the level of competition. Thus, we assess that EC Merger Control must guarantee that M&A improve technological effort and control the cases that can be detrimental to the enhancement of competition in European integrated markets.

Keywords: M&A; innovation; profit; market competition; competition policy.

JEL Classification: D21; O31; O32; L22

1. Introduction

Increased competition within the European single market and globalisation incentivizes companies to join resources through M&A. However, such reorganizations are only welcome if they do not hinder competition and, hence, are capable of increasing the competitiveness of European economy. Since the first Merger Regulation in 1989, EU merger control makes an important contribution to the functioning of the European internal market, both by providing a harmonised set of rules for concentrations and by guaranteeing that competition and thus consumers are not harmed by economic concentration in the marketplace. The objective of examining proposed mergers is to prevent harmful effects on competition and maximizing the consumer welfare must be the final goal to be accomplished.

After the 2004 Reform of the Merger Regulation in the European Union, merger control policy has become one of the main pillars of EU competition law and its application has tried to improve competence in the European Economic and Monetary Union. In this regard, the European Commission has recognized "*that merger review can foster innovation, as competition leads to better market outcomes. It does so not only by lowering prices or increasing output, but also by improving product quality, variety, and innovation*"(European Commission, 2014, p.6). However, the real effects of mergers on innovation and competitive performance remain understudied.

While companies combining resources (referred to below as mergers) can expand markets and bring benefits to the economy, some combinations may reduce competition. Combining the capabilities of different firms may allow to use R&D more efficiently, to reduce production or distribution costs through process or marketing innovation, or introduce new products in the markets. Through their increased efficiency, the market becomes more competitive and consumers benefit from goods with higher quality and novelty at fairer prices. However, some mergers may reduce innovation and, subsequently, the level of competition in a market or industry, usually by creating or strengthening a dominant player.

There exists a growing empirical literature that studies the relationship between M&A and innovation (or technological change). However, the empirical evidence about the effect of M&A on innovation is not yet conclusive. In fact, some studies find a positive effect on R&D and innovative activities by the merging firms (Clood et al., 2006; Cassiman et al., 2005; Ahuja and Katila, 2001). Additionally, other authors have found a negative impact of mergers on innovation in the post-merger stage (Blonigen and Taylor, 2000; Harrison et al., 1991).

Substantial research effort has also been made to examine the impact of M&A on sourcing strategies at the firm-level (Cefis, 2010; Cefis and Triguero, 2015). Technological

similarity, resource complementarity and value creation have been also studied. Nevertheless, there are few studies that focus jointly on the effects of M&A on innovation versus competition. As far as we know, Veugelers (2012) and Frey and Hussinger (2011) are the unique studies that analyse the effects of M&A of European firms operating in several sectors on technology and market integration. Among the most recent researches we find Colombo and Rabbiosi (2014) and Grimpe and Husssinger (2014).

This paper contributes to this discussion. We investigate the effect of M&A on innovation and competition taking into accounts the importance of unobserved firm heterogeneity in a dynamic context. Our paper distinguishes from other contributions by three important points. First, in contrast to other studies on this topic, we investigate the effects at the firm-level with a panel data set of observations related to the top-R&D 1000 European companies covering years from 2004 to 2012 instead of using case studies. Second, we analyze the potential effect of M&A on R&D intensity (as a proxy of innovation) and on competition level (using profit rate as proxy). We expect that M&A contribute to enhance both of them: innovation and competition of the large firms operating in the European market. Finally, we use the information published by the EC Control Organism to take into account 562 authorized M&A occurred in Europe over the period 2004-2012 after passing the phase-1 investigation. Indeed, we assess if the Commission's decision faces appropriately M&A permissions and remedies in addressing potential reduction in R&D effort and restraints in competition caused by integration processes.

The paper is organized as follows: Section 2 include the literature review to draw hypotheses on specific effects of M&A on innovation and competition level. In Section 3 the data and methodology are presented. Section 4 presents and discusses the main results of the econometric model. Finally, Section 5 concludes.

2. Theoretical framework. Potential Effects of M&A Innovation versus Competition

2.1 Effects of M&A on the level of innovation

Mergers and acquisitions could involve major changes in technological capabilities of merging firms. However, the existing empirical literature shows inconclusive results. On one hand, some studies find a negative relationship between the R&D expenditure level and the number of acquisitions and mergers in which has been involved the acquiring company (Blonigen and Taylor, 2000; Harrison et al., 1991). On the other hand, it has been shown that

merger have a positive effect on innovation performance or technological competencies *(*Clood et al., 2006; Cassiman et al., 2005; Ahuja and Katila, 2001; Frey and Hussinger, 2011*).*

The first group of studies confirms a negative correlation between the intensity of R&D and M&A involvement degree by the firm. They proved that firms access to product and process innovations (or required R&D for it) through the acquisition of companies own these specific assets. Therefore, firms decide to acquire another company with the technology they need instead of increasing their internal R&D *(*Blonigen and Taylor, 2000). Thus, the M&A produces a substitution effect of internal R&D by technological capabilities of acquired firm. This argument is related to a distinctive characteristic of R&D and innovative process: uncertainty. Moreover, the post-merger firm has little incentive for major investment in formal R&D due to the combination of target uncertainty and technical uncertainty after the acquisition (Abernathy and Utterback, 1978). Thus, M&A is an alternative for those companies who need to invest in R&D but have a high risk aversion to spend in R&D. M&A enable them to access to the necessary technology through the acquisition without jeopardize the company benefits (Hitt et al., 1996; Lee and Lieberman, 2010). In this sense, empirical evidence has shown that decision-makers who prefer acquisitions are those with greater risk aversion (Hitt et al 1990; Harrison et al. 1991).

However, a merger may also have a positive effect on innovation performance associated to the immediate technology access after the acquisition (Ahuja and Katila, 2001). The acquisition of a firm can contribute to broad the knowledge base of the company in the post-merger stage (Cloodt, et al., 2006). After M&A firms will attempt to increase their efficiency through the reorganization of their innovation processes diminishing their R&D expenditure (Blonigen and Taylor, 200). However, the redeployment of staff and equipment or the configuration of new joint teams can also enhance the development of new knowledge and technologies (Cassiman et al., 2005). In this regard, M&A boost the R&D and the innovation level of acquiring firm.

Following Cassiman (2005), the positive effects of M&A on the innovation process are due to the emergence of scale economies, scope economies and efficiency. First, the emergence of economies of scale can extend all the fixed costs of R&D between innovative products. Second, a greater diversification due to economies of scope allows a high leverage of the investment in R&D to get innovative product-market differentiation. Third, the removal of common inputs in R&D can involve greater efficiency. Finally, synergies produced by the union of different skills can increase technological power in the merged company. The consequence of the M&A -in terms of innovation- will depend on the similarities or differences of technological knowledge base of individual companies. According to Cassiman (2005), if the merging firms

are using complementary technologies, there could produce a positive effect on inputs (R&D) and outputs (number of product or process innovations). On the other hand, companies with similar technologies are more likely to decrease R&D due to the relocation of technological resources (rationalization of R&D operations). If companies which bind are using the same technology, M&A would have negative consequences on innovative performance unless they achieve a superior technological position after the acquisition. In similar way, if companies are supplying the same market demand, M&A would have negative consequences on firm performance unless they achieve to operate in different markets or open new destinations after the acquisition. In this regard, Frey and Hussinger (2011) show that M&A, especially across borders, have been an important tool for advance in the European market integration project. Using a final sample of 420 M&A deals over the period 1994-2000 in which all partners are European firms, they show that European firms enhanced their technological capabilities through firm acquisitions. In the same direction, Veugelers (2012) confirm that M&A contribute to higher efficiency related to innovation using a sample of 42 Phase II merger decisions in the European Union over the period 2004-2011despite the technological argument based in technological reasons is not usually claimed by the firm (only 4 of 42 cases use the technological argument in their merger defense).

On one hand, companies with a high absorptive capacity exploit new ideas and technologies instead of exploring old ideas and technologies (Gantumur and Stephan, 2007). Therefore, Hitt et al. (2010) and Veugelers (2012) point out that when merging companies have similar technologies, their knowledge is successfully integrated contributing to enhance innovation performance. Thus, technological complementarity as a result of M&A makes companies more efficient in terms of R&D (Ahuja and Katila, 2001; Cassiman et al., 2005; Hitt et al., 2010). After the merger, the companies try to reallocate resources to be present in a greater number of technological fields and increase their diversification based on the new skills acquired through the M&A. In the same line, Hitt et al. (2010) report that companies achieves greater quality and novelty of innovations after the merger due to technological complementarity. Technological similarity contributes to the emergence of economies of scale, whereas technological complementarity enables economies of scope (Cassiman et al., 2005; Cassiman, 2005).

On the other hand, a negative relationship between the knowledge base of the acquired company and innovation performance after the merger can occur. If the acquired company has an extensive knowledge base, an increasing demand of resources to absorb and integrate the acquired company would require more effort, and this cannot be accepted by the managers or stakeholders (Cloodt et al. 2006; Hitt et al. 1996; Veugelers, 2012). Veugelers (2012) also notes that the merger may eliminate R&D overlaps facilitating resource efficiency but R&D

expenditure can decrease. The problem arises if the existence of similar knowledge restrains the implementation of new technologies. Using a sample of 31 horizontal acquisitions of European firms in high and medium tech industries, Colombo and Rabbiosi (2014) confirm the negative effect of similarity of the R&D operations on post-acquisition innovation performance. However, they also find a positive links between technological similarity and rationalization of the acquired R&D operations and replacement of the acquired firm´s R&D top manager. Using a sample of 1,428 acquisitions, Grimpe and Husssinger (2014) show that patents associated with acquired firm explains the acquisition price, mainly with the existence of relatedness to the acquirer's knowledge base in high-tech companies. The relationship among competition, innovation and merger policy have also attracted an increasing attention in the last years. In this regard, Hüschelrath (2009) considers the effects of a horizontal merger on other competition variables such as product variety, marketing as well as R&D post-merger. Regarding to the concentration level of markets, Ornaghi (2009) shows that an increase in competition in very concentrated markets tends to increase innovation in merger cases in the hard disk drive industry. However, Kühn et al. (2012) confirm that a reduction in competition in concentrated markets reduces innovation incentives comparing two mergers happened in the hard disk drive (between Seagate and Samsung and between Western Digital and Hitachi). Recently,

Finally, M&A have consequences not only on the outputs of the innovation processes. M&A also affect the R&D corporate strategy of the firm. Similarly, the consequences of mergers and acquisitions on how to manage R&D differ depending on the level of technological complementarity. In this sense, Cassiman and Veugelers (1999) concludes that SMEs tend to focus on internal knowledge acquisition while larger companies are more likely to combine their innovation strategy in both the acquisition of internal knowledge as external knowledge (from third parties or a M&A). In this regard, M&A can have a different consequence in the mixed combination of internal and external knowledge. Using a sample of Dutch 2,913 manufacturing firms from 1994 to 2002, Cefis (2010) concluded that mergers and acquisitions appear to promote innovation through internal R&D. In this regard, Cefis and Triguero (2015) show M&A have a negative impact on both internal and external R&D using a large sample of Spanish manufacturing firms. Thus, the empirical results are inconclusive and depend on the analyzed sample and considered period.

2.2. Effects of mergers and acquisitions on the level of competition in the markets

M&A not only have effects on innovation. In fact, one of the main concerns generated by these processes is to see how it affects the level of competition in the markets. These processes not only affect firms, but consumers may be severely affected if a lessening of competition occurs; because M&A can raise prices and reduce the purchasing power of these,

due to the restriction of competition and increased market power or abuse of dominant position by the company resulting from the merger.

If M&A happen between companies that are competing in the same sector, a competitor is eliminated. Thus, the new company will have greater market share, and, therefore, the possibility of abuse dominance may be increased (Lee and Lieberman, 2010; Gugler et al, 2003). Keil et al. (2013) also refer to the impact of M&As on competition. To do this, they distinguish between mergers that take place within the same market and mergers that join to companies operating in different markets. They find that increased competition is observed in mergers among non-related sector companies due to the negative effect on the target firm profitability.

Since the concept of competition is one of the most discussed in the field of economics and industrial organization, different measures has been considered as an indicator of the degree of competition. Traditionally, the level of concentration has been considered a valid indicator of the degree of competition in a market (Mason, 1957). In this regard, one of the areas of action of the Defense Policy of the European Competition is the control of concentrations affecting the European market (European Commission, 2006). Therefore, European antitrust policy authorities usually meticulously supervise each M&A produced (Cassiman et al., 2005). In the case of European Union, merging firms have to communicate their merger or acquisition purpose to the competent authorities.

Regarding M&A processes, the European Commission (2013) only focuses on larger mergers with an EU dimension. If the merging firms represent more than two thirds of its EU-wide turnover within one and the same Member State, these mergers would be remit of Member States' competition authorities. Thus, the Commission must be notified of any merger with a "European" dimension prior to carry out. If the merging firms reach a market share threshold of 15% on any market where they operate, or 25% on vertically related markets, the Commission considers that the merger could give rise to significant competition problems and carries out a full investigation. There are two possible stages in this investigation, a phase I, in which the merger is cleared, either unconditionally or subject to accepted remedies and a phase II which is opened if the merger still raises competition concerns. Using data on 42 mergers in phase-II investigation provided by the European Commission, Veugelers (2012) find that only 26% of concentration processes lead to a situation of greater economic efficiency (this means that only a quarter of M&A seeking approval to the European Commission are authorized in this stage).

Despite the early theoretical and empirical work on merger decisions by the Competition Authority (Weir, 1992, 1993), the decisions of the European Commission have

recently attracted an increasing attention (Bergman et al., 2005, 2009; Davies et al., 2011). Using a sample of 96 mergers notified to the European Commission, Bergman et al. (2005) try to explain the variables influencing on the Commission decisions to initiate phase-II investigations or to prohibit/conditionally allow mergers. They show that high post-merger market shares, entry barriers and risk of collusion after the merger increase the probability of a phase-2 analysis, as well as the prohibition of these mergers. Similarly to Bergman et al. (2005), Davies et al. (2011) analyze 62 mergers during the period 1990-2004 in which collective dominance was considered as a potential problem in at least one market by the European Commission. In this study, the market share and concentration ratios and changes taken into account the two largest players in the post-merger, positively influence the Competition Authority decision-making on both single and collective dominance. However, our analysis differs from the latter empirical analyses explaining the consistency of the competition authorities' decisions with economic theory: the question that we want to address in this investigation is related to the effects of mergers on a specific efficiency measure, i.e., the profitability.

Williamson (1968) points out the role of considering the benefits of mergers. "*Thus it is not sufficient to justify a merger on the basis of merely potential economies. Not only is it relevant to consider whether the merger would produce net benefits, but whether the timing is such as to maximize these gains*". (Williamson, p. 25), In this regard, Conyon et al. (2002) confirm the positive influence of M&A on profitability analyzing 223 mergers and acquisitions made by 154 UK manufacturing firms over the period 1979–1991. Gugler et al. (2003) also confirm that mergers increase profits while decrease the sales of merging firms across countries. Profit level in the merging firms can also be increased due to valuation of mergers by shareholders (Andrade et al., 2001). However, some authors show that it is usual a profit decreasing after a merger process (Meeks, 1977; Ravenscraft, 1983). Even Gugler et al. (2003) recognized that there are mergers decreasing profits if merging firms are not able to increase their market power (or their efficiency). From a theoretical perspective, a merger may increase or decrease profitability. On the one hand, horizontal mergers can increase market power if firms are able to set a price above marginal cost. On the other hand, mergers can decrease the merging firms' market shares if the rival firms expand their production as a result of the merger. Since a merger may lead to rationalization or scale efficiencies, but it also reduces competition in the product market, the effect of a merger on the merging companies is an empirical issue (Röller et al., 2006).

3. Data and Methodology

3.1 Data

This study is based on data from two different sources: the "EU Industrial R&D Investment Scoreboard" made by European Commission and information about mergers notified to the EC Merger Control Organism. The EU Industrial R&D Investment Scoreboard contains economic and financial data for the top 1000 R&D investors based in the EU. As the information in the first dataset unable to identify the companies that suffer a M&A, we merge these dataset with information offered by EC Merger Control Organism about M&A. To do this, we had to carry out an individual search by industry, year and type of merger. After, we have added this information by each firm to our panel dataset constructed with the EU Industrial R&D Investment Scoreboard from 2004 to 2012.

The Scoreboard data is based on company data extracted directly from each company's Annual Report. It provides information on the 1,000 of firms and their innovation-related behaviour and main economic and financial indicators each fiscal year[1]. This information (turnovers, activities, locations, etc.) is supplemented at firm-level data. The EU Industrial R&D Investment Scoreboard also provides general information on firm structure and innovation performance. For each year, a ranking of the top 1,000 companies is published. The dataset contains information at firm-level about sector, country host, R&D Investment, net sales, employees, ratio between R&D and net sales, operating profit, ratio between R&D and employees, market capitalisation, and capital expenditure.

Regarding to the information gather in the EC Merger Control Organism, we have selected M&A approved in the phase I in accordance with the article 6 in M&A regulation 139/2004. More than 90% of all cases are solved in Phase I, generally without remedies. Furthermore, these M&As has been authorized with or without remedies and must not have competition concerns as phase II cases[2]. As details of all investigated M&A are published on the Commission's competition website, we look for the M&A in which have been involved the top 1000 R&D investors based in the EU included in the Scoreboards of nine years. To do this, we gather information about 1,898 firms during the period 2004-2012.

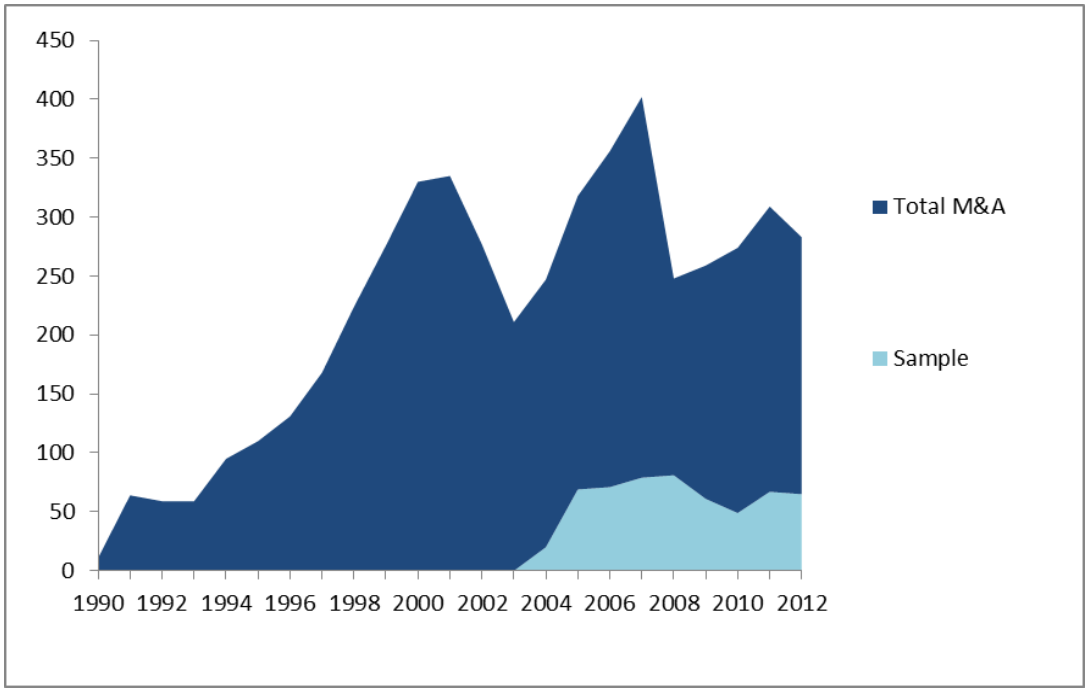
The enormous increase in notifications which have come to the EC is observed in the Figure 1. The highest point is achieved in 2007 with a total of 407 notifications. The crisis is shown to decrease the number of M&A in 2008. The sample of M&A in this paper represents

[1] The EU Industrial R&D Investment is published annually in order to provide a reliable, up-to-date benchmarking tool for comparisons between companies, sectors, and geographical areas, as well as to monitor and analyze emerging investment trends and patterns.

[2] Reports available at http://www.ec.europa.eu/competition/mergers/cases/ consulted in April 2014.

21% over the total of M&A European notifications. Thus, we consider that our sample has a high representativeness of the total authorized M&A in the EU.

Figure 1. Notifications of M&A received by European Commission (2004-2012)



Source: Own elaboration based on EC Control Merger Organism

The dataset is structured as an unbalanced firm-year panel, with observations for each firm. Since the data are collected through 2004, we observe each firm for a maximum of eight years, except in cases where the firm is prior to 2012. Our data set thus includes observations at the firm-year level for each year in which the firm is in operation, including those years following an M&A). We do not, however, include observations for those years after which a firm ceases to exist as a consequence of a dissolution event.

Our dataset consists of nearly 1900 firms, of which 279 of them merged between 2004 and 2012. Nevertheless, the total number of M&A was 562 due to the participation of some firms in more than one merger process. Specifically, 156 firms are involved in one M&A, 55 in two operations, 26 in three transactions, 18 in four, 10 in five operations, 5 firms are involved in six operations of M&A, and finally, 6 and 3 firms take part in seven and eight mergers, respectively. In the table 1, we can observe the movements of firms which take place in our dataset as well as the percentages of our sample about total. The largest number of M&A occurred in the year 2008 (81 M&A) while in 2004 the number of M&A was 20.

Table 1: Number of M&A identified in RIS dataset

Year	# of M&A	% / total authorized M&A in EU
2004	20	n.a.
2005	69	n.a.
2006	71	14.12%
2007	79	17.01%
2008	81	15.27%
2009	61	12.78%
2010	49	11.24%
2011	67	17.48%
2012	65	12.10%
Total sample	562	29.61%

Source: Own Elaboration

3.2. Descriptive statistics[3] and Univariate Analysis.

The first analysis performed is a test of mean differences where we distinguished between merged and not-merged firms. It is found that all variables, with the exception of capital expenditure, are significant at the level of 5%. Thus, for these variables we reject the zero hypothesis. It is showed that there are statistically significant differences in the R&D expenditure, net sales, average number of employees, profit ratio and market capitalization between merging firms and not-merging firms (Table).

[3] Table 1 displays descriptive statistics for the whole sample (Appendix 1).

Table 2 : Mean Difference Tests

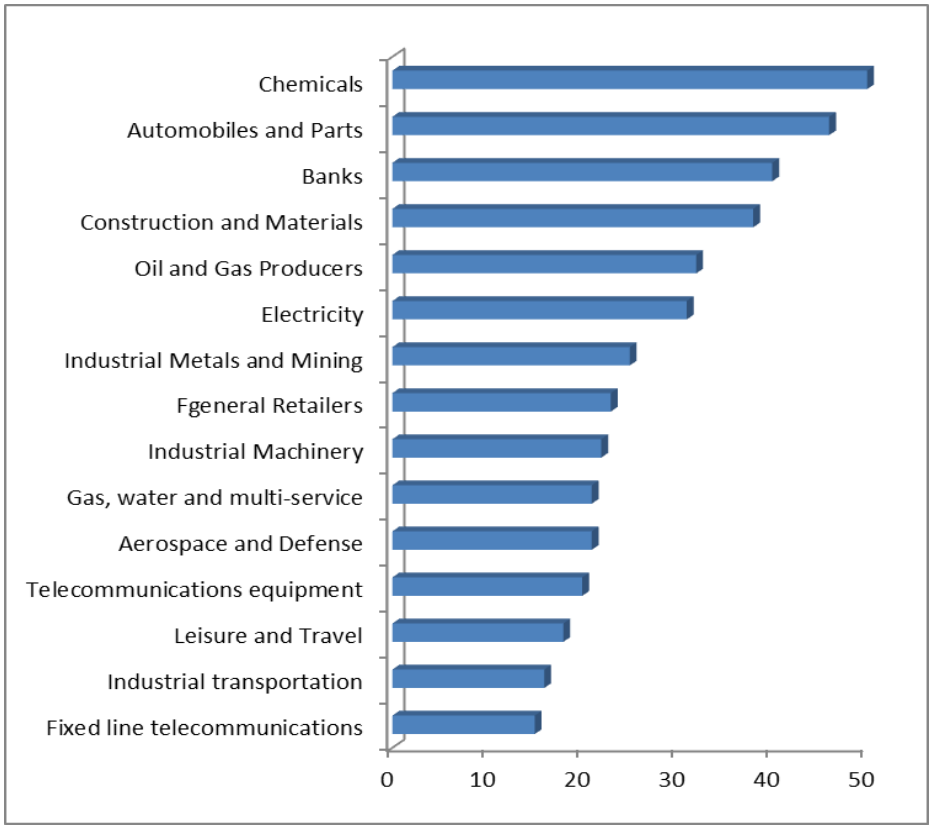
	M&A firms	**Non- M&A firms**	**t test**	**p-value**
Employment (# of employees)	438.48	49.06	-17.49	<2.2 e-16
Profit (% over sales)	17,627.64	2,291.40	-23.79	<2.2 e-16
MARKET (thousands of €)	18,709.43	26,077.60	-5.29	1.31E-07
CAPEX (% over sales)	-4.13	-1,661.21	-2.96	0.003058
Employment (# of employees)	7,788.77	5,248.17	-4.06	5.06E-05
Profit (% over sales)	195.12	128.24	-0.83	0.4049

Source: Own Elaboration

Distinguishing by sector activity, Chemical Industry, Parts and Automobiles and Banks are the branches with the highest number of M&As during the period. On the other hand, Leisure and Travel, Industrial Transport and Telecommunication of Fixed Line are the sectors with the lowest number of M&A in our dataset (Figure 2).

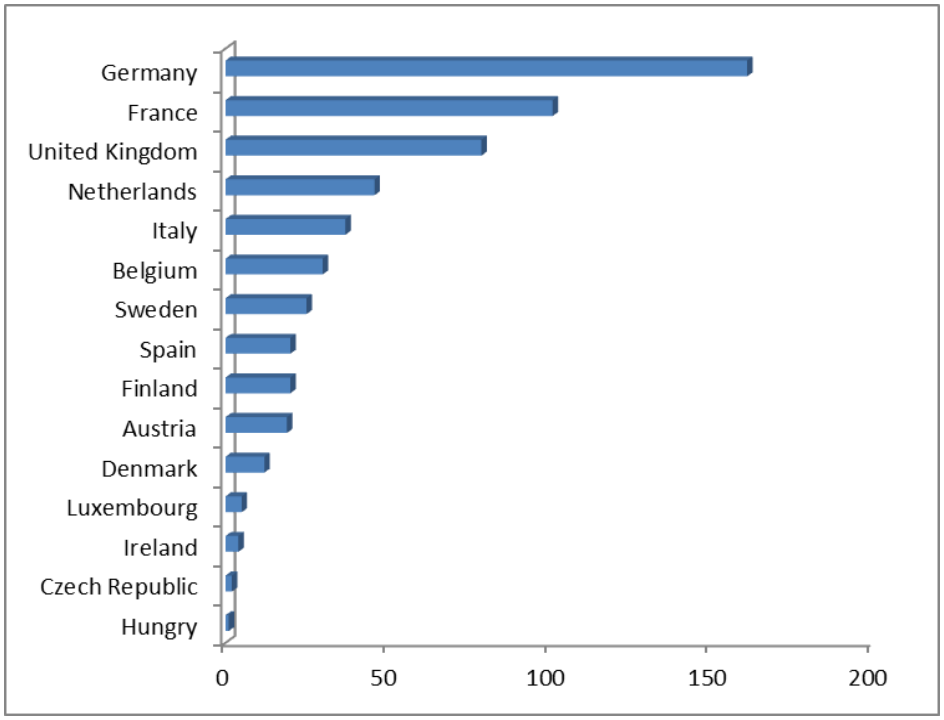
The ranking of countries with higher number of M&A is also shown (Figure 3). Companies from Germany, France and United Kingdom are in the top three positions in the EU. On the other hand, the number of M&A occurred in companies from Hungry, Czech Republic and Ireland in is very low. In this sense, only fifteen European countries of 27 in the EU have been involved in M&A processes which have required an authorization of European Commission.

Fig. 2: Ranking of sectors with higher number of M&A



Source: Own elaboration from the extracted information on M&A of the EC and the statistical dataset EU Industrial R & D Investment Scoreboard

Figure 3: Ranking of countries with higher number of M&A



Source: Own elaboration from the extracted information on M&A of the EC and the statistical dataset EU Industrial R & D Investment Scoreboard

3.2 Econometric methodology and purposed model.

The model of fixed individual-effects with panel data have the following form:

$$y_{it} = \alpha + X_{it}\beta + \varepsilon_{it} \quad (1)$$

Where i is the company, t the time, α a number, β a vector and x_{it} is the observation i^{th} of k independent variables. In this model, the random disturbance has the following form:

$$\varepsilon_{it} = \mu_i + v_{it} \quad (2)$$

Where μ_i is the unobserved specific and individual effect and v_i the remaining perturbation. The problem is due to lack of independence of residues because it is not possible that you can consider all variables which influence in $cov(x_{it}, \varepsilon_{it}) \neq 0$. To prevent this problem, alternative models are proposed like fixed effects model or random effects model (Montero, 2011).

Therefore, knowing why we use fixed-time effects models can be interesting. Arellano (2003) show that if T is fixed and N tends to infinity, which is typical in panel data models with reduced size, only the estimator β of fixed effects is consistent, while that the estimator of individual effects ($\alpha+\mu_i$) will not be consistent because the number of parameters is increased when also N is increased. In this paper, fixed and random effects models are estimated with identical explanatory variables[4]. Several diagnosis tests are carried out to get the best fitness of the chosen models and the value of including country, time, and sectoral dummies.

We empirically examine the influence of M&A on innovative and profit performance using the following model:

$$Log(Y_{it}) = \alpha + \beta_1 \cdot MA_{it} + \beta_2 \cdot SIZE_{it} + \beta_3 \cdot MARKETSHARE_{it} + \beta_4 \cdot SALESGROWTH_{it} + \beta_5 \cdot SECTORS_{it} + \beta_6 \cdot COUNTRIES_{it} + u_{it} \quad (3)$$

where Yit denotes the firm performance measuring R&D intensity or profitability. R&D Investment (RD) and operating profit (PROFIT) has been selected as dependent variables. RD is the internal R&D expenditure. Regarding the variable PROFIT, it is measured by profits

[4] Before these estimations, we carry out lineal regressions and we found with F, Wooldridge and Lagrange tests that fixed- effects models were better than lineal regression models.

before taxes plus net costs of interest subtracting the gains from sales/transfer of business or fixed assets. Both dependent variables are measured by the number of employees.

Since this paper focuses on the influence of M&A, we have incorporated such effects by including MA=1 if firm *i* is involved in an acquisition at time *t* and 0 otherwise. As other independent variables, we include other factors that could affect innovative and profit firm performance. Thus, we control for size effect of a firm through the logarithm of number of employees (SIZE). This variable has been previously used as important determinants affecting the innovative performance of firms and profitability in previous literature. In addition to the size, we include the MARKET SHARE proxy by the logarithm of net sales of the company. Net sales include the usual definition of sales where taxes and sales of mixed and associated firms are not included. In addition, SALES GROWTH has also been included to consider the influence of dynamic behaviour of the firm in the market and its competitiveness level. In order to control for technological opportunities, we include sector dummies to explain variation in firm´s performance across sectors. Moreover, we use Licht and Peters' division (2013) and NACE rev. 2 sectorial classification to distinguish five sectors: High-Tech, Medium-Tech, Low-Tech, Knowledge Intensive Services (KIS) and Knowledge Low Intensive Services (low KIS).

We have also introduce dummies that group countries according to their incorporation into the European Union: EU6 (Germany, Belgium, France, Italy, Luxembourg and Netherlands), EU12-6 (United Kingdom, Ireland, Denmark, Greece, Spain and Portugal), Countries of Central and Eastern Europe (CCEE: Czech Republic, Cyprus, Slovakia, Slovenia, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania and Bulgaria) and rest of countries (Rest: Austria, Finland and Sweden)[5].

4. Results and Discussion

The econometric analysis reveals that M&A have influence on R&D intensity (Table 2). The results of the R&D intensity equation are provided in Table 4. In particular, M&A transactions appear to positively affect R&D intensity two or three years after the event. Additionally, size measured in terms of the number of employees influences negatively on the level of R&D expenditure. As we expected, the companies with high market share also show a high R&D intensity at the firm level. The coefficient is positive with a 99% level of significances.

[5] The process of expanding the European Union (through the accession of new member states began with the Inner Six, who founded the European Economic Community in 1958, when the Treaty of Rome came into force. Since then, the EU's membership has grown to 21 members, with the latest member state being Croatia, which joined in July 2013.

Table 2: Effects of M&A on R&D intensity (Fixed- effects Models)

	Model I	Model II	Model III	Model IV	Model V
MA_1	0.015				
	(0.021)				
MA_2		0.060***			
		(0.021)			
MA_3			0.042*		
			(0.022)		
MA_4				-0.020	
				(0.023)	
MA_5					0.039
					(0.026)
SIZE	-0.995***	-1.000***	-0.995***	-0.988***	-0.988***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.006)
MARKET SHARE	0.218***	0.176***	0.145***	0.137***	0.115***
	(0.012)	(0.014)	(0.015)	(0.016)	(0.020)
Constant	2.055***	2.463***	2.540***	2.650***	3.075***
	(0.347)	(0.387)	(0.161)	(0.141)	(0.197)
Observations	6,719	5,119	3,874	2,879	2,078
R-squared	0.940	0.947	0.947	0.954	0.952
Number of firms	1,559	1,240	1,001	817	671

*, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

As a robustness test, we estimate two alternative specifications with M&A lagged two periods (Table 3). In this regard, we consider the M&A lagged with high influence on the R&D intensity in all the specifications (MA=1 if M&A occurred two periods ago). Moreover, the second and the third columns of Table 3 include the lagged dependent variable and sales growth as new explanatory variables. We obtain that the probability of an increase of R&D intensity in the 1000 European top companies is higher if the firm suffered a M&A two years ago. As we can expected, lagged dependent variable influence positively on the actual R&D intensity. In the same line, sales growth also influences positively on innovative performance. Finally, size and not belonging to high-tech sectors affects negatively to innovative performance. In these specifications, the coefficients related to size and market share are also significant in all specifications (negative and positive, respectively). These findings confirm the robustness of our results.

Table 3: Effects of M&A on R&D intensity. (Robustness Models)

	Fixed-effects models			Random-effects models		
	(I)	(II)	(III)	(I)	(II)	(III)
RD LAGGED		0.225***	0.236***		0.604***	0.707***
		(0.012)	(0.015)		(0.010)	(0.010)
MA_2	0.060***	0.054***	0.040*	0.078***	0.094***	0.067***
	(0.021)	(0.020)	(0.021)	(0.022)	(0.025)	(0.025)
SIZE	-1.000***	-1.001***	-0.997***	-0.997***	-0.995***	-0.991***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
MARKET SHARE	0.176***	0.237***	0.287***	0.272***	0.717***	0.815***
	(0.014)	(0.014)	(0.020)	(0.009)	(0.008)	(0.008)
SALES GROWTH			0.006***			0.017***
			(0.002)			(0.002)
KIS				-0.321***	-0.193***	-0.168***
				(0.057)	(0.034)	(0.034)
LOW-KIS				-0.671***	-0.337***	-0.323***
				(0.099)	(0.057)	(0.059)
LOW-TECH				-0.601***	-0.372***	-0.377***
				(0.085)	(0.051)	(0.048)
MEDIUM-TECH				-0.244***	-0.174***	-0.231***
				(0.043)	(0.033)	(0.033)
Constant	2.463***	1.699***	1.755***	1.625***	-2.260***	-2.941***
	(0.387)	(0.370)	(0.411)	(0.229)	(0.135)	(0.142)
Observations	5,119	5,077	3,832	5,119	5,077	3,832
R-squared	0.947	0.952	0.957			
Number of firms	1,240	1,231	987	1,240	1,231	987

*, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively. Reference sector group= HIGH-TECH.

The Table 3 also provides the random-effects models for the determinants of R&D intensity. Results show that M&A lagged two periods, past R&D behaviour, size, market share, sales growth and sector are important in estimating the R&D intensity. Although the coefficients of the random effects are not significantly different from the fixed-effects estimations, we do a Hausman test to make the distinction between fixed and random effects models. The chi-squared with 17 degrees of freedom is 1474.72. The hypothesis that the

individual effects uncorrelated with the other regressors in the model can be rejected. Based on the LM test, which is decisive that there are individual effects, and the Hausman test, which suggests that these effects are uncorrelated with the other variables in the model, we would conclude that of the two alternatives we have considered, the fixed effects model is the better choice.

The influence of M&A on our proxy of competition level is provided in Table 4. Similar to the analysis carried for our proxy of innovation, we estimate the influence of M&A from one to five lags. M&A transactions affect positively to profitability of the company, but the influence of M&A on firm´s profitability requires a longer span than on R&D intensity. In particular, M&A influence profitability by employee five years after acquisition. This result will also be robust to the different types of econometrical procedure used. After controlling for company specific fixed effects and macro-economic factors (by the inclusion of time dummies), the effect of size is also negative and significant to explain the profitability. Also, as would be expected, increases in market share (measured by sales) have a positive impact on profitability (at 90% level of significance probably due to the sample attrition when we consider five lags in M&A).

Table 4: Effects of M&A on Profitability (Fixed- effects Models)

	Model I	Model II	Model III	Model IV	Model V
MA_1	0.019				
	(0.068)				
MA_2		-0.048			
		(0.078)			
MA_3			-0.002		
			(0.082)		
MA_4				-0.101	
				(0.091)	
MA_5					0.269**
					(0.114)
SIZE	-0.998***	-1.001***	-0.998***	-0.997***	-0.950***
	(0.012)	(0.015)	(0.017)	(0.020)	(0.028)
MARKET SHARE	0.075	0.075	0.096	0.163**	0.186*
	(0.053)	(0.065)	(0.071)	(0.081)	(0.101)
Constant	0.360	0.644	1.091*	0.692	-0.311
	-1.053	-1.313	(0.603)	(0.678)	(0.957)
Observations	5,16	3,952	3,181	2,372	1,727
R-squared	0.656	0.634	0.613	0.610	0.539
Number of firms	1,391	1,120	927	743	617

*, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

Table 5 also shows the fixed and random-effects models for the determinants of profitability. Results show that only M&A lagged five periods, the lagged dependent variable and the proxy of size are significant in the fixed and random-effects models. As the coefficients for other variables from random-effects model are significantly different from the fixed-effects estimations, we run the Hausman test to identify what is the more accurate specification. The probability of chi-squared is 0.000 (chi (10) = 285.67), which suggests that these effects are correlated with the other variables in the model. Thus, the fixed effects model is the better choice.

Table 5: Effects of M&A on Profitability. (Robustness Models)

	Fixed-effects models			Random-effects models		
	(I)	(II)	(III)	(I)	(II)	(III)
PROFIT LAGGED		-0.303***	-0.445***		0.145***	0.028
		(0.030)	(0.037)		(0.025)	(0.031)
MA_5	0.269**	0.216*	0.385**	0.150	0.051	0.089
	(0.114)	(0.113)	(0.155)	(0.096)	(0.097)	(0.129)
SIZE	-0.950***	-0.967***	-1.007***	-0.986***	-0.990***	-0.990***
	(0.028)	(0.029)	(0.045)	(0.015)	(0.013)	(0.016)
MARKET SHARE	0.186*	0.089	0.504	-0.066***	-0.052***	-0.072***
	(0.101)	(0.192)	(0.362)	(0.019)	(0.016)	(0.021)
SALES GROWTH			0.222			-0.065
			(0.269)			(0.186)
KIS				-0.086	-0.009	-0.065
				(0.096)	(0.078)	(0.104)
LOW-KIS				-0.818***	-0.580***	-0.939***
				(0.162)	(0.131)	(0.174)
LOW-TECH				-0.636***	-0.535***	-0.657***
				(0.126)	(0.104)	(0.140)
MEDIUM-TECH				-0.413***	-0.263***	-0.343***
				(0.089)	(0.074)	(0.096)
Constant	-0.311	1.118	-1.725	3.244***	2.789***	3.336***
	(0.957)	-1.574	-2.884	(0.411)	(0.333)	(0.453)
Observations	1,727	1,507	1,039	1,727	1,507	1,039
R-squared	0.539	0.582	0.560			
Number of firms	617	559	473	617	559	473

*, **, and *** indicate statistical significance at 10%, 5%, and 1%, respectively.

There is not clear evidence on the influence of market share in the profit ratio. Although this variable presents the expected sign (positive), the parameter only show significance in the first model (without lagged profit as dependent variable) and with at 90% level of significance. The variable related to SALESGROWTH reports the expected sign in the fixed-effect model but neither is significant. Finally, belonging to LKIS, Low-Tech and Medium-Tech negatively influences to explain firm profitability. In order to spare space, the coefficients of the control variables are omitted from the results and are available from the authors upon request.

5. Conclusions

The results confirm that M&A influence the R&D performance and profitability. Indeed, using a unique dataset that combines nine EU R&D Scoreboards and information of EC Merger Control Organism over the period 2004-2012, we show that merger impact positively on R&D and profits, but the timing and magnitude of these effects differs.

Our first finding confirms the positive influence of M&A on R&D intensity of the top companies in EU after two or three years. Particularly, the effect of M&A is confirmed from one to five lags. Furthermore, the variations that occur in RD intensity are explained by independent variables considered. In particular, Furthermore, it is showed a negative influence of low tech sectors. Therefore, it can be confirmed that M&A have effect in short-term in R&D per employee.

Our results also suggest that M&A have negative influence in profits. Thus, mergers and acquisitions have effect on competition level in the European markets. In this way, results of this paper allow to confirm that M&A, which have took place in EU, have endangered free competition of European Internal Market in spite of the technology-driver M&A effect.

In summary, previous analyses have allowed to show that mergers and acquisitions are important to explain the behaviour of many variables of firms; particularly, the positive effect of M&A in R&D expenditures. Nevertheless, profits do not appear to be affected by merger or acquisition processes. This supports the conclusion that mergers authorised in first phase by DGC of European Commission can help to increase technological efforts in the largest firms in EU and it has not endangered the level of market competition. Hence, competent authority approved mergers and acquisitions properly taken into account technological enhacement. In spite of crisis and economic cycle might explain this result, empirical evidence show that authorised M&A by DGC have not been such good for competition in European markets because it does affect positively profits. Moreover, our results suggest that the R&D performance by these firms depends of their past R&D behaviour. Although there exist an extant literature about persistence in innovation and R&D, our results show that this persistence

must be accounted for analysing the effects of M&A on innovative performance. This direction could be fruitful for further research. Another contribution could take into account the technological leadership. More precisely, it would consist in examining whether the effects of M&A on technological leaders differs to the consequences on technological laggards. Another extension could be to analyse the differences among since the countries has been recently classified as.

Finally, our results enable to confirm the existence of efficiencies in the M&A process related to R&D use. In this regard, the argument based in incentives in innovation can be used to reach the authorization of a M&A, according to the current European Commission Merger Guidelines, In particular dynamic efficiencies, which take place when acquiring firms increase their innovative capabilities through knowledge transfer from the acquired firms or complementarity among acquiring and acquired firms. However, the positive influence of M&A on profitability can be interpreted as a reduction of competition. Thus, M&A will contribute to the loss of allocation efficiency in the European large companies if EC Merger control does not take into account the equilibrium among innovative and competitive effects of authorized M&A in phase I.

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APPENDIX 1

Summary statistics on mergers and acquisitions from around the world from 2004 to 2012

Whole sample

Table: Descriptive Statistics (All firms)

	Mean	**Maximum**	**Minimum**	**Observations**
R&D (thousands of €)	131.41	9,515.00	0.00	9,000
Net sales (thousands of €)	5,551.80	363,375.10	0.00	8,955
Employment (# of employees)	20,943.00	648,254.00	0.00	8,870
Profit (% over sales)	-1,239.70	3,031.80	- 1,794,500.00	7,873
MARKET (thousands of €)	5,866.20	183,476.00	0.00	5,453
CAPEX (% over sales)	138.53	111,800.00	0.00	7,858

Source: Own Elaboration