UNIVERSITAT ROVIRA I VIRGILI
DEPARTAMENT D'ECONOMIA

CENTRE DE RECERCA EN ECONOMIA INDUSTRIAL I ECONOMIA PÚBLICA

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To acquire or not to acquire: Mergers and Acquisitions in the Software Industry

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Document de treball n.14 - 2018

DEPARTAMENT D'ECONOMIA – CREIP
Facultat d'Economia i Empresa

UNIVERSITAT ROVIRA I VIRGILI

DEPARTAMENT D'ECONOMIA

Edita:

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Adreçar comentaris al Departament d'Economia / CREIP

ISSN edició en paper: 1576 - 3382
ISSN edició electrònica: 1988 - 0820

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To acquire or not to acquire: Mergers and Acquisitions in the Software Industry

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Abstract:

The aim of this paper is to analyse the impact of Mergers and Acquisitions on firm growth for Software firms located in Catalonia. We investigate firms which are targeting, or are themselves the target of an acquisition and we find that the impact on is heterogeneous; there appear to be positive and negative impacts on productivity and sales growth rate. This paper contributes to the understanding of the M&A process in this young industry characterised by an exponential growth and how such activity interacts with the growth and productivity of the firms involved.

Keywords: Software industry, Mergers and acquisitions, firm growth, Catalonia

JEL Codes: D22, C33, L86, O30

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1. Introduction

The Software industry has played a crucial role in reconfiguring the way in which firms, businesses, and people interact and work. This young industry, whose appearance in the mid-1970's with the Computer Revolution, is characterised by an exponential growth. Nowadays, the industry is important for the world economy, being a significant part of the information and communication technology sector and representing 5.4 percent of the global gross domestic product (Dutta and Mia, 2010). Hence, this high-tech industry impacts on the global economy, increasing technical progress, connectivity, productivity, and innovation.

The aim of this paper is to analyse the impact of the Mergers and Acquisition process (hereafter M&A) on software firms located in Catalonia, an autonomous region of Spain. Industries such as Software are characterised by intense M&A processes. M&As have increased in response to factors such as globalization, liberalization, improvements in technology, and competitive business environment (Leepsa and Mishra, 2012; Usman et al., 2010).

M&As have a different relevance at the industry than at the firm level. On the one hand, M&As among companies in the same sector have traditionally increased the market concentration. Evidence shows that M&As may alter the firm size distribution (Cefis, Marsili, and Schenk, 2009[1]). On the other hand, M&As help firms to integrate key resources and represent an important strategic weapon for enhancing a firm's assets. Merging or acquiring a firm gives the opportunity to improve the internal organization and learn from different ideas based on different technological capabilities among firms (Ghoshal, 1987; Hitt et al., 1996). Furthermore, an M&A represents a market reallocation process because it reallocates, not only the physical capital, but also other intangible assets. These processes allow firms to acquire diverse external knowledge bases and use this knowledge to improve the innovative performance of the acquiring firm.

Furthermore, M&As have consequences at the macroeconomic level (Jovanovic and Rousseau, 2002) and in the complementarity of assets (Rhodes-Kropf and Robinson, 2008). Xu (2017) interestingly shows that prohibiting M&As would decrease the US aggregate growth rate and aggregate TFP by 0.1% and 5%, respectively. This raises the question of whether M&As have a positive or negative impact on firms in the Software industry. We

[1] Cefis, Marsili, and Schenk (2009) show that M&As lead to a departure from log-normality of the firm size distribution.

investigate this in a framework which conditions the possible outcomes on the pre-acquisition characteristics of both the target and the acquiring firm. We are interested in comparing the changes in the combined performance of the target and acquiring firms, pre- and post-M&A (see e.g. Ornaghi, 2009a, 2009b). The combined analysis can help us to understand, not only the patterns of firms which acquire and are acquired, but also to understand the impact of the M&A process on the firm's subsequent performance.

Catalonia, a northeast region of Spain with a population of more than 7 million inhabitants (16% of the total population of Spain, but only the 6.3% of Spanish territory) is the best Spanish region to study this phenomenon. In recent years, a large number of software firms have sprung up (mainly in the city of Barcelona) for varying reasons, such as the high number of university degrees related to software and high-tech activities (generating a wide range of skilled labour), a highly creative environment and the 22@ district, an innovative and high-tech cluster where many knowledge-based activities take place (Méndez-Ortega and Arauzo-Carod, 2017; Viladecans-Marsal and Arauzo-Carod, 2012). In 2015, Catalonia captured more than 324 million euros in *start-up* investment (more than the 60% of the total *star-up* investment in Spain).[2] The software industry in Catalonia provides more than 84 thousand job positions (20% of the Spanish total), with an average annual salary of more than 30 thousand euros per employee. It generates more than 15 billion euros of gross output (approximately the 25% of the Spanish total).[3][4] The industry includes Software management, programming, editing electronics firms, mobile Software (or apps) developers and the Videogame industry

Our main result is that being the target of an acquisition has a negative impact on a firm's the productivity and sales growth rate. However, we observe a heterogeneous impact on firms. Similarly, the impact for firms carrying out an acquisition has a positive impact on productivity and sales growth rate. Finally, we see that our hypotheses are partially confirmed in some cases, and totally confirmed otherwise.

Our contributions to the literature improve understanding of M&As, the impacts on the software industry and how these transactions interact with the sales and productivity growth of firms.

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[2] Idescat (*Institut d'Estadística de Catalunya*), Companies and employment of the ICT sector. Catalonia. 2015.
[3] INE (*Instituto Nacional de Estadística*), Sector ICT indicators, ed. 2015.
http://www.ine.es/dyngs/INEbase/es/operacion.htm?c=Estadistica_C&cid=1254736176742&menu=ultiDatos&idp=1254735576692
[4] Idescat, Companies and employment of the ICT sector. Catalonia. 2015.
https://www.idescat.cat/pub/?id=etic&n=2&lang=en

The paper is organised as follows. Section 2 reviews the theoretical and empirical literature on M&A and firm growth, presents the particularities of the software industry and presents our hypotheses. Section 3 describes the database and main variables; Section 4 introduces some descriptive statistics and discusses results. Section 5 contains the econometric methodology, and Section 6 the empirical results. Finally, Section 7 presents the main conclusions.

2. Literature

There is an extensive literature on firm growth, but empirical findings are mainly based on organic growth (Audretsch et al., 2014; Coad et al., 2016). The impacts of mergers on firm performance have been addressed by many researchers in recent decades (Healy et al., 1992; Papadakis and Thanos, 2010; Seth, 1990; Tuch and O'Sullivan, 2007; Cartwright and Schoenberg, 2006; Zollo and Meier, 2008). The phenomenon of M&As has however been particularly intense in specific sectors. This review section aims to summarize the arguments regarding the relationship between an M&A and firm growth, and to present the particularities of the software industry.

2.1. Review of the literature: M&As and firm growth

M&As and firm growth

Firm growth can be "organic" through the internal investment, or "inorganic" through M&As, the latter being a fast way for firms to expand their business. However, this process proves difficult and not entirely risk-free (Rashid and Naeem, 2017). Here, we aim to analyse the question of whether, and how, acquisitions affect a firm's performance as measured in growth terms.

The firm growth literature starts with Gibrat's Law, the "Law of Proportionate Effects", (Gibrat, 1931) which predicts that firm size follows a random walk and, hence, that growth is independent of size.[5] Cefis et al. (2009) have shown that M&As have a non-homogeneous impact on firms depending on firm size and thus the process does not follow Gibrat's Law. Their results confirm previous empirical estimations from Hannah and Kay (1977), who found that the impacts of merger on growth are so strong that, without mergers, smaller firms would have grown faster than larger firms.

[5] For surveys, see Sutton (1997) and Coad (2009).

Another strand of the literature offers a number of insights about the impact of M&As on firm performance. They have consequences in terms of enhancing a firms' asset base, avoiding time-consuming internal accumulation of innovation enhancing resources (Barney, 1991; Dierickx and Cool, 1989; Teece et al., 1997) and both revitalizing the knowledge base of a firm and avoiding inertia (Capron and Mitchell, 1998; Vermeulen and Barkema, 2001). However, they may also have negative consequences, as firms face several obstacles which prevent such benefits from being completely realized (Chakrabarti, 1990; Fang et al., 2004; Ivancevich et al., 1987; Nahavandi and Malekzadeh, 1988; Schweiger and Denisi, 1991).
Hence, there is no consensus on the impacts of M&A since the empirical literature shows positive, negative or no gains from M&As (Tichy, 2001). A reason for the heterogeneous results might be the diversity of variables measured which includes R&D output (Hitt et al., 1991; Chakrabarti et al., 1994; Cloodt et al., 2006; Ornaghi, 2009a; Desyllas and Hugues, 2010), productivity (Schiffbauer et al., 2017), and financial performance and profitability (Pilloff, 1996; Poornima and Subhashini, 2013; Al-Hroot, 2016). Another reason might be the variety of motivations for M&As. According to Andrade et al. (2001), there are five main reasons for an M&A: (1) efficiency-related, (2) creation of market power, (3) market discipline, (4) agency costs and, (5) opportunities for diversification.

Hence, despite the wide number of studies which have enhanced our understanding of the relationship between M&As and firm performance, and the wide number of empirical studies on firm growth, there is still room to analyse how they are related. Furthermore, the range of motivations gives rise to different impacts on firm growth (Burghardt and Helm, 2015).

M&As and Employment

The impact of M&As on employment is unclear. At an empirical level, some studies find positive impacts on employment, Furlan et al. (2015), Green and Cromley (1982) and McGuckin and Nguyen (2001), for example, showing evidence of employment growth after an M&A. In contrast, two businesses may merge because of the empire-building propensities of their managers (Scherer, 1980) as a particular form of agency costs. Furthermore, it may be the case that apparent economies of scale or scope may actually turn out to be diseconomies due to an increase in organizational requirements. In both situations, the managers will employ more workers. By contrast, if M&As seek gains in efficiency, that implies that there are overlapping functions that can be reduced. Here, economies of scale

make the elimination of duplicate efforts in similar projects possible and result in operation, financial and managerial synergies (Moeller and Brady, 2007; Petitt and Ferris, 2013).

M&As and Sales

M&As are expected to be drivers of sales growth (Rashid and Naeem, 2017). On the one hand, they increase market power, facilitate achieving internationalization, and have production and cost efficiencies (Beena, 2000). According to M&A theory, successful M&As increase the profitability of the merged/acquirer firms. Furthermore, firms may benefit from belonging to a well-recognized consumer brand. However, the process may have a negative impact on the day-to-day activity of the firm. First, they may cause a loss of existing customers and a conflict in firm cultures (Rashid and Naeem, 2017). Second, they may give rise to conflicts among firms' personnel. Third, they may have a negative impact on sales, due to the diversion of managerial time and energy, or the disruptions of organizational routines (Ahuja and Katila, 2001; Cassiman et al., 2005; Chakrabarti et al., 1994; Cloodt et al., 2006; Hagedoorn and Duysters, 2002; Prabhu et al., 2005).

At an empirical level, Conyon et al. (2002) find evidence suggesting that firms in the UK reduce their overall use of output after a merger though the analysis focuses on foreign acquisitions. More recently, Burghardt and Helm (2015) analyse the impact of acquisition on firm growth (2001 on 2005) for US firms. These authors show a negative impact on firm growth, which becomes positive once they control for different firm characteristics. Furthermore, their impact becomes clearly significant for service sectors.

M&As and Productivity

M&As may have also an ambiguous impact on productivity depending on the combined impact that the process may have on sales and the number of employees. On the one hand, they may be of benefit in overcoming indivisibilities in projects (Calderini et al., 2003; Cassiman et al., 2005). Productivity can increase by spreading fixed costs across a larger production output, by improving capacity utilization efficiency, and by an increase in the specialization of their employees (Cassiman et al., 2005). On the other hand, as we have seen, productivity may decrease due to initial frictional problems between employees, time consuming procedures, and problems of organizational rearrangement / disruption of routines.

2.2. M&As in the software industry

Despite the diverse impacts of M&As on firm growth, there are some sectors which may be benefit more from this process. Schiffbauer et al. (2017) analyse a sample of UK foreign M&As between 1999 and 2007. Their results highlight that there are heterogeneous impacts at industry level, and that this heterogeneity across industries potentially explains the absence of positive total-factor productivity e□ects at the aggregate level. These sectoral differences have been also found by Doytch and Cakan (2011) who analyse the impact of mergers on economic growth for a sample of OECD countries. Their results show the positive impact of mergers on growth in the service sector, while mergers of primary and manufacturing sectors affected growth rates negatively

Concretely, M&As are particularly important in the software industry. For acquiring firms, this strategy allows them to grow rapidly through gaining market power and acquiring skilled labour. Furthermore, it may be opportune to increase the appropriability of inventions by reducing technological spillovers to competitors. For target firms, an M&A may be a good signal for the team. Usually, target firms are small (composed of 1 or 2 employees) whose purpose is to grow rapidly, and later be acquired by a big firm in order to increase salaries and enhance security being an employee rather than the owner of a firm. Some empirical papers highlight the importance of human capital for the software industry, which can affect to their localization process and payoff system of the workers (Andersson et al., 2009; Berger and Frey, 2015).

Hypotheses:

We hypothesize that, in the software industry, both for the target and the acquiring firm, the positive impacts will overcome the potentials drawbacks of an M&A:

Hypothesis 1. The impact of M&A on firms is on average positive for sales and productivity growth.

Here, we suppose that, on average, the impact of merging or acquiring in a firm will have a positive impact in terms of tangible and intangible assets. With the M&A, the companies acquire all the assets and the customer base of the target firm and, also, the acquiring firm will provide complementary assets to the target firms.

However, even in the highly risky activity in the software industry, M&As can generate still more risk. An M&A can cause important damages in a high-tech industry by generating collateral damage in the form of conflicts and disruption among firms' personnel that can destroy the potentially beneficial effects (Colombo and Rabbiosi, 2014). But for those firms

with high-capabilities to exploit the benefits, an M&A will have a positive impact. Hence, we hypothesize:

> *Hypothesis 2. M&As exert a dual impact by increasing the impact in high-growth firms, while having a negative impact for low-growth firms.*

Finally, one important issue is to try to disentangle the different impacts of M&As on the acquiring and the target firm (Szücs, 2014). Here, following Gugler et al. (2003), we consider that there are substantial differences between target and acquiring firms with respect to their characteristics (size and success) and also with respect to their goals and bargaining capacity in managing post-merger business affairs. Previous evidence (Capron, 1999) shows that target firms are more likely to diminish their R&D assets and R&D personnel than are acquiring firms. Consequently, we expect that target firms will be more affected by the M&A than acquiring firms (e.g., Datta, 1991; Pablo, 1994).

> *Hypothesis 3. M&As have a more positive impact on acquiring firms than on target firms.*

Hence, we distinguish between the impacts of target and acquiring firms and also between prior- and post-M&A. In this way, we will be able to capture the heterogeneous impact on firm growth at firm level in the software industry.

3. Database and variables

The data used in this paper were obtained from SABI (*Sistema de Análisis de Balances Ibéricos,* INFORMA), a database that compiles data on firms using the Register of Companies for the Iberian Peninsula (Spain and Portugal). In our analysis, we focus in Catalonia.

[INSERT FIGURE 1]

Figure 1 shows that the software industry in Catalonia is located mainly in the Metropolitan Area of Barcelona and along the Mediterranean coast, in places where there is a high population density (Urban areas) and not rural areas.

To define the Software industry, we use 6201 (Computer programming activities) and 582 (Software publishing) from NACE Rev.2.[6] After a filtering process, the final sample is

[6] NACE Rev.2: European Classification of Economic Activities.

composed by 879 firms.[7] We analyse data between 1999 and 2014 (15 years), because data prior to 1999 does not have usable mergers and acquisition data.

Finally, we applied a deflator[8] to the economic variables to have all the years at current values. Regarding mergers and acquisitions information, SABI provides extensive information on the process for the firms in the sample, giving the data on the movement, the type of movement, detailed information and the number of movements per firm. In our sample, there are a total of 87 M&As movements. The dummy variables were created using and interpreting the detailed information for each movement.[9] The data variables are presented in Table 1.

[INSERT TABLE 1]

4. Statistical description

Table 2 presents some metadata from the dataset.

[INSERT TABLE 2]

One sees that the software industry is a young industry in Catalonia (the mean and median firm ages our sample being 9 and 8 years respectively). It is also an industry where most firms are small (mean of 12 and median of 4 employees).

The debt ratio shows that this industry is not particularly indebted —although the maximum of this variable is 69.69, its mean is 0.373 and its median, 0.184. Finally, it is interesting to highlight the logarithmic sales growth, with both mean and median being slightly positive, which indicates that, on average, some firms are growing while other firms are decreasing. Moreover, in the case of logarithmic productivity growth, we observe that mean and median are close to 0 (but negative).

Kernel Densities descriptive analysis:

Figure 2 shows kernel densities for the logarithmic growth rate of sales (*GRlnSales*) and productivity (*GRlnPRO*):

[7] Initially, we compiled 879 Software firms from the region of Catalonia (NUTS 2 level) from the SABI for 15 years obtaining 14,943 observations. After some filtering, we discarded 8,225 observations with missing data in order to obtain a final dataset of 6,718 observations (retaining the 879 Software firms).
[8] We use the IPC (Price Consumption Index in English), Base 1999 (=100) as a deflator.
[9] Due to the nature of the database, we cannot differentiate between partial or total acquisitions.

[INSERT FIGURE 2]

As we mentioned above, the median for the *GRlnSales* is positive, while the median for the *GRlnPRO* is negative. Furthermore, they are not normally distributed; there is a huge concentration around 0 in both kernel densities, which indicates that there are few firms with higher or lower growth rates.

Figure 3 shows kernel densities of the logarithm of Sales (*lnSales*) and the logarithm of Productivity (*lnProductivity*) before/after receiving/doing an acquisition simultaneously.

[INSERT FIGURE 3]

It is clearly observed that the fact of receiving and/or undertaking an acquisition positively affects *lnSales*, since subsequently, both kernel densities are moved to the right (indicating more sales). In the case of the logarithm of productivity, receiving/undertaking affects the firm negatively (both kernel densities are moved slightly to the left). To sum up, we can conclude that *M&As* positively affect sales but negatively affect productivity for the acquired/acquiring firm.

Mean test differences:

Table 3 shows mean test differences for different variables (Sales, number of employees, productivity and debt ratio) for firms that have received/undertaken an acquisition.

[INSERT TABLE 3]

In this mean test, we compare the prior mean to the posterior mean after the acquisition. Firstly, we show the acquisition done (AIDA), where we observe a huge increase in sales after the acquisition, this test is significantly different from 0, being negative. This was expected, because a firm that acquires another also acquires the customer base of the acquired firm and whether the firm makes and investment, this firm will take part on the profits of the invested firm. In regard to the number of employees, the mean of this variable after the acquisition is higher and significantly different from 0, because on acquiring a firm, one also acquires its employees (this result is in accordance with Green and Cromley (1982) and McGuckin and Nguyen (2001), whose papers shows a positive impact on employees). Finally, in the case of productivity and debt ratio, the mean differences are not statistically different from 0. The second part of Table 3 shows the acquisition received (AIRA). In the case of sales, employees and debt ratio, one sees that the difference between before and after is statistically equal to 0. Thus, we focus on Productivity, which shows a statistically

significant decrease after the AIRA. There are several possible causes (e.g. initial frictional problems between employees, time consuming procedures, and problems of rearranging the organization / disruption of routines).

In conclusion, we note that the software industry in Catalonia is a young industry with small firms which is growing slightly in terms of sales, but decreasing slightly in terms of productivity (both on the average and the median). When a firm acquires another, it will increase its sale but decrease its productivity.

5. Econometric methodology

In order to estimate the impact of mergers and acquisitions received or undertaken, on productivity growth and on sales growth we estimate the following equations:

$$GRlnSales_{it} = \beta_{10} + \beta_{11} lnSales_{it-1} + \beta_{12} lnAge_{it} + \beta_{13} lnAge_{it}^2 + \beta_{14} Merger_{it} + \beta_{15} AIR_{it} + \beta_{16} AID_{it} + \beta_{17} Debtr_{it-1} + \varepsilon_{1it} \quad [1]$$

$$GRlnPRO_{it} = \beta_{20} + \beta_{21} lnPRO_{it-1} + \beta_{22} lnAge_{it} + \beta_{23} lnAge_{it}^2 + \beta_{24} Merger_{it} + \beta_{25} AIR_{it} + \beta_{26} AID_{it} + \beta_{26} Debtr_{it-1} + \varepsilon_{2it} \quad [2]$$

Where β_i are the coefficients and ε_{it} is the usual error term of firm *i* at time *t*. In this analysis, the two dependent variables are the logarithmic growth of sales (*GRlnSales*) and of productivity (*GRlnPRO*). We focus on the explanatory variables *AIR* and *AID* in order to capture the impact of the acquisitions on the growth of the firm. *AIR* identifies firms that have received M&As, while *AID* identifies firms that have undertaken M&As. The remaining explanatory variables follow from previous work on the determinants of firm growth, hence we include the lagged value of the firm sales (*lnSales*) or firm productivity (*lnPRO*), the logarithmic firm age, its squared value (*lnAge* and *lnAge*^{2}) and the ratio of long-term debt to total assets in the firm (*Debtr*) (see Coad, 2009, for a survey).[10] Finally, we include time dummies to control for time periods.

In this paper, we apply quantile regression in order to see the impact of these variables on growth. The quantile regression estimator was originally designed for the analysis of cross-sectional datasets (Koenker and Bassett, 1978). In view of the high heterogeneity of the firm growth distribution, characterised by heavy tails (see previous Figure 2), this is the most

[10] See Annex Table A1. for correlations between variables.

convenient econometric technique. But recently, some works apply this technique in a panel context in order to control time-invariant, firm-specific effects (Canay, 2011; Galvao, 2011; Koenker, 2004). We write the formula in a more general form:

$$Y_{it} = X_{it}\beta + \varepsilon_{it}$$

Further details of our panel quantile regression estimator are given in Canay (2011). In order to obtain more precision in our inference, we report bootstrapped standard errors (with 100 bootstrap replications). The results of these regressions are given in the following section where we present results for the θ = 0.05, 0.10, 0.25, 0.50, 0.75, 0.90 and 0.95 quantiles.

6. Results

In this section, we present the results of our estimations. Tables 4 and 5 give our quantile regression results for θ = 0.05, 0.10, 0.25, 0.50, 0.75, 0.90 and 0.95. Quantile coefficients can be interpreted as the marginal change in *y* at the θth conditional quantile arising from by marginal change in a particular regressor.

6.1 Quantile regression using logarithm growth rate of Sales (*GRlnSales)*

Table 4 presents the results using the logarithmic growth of sales as a dependent variable.

[INSERT TABLE 4]

Our main variables of interest are *Merger*, *AID* and *AIR* (Merger, acquisition Done and Receive respectively) which captures the impact of merging, acquiring or being acquired on the logarithmic growth of sales. First, the impact of merging has a significant negative impact in the dependent variable in the upper quantiles. Second, the impact of acquiring in another firm has a significant positive impact on the sales growth rate for firms that are growing (upper quantiles). Indeed, acquiring a firm is expected to be a driver for sales growth (Rashid and Naeem, 2017), increasing the market power and cost efficiency (Beena, 2000). Third, another firm acquiring in it has a significant negative impact on the dependent variable for the lower quantile firms (those firms with a negative sales growth rate). This is mainly when the firm's sales decrease (e.g. due to the diversion of managerial time, disruptions, or organizational routines), which is in line with Ahuja and Katila (2001), Cassiman et al. (2005), Chakrabarti et al. (1994) and Cloodt et al. (2006). In the case of the lagged sales value, this

has a significant negative impact on the dependent variable. This implies that larger firms in terms of sales will have a negative impact on future sales growth. Furthermore, firm age is negatively correlated with sales growth but the oldest firms show a positive impact.

In consequence, in this first estimation, our Hypothesis 2 and 3 find support, while the Hypothesis 1 is partially confirmed. First, an M&A exerts a dual effect, increasing the impact on high growth firms, while having a negative impact on low-growth firms (in support of Hypothesis 2). Second, an M&A has a more positive impact on acquiring firms than on target firms (in support of Hypothesis 3). Third, the impact of an M&A on a firm is not, on average, neutral sales growth, inasmuch as the impact on average (θ =0.50) is positive for acquiring firms and negative for acquired firms, so Hypothesis 1 is partially satisfied.

6.2 Quantile regression using logarithm growth rate of Productivity (*GRlnPRO)*

Table 5 presents the results using the logarithm growth rate of productivity as a dependent variable.

[INSERT TABLE 5]

As in the previous table, our main variables of interest are *Merger*, *AID* and *AIR,* which capture the impact of merging, acquiring or being acquired on the logarithm growth rate of Productivity.

In the case of merging, the fact of being merged has a significant positive impact on the productivity growth rate for firms which have a negative growth rate of productivity (lower quantiles). The same happens with the variable *AIR*, which has a significant negative impact for firms with a negative growth rate and, additionally, firms which are growing (upper quantile). This effect is in line with what was previously seen regarding kernel densities and mean test differences, the fact of receiving an acquisition negatively affects productivity in the acquired firm. Moreover, it is observed that the variable *AID* has a positive significant impact on the productivity growth rate at θ =0.75, this may occur due to an improvement in the capacity utilization efficiency, or increasing the employee specialization (Cassiman et al., 2005). Lastly, the lagged value of productivity has a significant negative impact on the dependent variable; this means that the fact of being in a growth phase will have negative impact on the present growth. We also note the age impact, which is negative for productivity growth but positive for the oldest firms in some quantiles (which we are capturing with age squared).

Finally, in this second estimation, our Hypothesis 1, 2 and 3 find partially support. First, Hypothesis 2 states that M&As exert a dual effect, increasing the impact in high growth firms, while having a negative impact for low-growth firms. We support for this in low-growth firms but, also, we found a negative impact on high growth in the case of firms which had received an acquisition. Second, Hypothesis 3 states that M&As have a more positive impact on acquiring firms than they do on target firms, this supports Hypothesis 3. Finally, the impact of M&A on firms is, on average, neutral productivity growth for the acquiring firms, but for target firms the impact on average (θ =0.50) is negative, so Hypothesis 1 is not satisfied.

[INSERT FIGURE 4]

Figure 4 shows the impact of AIR, AID and Merger on the dependent variable across quantiles and details the values each variable takes. We observe that values vary throughout quantiles, showing that the impact is not homogeneous across the firm's growth.

6.3 Robustness checks

In our main estimations, we consider in the same regression being acquired by a firm (*AIR*), acquiring a firm (*AID*) and merging (*Merger*) with a firm. In further analyses not reported here, we estimated alternative models taking each variable separately and obtained similar results.

In addition, we check whether our results have some spatial effect, inasmuch as MAB contains almost the 60% of the software firms in Catalonia, we estimated the same models [1] and [2] presented previously but only with software firms located in the MAB, with the purpose of finding different impacts to those found with all the sample (Catalonia). Table 6 summarizes these impacts.[11]

[INSERT TABLE 6]

The impact of *AIR*, *AID* and *Merger* on logarithm growth rate of sales and productivity is almost the same as in the main regressions, the coefficients sign does not change and the significances vary very little. We also replaced our panel regressions with the standard style created by Koenker and Bassett (1978) and obtained similar findings. Finally, we repeated

[11] To check the impact of these variables on dependent variables across quantiles, see Annex, Figure A2.

our panel quantile regression estimations excluding the year's variables and, again, obtained similar results.

7. Conclusions

This paper has analysed the impact of Mergers and Acquisitions processes on Software firms located in Catalonia. These processes have been particularly intense in this industry. Although there is previous theoretical and empirical literature attempting to explain the impact of M&As on firm growth, sales and productivity, no study has analysed this impact classifying by high-growth and low-growth firms.

Our main results show a heterogeneous impact on firms. It shows a clear difference in terms of sales and employees after receiving an acquisition, but there is no difference in productivity with some firms even being less productive after receiving an acquisition. On the one hand, the impact of receiving an acquisition, negatively affects sales and productivity in low-growth firms. On the other hand, the impact of undertaking an acquisition positively affects sales and productivity in high-growth firms. Furthermore, the impact of merging negatively affects sales in high-growth firms, positively affects productivity in low-growth firms and has a slight negative impact on productivity in high-growth firms. Finally, our hypotheses were partially confirmed in some cases, and totally in others.

This paper gives rise to some interesting suggestions for policy makers. First, the process of M&As in the software industry suggests a reallocation of assets among active firms. The main reason is that acquisitions processes positively affect a firm's productivity and sales growth, for those firms that are growing and negatively affect these variables for firms that are contracting. Second, M&As should be taken into account by policy makers who are responsible for market competitiveness. Our results confirm a process of market concentration in the market.

Overall, our results should be interpreted with care due to some potential limitations that we intend to address in future research. The paper corresponds to a specific region and period of time and, therefore, may be biased due to geographical or business cycle issues.[12] Further research should explore all these concerns in order to provide more robust results.

[12]For example, the recent crisis contraction of economic activity in 2008.

Acknowledgements:

This paper is part of the investigations carried out with the financial support of the Consolidated Research Groups 2014–SGR–1395 and 2017-SGR-159 of the Catalan Government, the *Xarxa de Referència d'Economia Aplicada* (XREAP), the *Xarxa de Referència d'R+D+I en Economia i Polítiques Públiques* (XREPP) and the competitive projects ECO2015-68061-R "Gender Diversity as a Determinant of Innovation: An Analysis of the Impact of Gender Diversity on Firm Innovation" and ECO2017-88888-P ""Clusterization", terciarization and relocation: emerging questions in the location of economic activities (RE)LOCATION" funded by the Ministry of Economics and Competitiveness Spanish Government and by European funds from FEDER. The usual disclaimers apply.

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TABLES:

Table 1. Description of the variables.

Variable	Definition	Source
$TACT_{it}$	Total assets per firm.	SABI
Age_{it}	Years of the firm.	Own variable
$Sales_{it}$, EMP_{it}	Sales and Employees per firm.	SABI
PRO_{it}	Productivity of the firm (*Sales per Employee*).	Own Variable
$GRlnSales_{it}$, $GRlnPRO_{it}$	Sales Growth Rate per firm. Productivity Growth Rate per firm.	Own variables
$PASF_{it}$	Long term passive per firm.	SABI
$Merger_{it}$	Dummy that indicates if the firm suffers a merge (1) or not (0).	Own variable
$AIDA_{it}$, $AIRA_{it}$	Dummy variable that take value 1 from the first year that a firm does (*AIDA*) or receives (*AIRA*) an acquisition (Total or partial).	Own variables
AID_{it} , AIR_{it}*	Dummy variable that take value 1 from the first year that a firm does (*AID*) or receive (*AIR*) an acquisition (Total or partial).	Own variables
$Debtr_{it}$	Ratio that measures the debt degree of the firm. (*PASFit / TACTit)*	Own variable
$Metro_i$	Dummy variable that take value 1 if the firm is inside the Metropolitan Area of Barcelona.	Own variable
Time dummies	Time dummies to control for common macroeconomic effects.	Own Variables

Source: Authors. (*) AID and AIR are the same variable as AIDA and AIRA but taking into consideration all the firms of the sample and not only the firms that endure a M&A.

Table 2. Descriptive statistics for the main variables.

Variable	Mean	Standard Deviation	Max	Min	Range [Max-Min]	Median
$TACT_{it}$	817.3	2606	47721	0.0287	47721	171.1
Age_{it}	9.024	7.052	52	0	52	8
$lnAge_{it}$	1.930	0.880	3.951	0	3.951	2.079
$lnAge_{it}^2$	4.498	3.064	15.61	0	15.61	4.324
$Sales_{it}$	1149	4468	85724	0.0108	85724	252.1
$GRlnSales_{it}$	0.0484	0.653	7.821	-7.646	15.47	0.0118
EMP_{it}	12.08	29.74	526	1	525	4
PRO_{it}	78.56	146.8	3803	0.0084	3803	51.17
$GRlnPRO_{it}$	-0.00447	0.649	6.996	-6.253	13.25	-0.0118
$PASF_{it}$	241.5	824.3	13423	1.00e-05	13423	46.55
$Merger_{it}$	0.000298	0.0173	1	0	1	0
$AIDA_{it}$	0.273	0.447	1	0	1	0
$AIRA_{it}$	0.456	0.499	1	0	1	0
AIR_{it}	0.00566	0.0750	1	0	1	0
AIR_{it}	0.0153	0.123	1	0	1	0
$Debtr_{it}$	0.373	1.779	69.69	3.25e-08	69.69	0.184
$Metro_i$	0.589	0.492	1	0	1	1

Source: Authors. Monetary values are in thousands of euros.

Table 3. Mean test differences

	Mean Values		Ho: diff=0		
	Before (0)	After (1)	Ha: diff < 0	Ha: diff <=> 0	Ha: diff > 0
Acquisitions Done (AIDA)					
$Sales_{it}$	2694.09	7124.488	0.0002***	0.0004***	0.9998
EMP_{it}	39.03	118.685	0***	0***	1
PRO_{it}	80.3057	71.41	0.7979	0.4042	0.2021
$Debtr_{it}$	0.16375	0.172816	0.424	0.848	0.576
Acquisitions Received (AIRA)					
$Sales_{it}$	1464.382	1976.604	0.1455	0.2909	0.8545
EMP_{it}	32.916	32.282	0.527	0.9461	0.473
PRO_{it}	64.898	49.621	0.9696	0.0607*	0.0304**
$Debtr_{it}$	0.3285	0.3331	0.4614	0.9228	0.5386

Source: Authors. Notation: *** p<0.01, ** p<0.05, * p<0.1 (Significance at 1, 5 and 10 % respectively).

Table 4. Quantile Regression. Dep. Var: Sales Logarithm Growth Rate (*GRlnSales*$_{it}$)

	(1) 5%	(2) 10%	(3) 25%	(4) 50%	(5) 75%	(6) 90%	(7) 95%
lnSales $_{it-1}$	-0.435***	-0.445***	-0.475***	-0.492***	-0.503***	-0.535***	-0.557***
	(0.0158)	(0.00875)	(0.00596)	(0.00384)	(0.00743)	(0.00945)	(0.0141)
lnAge $_{it}$	-0.375**	-0.505***	-0.601***	-0.596***	-0.719***	-0.736***	-0.844***
	(0.169)	(0.100)	(0.0414)	(0.0180)	(0.0675)	(0.109)	(0.110)
lnAge $^2_{it}$	0.355***	0.382***	0.404***	0.407***	0.438***	0.444***	0.466***
	(0.0439)	(0.0237)	(0.0102)	(0.00502)	(0.0155)	(0.0254)	(0.0267)
Merger $_{it}$	0.877	0.522	0.161	-0.204	-0.579**	-1.066**	-1.226**
	(0.539)	(0.342)	(0.0999)	(0.139)	(0.289)	(0.485)	(0.574)
AID $_{it}$	-0.0512	0.0222	0.0934	0.196**	0.336***	0.580***	0.494***
	(0.376)	(0.194)	(0.0698)	(0.0908)	(0.115)	(0.130)	(0.107)
AIR $_{it}$	-0.531***	-0.420**	-0.289***	-0.141**	-0.0194	0.0622	0.161
	(0.179)	(0.171)	(0.0511)	(0.0624)	(0.0642)	(0.0978)	(0.149)
Debtr $_{it-1}$	-0.138	-0.0285	-0.0158	-0.0103	-0.00850	0.00452	-0.00614
	(0.0880)	(0.0430)	(0.0124)	(0.00669)	(0.0178)	(0.0269)	(0.0588)
Constant	2.006***	2.320***	2.797***	3.115***	3.515***	3.985***	4.337***
	(0.189)	(0.120)	(0.0640)	(0.0543)	(0.115)	(0.146)	(0.222)
Observations	2,828	2,828	2,828	2,828	2,828	2,828	2,828
Pseudo R²	0.539	0.601	0.668	0.700	0.689	0.659	0.635
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. Quantile Regression estimates with robust standard errors. All regressions are controlled by Year and Firm Fixed Effects. Notation: *** p<0.01, ** p<0.05, * p<0.1 (Significance at 1, 5 and 10 % respectively).

Table 5. Quantile Regression. Dep. Var: Productivity Logarithm Growth Rate (*GRlnPro$_{it}$*)

	(1) 5%	(2) 10%	(3) 25%	(4) 50%	(5) 75%	(6) 90%	(7) 95%
lnPro $_{it-1}$	-0.824***	-0.805***	-0.825***	-0.804***	-0.779***	-0.789***	-0.838***
	(0.0360)	(0.0221)	(0.0134)	(0.00882)	(0.0156)	(0.0263)	(0.0393)
lnAge $_{it}$	0.116	0.107	-0.102	-0.111***	-0.103	-0.237**	-0.286*
	(0.258)	(0.128)	(0.0650)	(0.0224)	(0.0637)	(0.110)	(0.164)
lnAge² $_{it}$	0.00702	0.00169	0.0444***	0.0465***	0.0395***	0.0541**	0.0505
	(0.0575)	(0.0299)	(0.0150)	(0.00589)	(0.0142)	(0.0259)	(0.0366)
Merger $_{it}$	0.949**	0.795**	0.437*	0.138	-0.149*	-0.324	-0.759
	(0.476)	(0.383)	(0.245)	(0.0958)	(0.0871)	(0.328)	(0.511)
AID $_{it}$	0.0913	0.00269	0.0535	0.0724	0.164***	0.0618	0.456
	(0.175)	(0.134)	(0.0826)	(0.0871)	(0.0633)	(0.318)	(0.459)
AIR $_{it}$	-0.298**	-0.263***	-0.219***	-0.0703*	-0.0278	-0.0173	-0.180**
	(0.133)	(0.0933)	(0.0840)	(0.0415)	(0.0474)	(0.0813)	(0.0806)
Debtr $_{it-1}$	-0.0834	-0.0704*	-0.0247	0.00810	0.0276***	0.0162	0.0255
	(0.0531)	(0.0400)	(0.0263)	(0.0162)	(0.00937)	(0.0183)	(0.0593)
Constant	2.618***	2.767***	3.309***	3.466***	3.529***	4.172***	4.823***
	(0.383)	(0.198)	(0.0986)	(0.0732)	(0.112)	(0.205)	(0.340)
Observations	2,436	2,436	2,436	2,436	2,436	2,436	2,436
Pseudo R²	0.518	0.530	0.536	0.542	0.514	0.516	0.550
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. Quantile Regression estimates with robust standard errors. All regressions are controlled by Year and Firm Fixed Effects. Notation: *** p<0.01, ** p<0.05, * p<0.1 (Significance at 1, 5 and 10 % respectively).

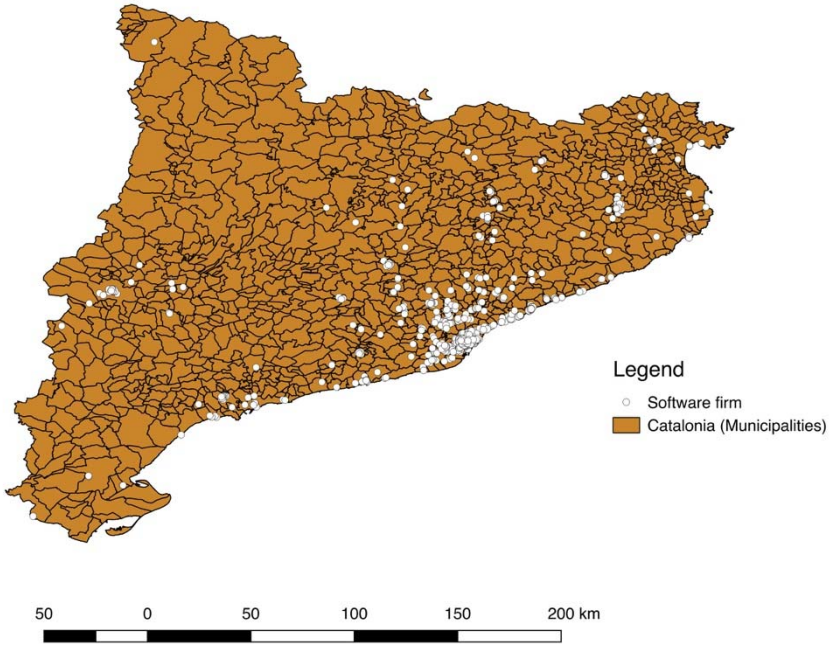
Table 6. Quantile regression using *GRlnSales it* and *GRPro it* for MAB firms.

	(1) 5%	(2) 10%	(3) 25%	(4) 50%	(5) 75%	(6) 90%	(7) 95%
				GRlnSales it			
Merger it	0.908	0.513*	0.109	-0.233*	-0.607*	-1.137**	-1.257**
	(0.554)	(0.307)	(0.103)	(0.136)	(0.312)	(0.554)	(0.626)
AID it	-0.123	0.0323	0.0960	0.199***	0.330***	0.577***	0.508***
	(0.306)	(0.156)	(0.0759)	(0.0717)	(0.109)	(0.126)	(0.0878)
AIR it	-0.505***	-0.425***	-0.241***	-0.119*	0.00383	0.0593	0.166
	(0.153)	(0.164)	(0.0570)	(0.0613)	(0.0834)	(0.0919)	(0.143)
Observations	1,628	1,628	1,628	1,628	1,628	1,628	1,628
Pseudo R²	0.617	0.660	0.717	0.746	0.730	0.702	0.687
				GRPro it			
Merger it	0.710	0.759**	0.359*	0.0650	-0.171	-0.338	-1.017*
	(0.434)	(0.333)	(0.210)	(0.0728)	(0.113)	(0.341)	(0.570)
AID it	0.146	-0.0907	0.0585	0.0761	0.147**	0.0466	0.445
	(0.149)	(0.139)	(0.0899)	(0.0805)	(0.0698)	(0.261)	(0.373)
AIR it	-0.245*	-0.323***	-0.274***	-0.126***	-0.0950*	-0.135	-0.152*
	(0.140)	(0.107)	(0.105)	(0.0473)	(0.0486)	(0.0913)	(0.0822)
Observations	1,406	1,406	1,406	1,406	1,406	1,406	1,406
Pseudo R²	0.542	0.558	0.566	0.562	0.534	0.526	0.559
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Standard errors in parentheses. Quantile Regression estimates with robust standard errors. All regressions are controlled by Year and Firm Fixed Effects. Notation: *** p<0.01, ** p<0.05, * p<0.1 (Significance at 1, 5 and 10 % respectively). Note: This table only shows main results, the rest of the results are available upon request.

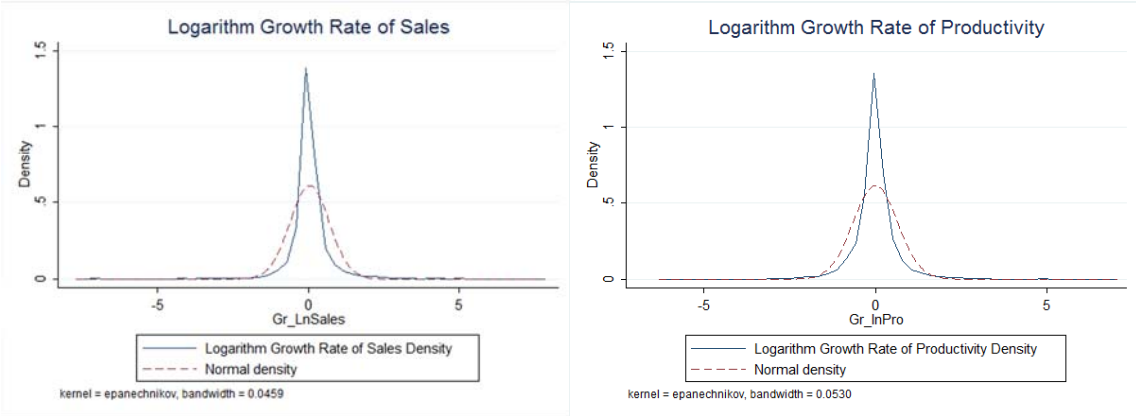
FIGURES:

Figure 1. Distribution of Software firms in Catalonia.



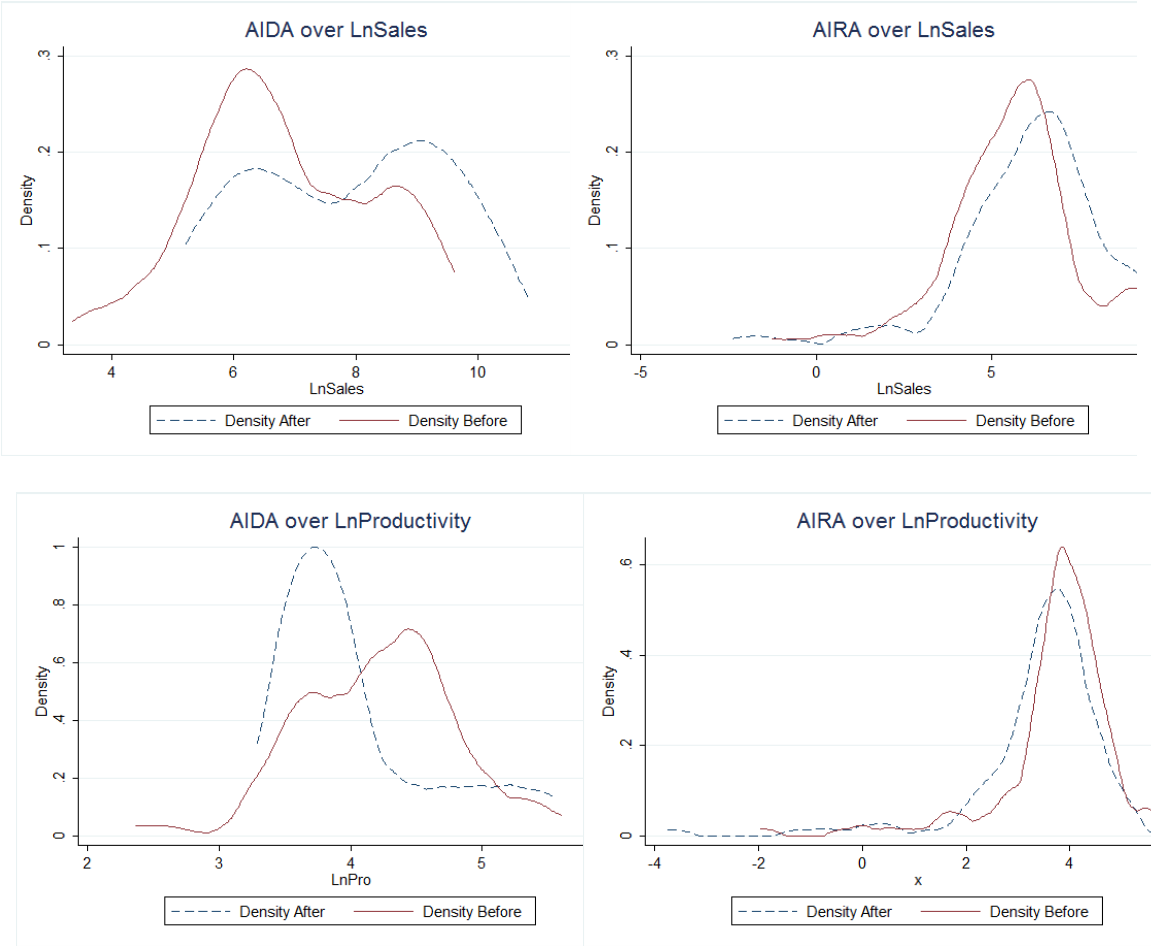
Source: Authors. Note: Catalonia is bordered on the west by Aragon region, on the north with Andorra and France, on the south with the Valencian region and on the east by the Mediterranean Sea.

Figure 1. Kernel Densities of *GRlnSales* and *GRlnPro.*



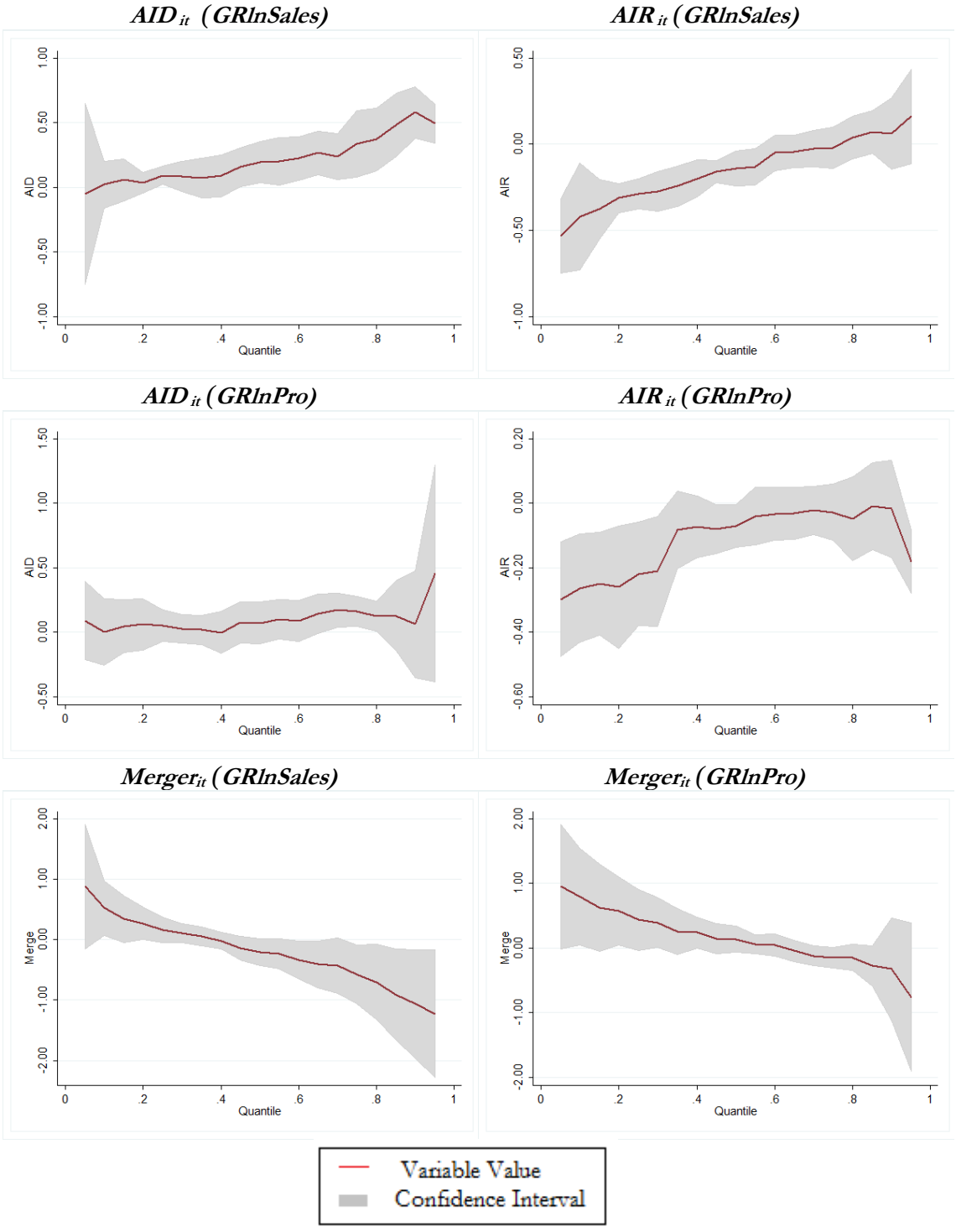
Source: Authors.

Figure 3. Two way Kernel Densities of *lnSales*. *AIDA* and *AIRA* comparisons.



Source: Authors. Note: We realize the Kolmogorov-Smirnov test for equality of distribution functions. We refuse the null-hypothesis of equality with a p-value of 0.020 AIDA (LnSales), 0.001 AIRA (LnSales), AIDA 0.006 (LnPro) and AIRA 0.023 (LnPro) densities.

Figure 4. Impact of *AID*, *AIR* and *Merger* on dependent variables across quantiles.



Source: Authors. Note: Coefficients of AID, AIR and Merger across quantiles. The respective values are connected by a solid red line along with an estimated 95% Confidence Interval. Source: Authors.

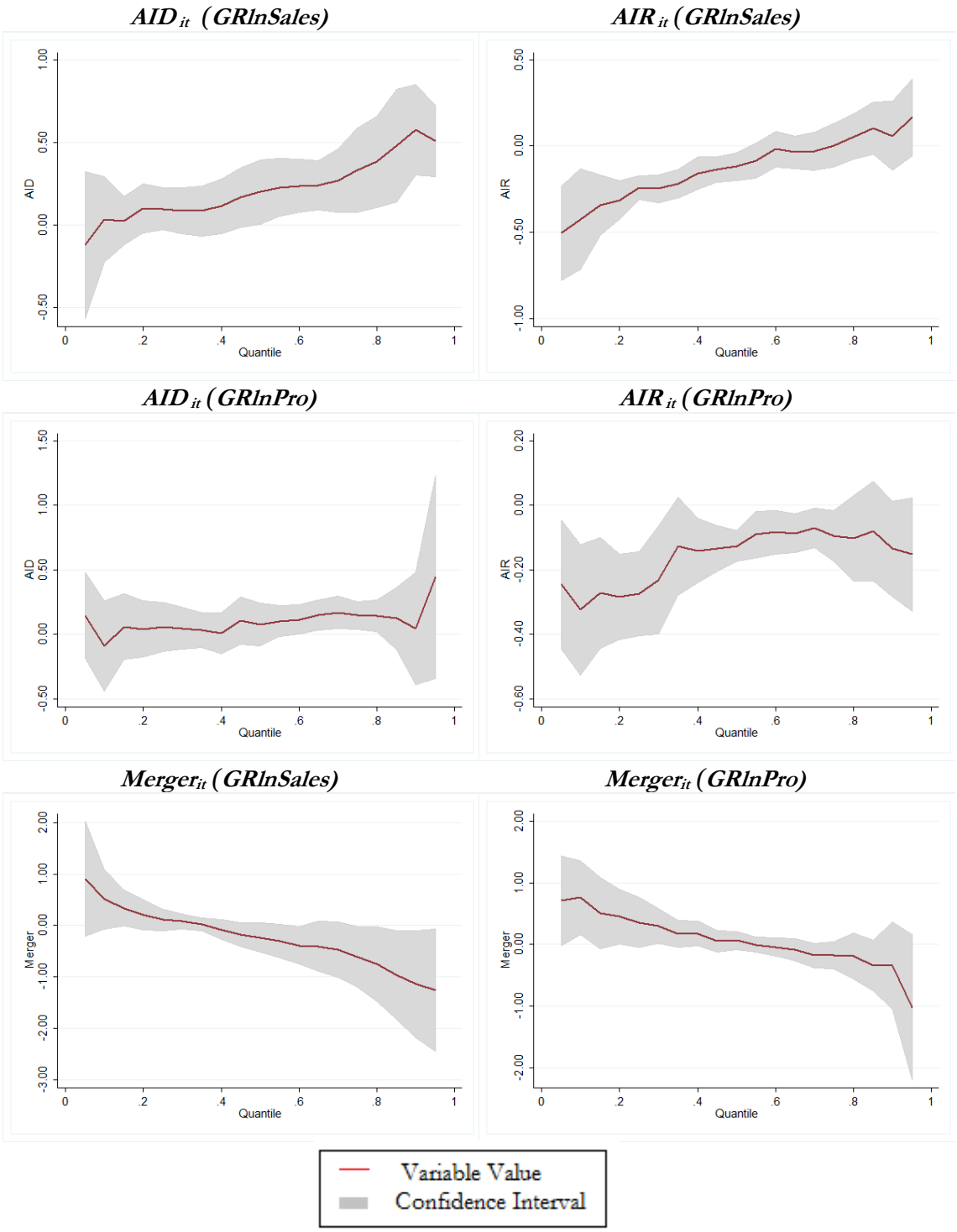
ANNEX

A1. Correlation Table

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) LnSales (lagged)	1.000							
(2) lnPro (lagged)	0.604*	1.000						
(3) LnAge	0.313*	0.134*	1.000					
(4) LnAge^2	0.288*	0.111*	0.958*	1.000				
(5) Merger	0.011	-0.008	-0.011	-0.015	1.000			
(6) AID	0.114*	0.010	0.033*	0.033*	0.114*	1.000		
(7) AIR	0.059*	-0.073*	-0.058*	-0.068*	0.068*	0.055*	1.000	
(8) Debtr (lagged)	-0.198*	-0.117*	-0.063*	-0.066*	0.002	-0.018	-0.004	1.000

Note: (*) Significance at 5%.

A2. Impact of *AID*, *AIR* and *Merger* on dependent variables across quantiles (Only firms located in the MAB).



Source: Authors. Note: Coefficients of AID, AIR and Merger across quantiles. The respective values are connected by a solid red line along with an estimated 95% Confidence Interval. Source: Authors.