Effects of foreign acquisitions on R&D activity: some evidence from firm-level data

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Abstract

This paper investigates the causal effect of foreign acquisitions on the research and development (R&D) activity of target firms over the period 1994-2004. Based on an unique accounting database of French manufacturing firms, we implement appropriate difference-in-difference estimation techniques associated to a matching propensity score procedure. Our results cast some doubt on the usual fears regarding foreign takeovers and their impact on the R&D activity of target firms and the national innovation system of the host country: international acquisitions do not hamper the R&D development of the target firm. On the contrary, they seem to bring positive long-run effects on the volume and nature of R&D projects. R&D expenditures and the skilled-intensity of R&D staff increase after the acquisition, while the share of basic R&D remains constant. In high-intensive technological sectors, we detect a positive impact on innovative output, measured by the number of patents. In addition, we observe that foreign partners finance more the R&D activity of the target firm after its acquisition. R&D is also more contracted out to local public laboratories and universities. These findings suggest that efficiency gains could be predominant over market power and that international mergers are motivated by technology sourcing and overseas R&D development. Buyers might access new R&D capabilities from firm knowledge assets and country environment that they strengthen and develop further. In contrast, it is likely that domestic acquisitions are more focused on short-term defensive actions and driven by the seek of market power or subject to a redeployment of R&D resources from the target firm to the parent company.

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1 Introduction

The 1990 decade experienced a new wave of mergers and acquisitions (M&A) which was unprecedented in terms of its size, sectoral coverage, and number of countries involved (UNCTAD, 2000). Compared to previous phases of consolidation, the activity of M&A was also characterized by a dramatic growth of cross-border operations.[1] They represented on average one quarter of M&A transactions, both in deal value and number. The return of merger operations since the years 2004 and 2005 continues to be distinguished by cross-border restructuring. This increasing role of foreign acquisitions in industrial globalization has raised some concerns for host countries. Governments are most often sceptical towards foreign takeovers of domestic firms, especially when acquired domestic firms are endowed with technological assets. There exists a fear that the innovative activity of the acquired firms will be reduced and shifted away, thereby depriving the local economy of strategic technologies and technological spill-overs. The impact of foreign takeovers might be crucial given their importance and the place of R&D as a source of innovation, and more generally of competitiveness and economic growth.

Motivated by this issue, we investigate empirically whether the acquisition of French firms by foreign companies affects their R&D behavior and if it does how. To the best of our knowledge, there are virtually no paper tackling this question, with the exception of Bertrand and Zuniga (2006). Bertrand and Zuniga investigate the impact of national and cross-border M&A on R&D investments in OECD countries from 1990 to 1999 at an industry level. They find that M&A contributed to increase R&D spending in some specific industries only and that domestic and

[1] Note that we will use indistinctly the terms merger and acquisition along this paper.

cross-border M&A might differ in their impact. In particular in medium-technology intensive industries, target firms seem to have benefited from foreign take-overs.[2] This present paper extends this previous work using firm-level data.

Most of existing studies on the impact of M&A on R&D investment and technology performance do not distinguished cross-border M&A from domestic operations or only consider domestic restructuring. Past works tend to conclude that M&A decrease R&D investment of merging firms (Hitt *et al.*, 1991 and 1996; Ravenscraft and Scherer, 1987). More recent studies converge to highlight more technology-pushing effects. At the firm level, Hall (1999) find an increase in R&D spending in the American manufacturing industry over the period 1976-1995. Also, Hagedoorn and Duysters (2000) observe in the American computer industry that related M&A might lead to an improvement in firm technological performance. Arora *et al.* (2000) come to similar conclusions in the American chemical industry for the years 1987 to 1997.[3] Besides, Capron (1999) and Cassiman *et al.* (2005) strive at identifying some corporate contexts and partner characteristics contributing to the development of innovative activity. Capron stresses that rationalization and restructuring economies might enhance technical capabilities and then stimulate R&D efforts of merging firms. Cassiman *et al.* show that merging firms were less likely to expand into new R&D fields or leverage their technological competences across products and markets, when they were rivals in the product market and endowed with market-related technologies.

The relationship between foreign acquisitions and R&D also matters with respect to the large increase in the overseas R&D of multinational firms. Affiliate R&D expenditures increased by

[2]Note that to our knowledge, studies on technological determinants of cross-border M&A are also lacking (Frey and Hussinger, 2006; Takechi, 2006).

[3]See also Valentini (2004) and Ornaghi (2006) or Danzon *et al.* (2004) for investigations on mergers in the pharmaceutical industry.

more than 50 percent in the OECD area over the 1990s (UNCTAD, 2005). This increasing internationalization of R&D activities might reflect a shift in the role of R&D abroad from primarily supporting the local production units and adjusting products to the local market to knowledge creation and sourcing.

In this context, our contributions to the industrial organization and R&D literature are twofold. First, we analyze at the firm-level the R&D activity of target firms before and after a foreign acquisition. Second, we explore the impact of M&A on both the internal and external dimensions of R&D. To the best of our knowledge, this paper is the first to examine this question. Our study covers French manufacturing companies over a long period going from 1994 to 2004. To evaluate the impact of take-overs, we apply appropriate difference-in-difference estimation techniques associated to a matching propensity score procedure.[4] We investigate if acquisitions could influence the quantity and quality of R&D inputs and outputs. We also wonder whether they modify R&D linkages between target firms and the local economy through the decisions of R&D outsourcing and the financing of R&D from external partners. From the point of view of the host country development, what matters is not only the performance of the target firm but also the intensity of its linkages with the local economy. As an unique opportunity to redesign the organizational firm boundary, foreign acquisitions might affect the national innovation system of host countries and local knowledge spill-overs from and to target firms. We finally test the robustness of our findings by decomposing our sample according the level of technology intensity or the country origin of the acquiror. We also compare foreign acquisitions to domestic operations. The policy of national champion tends to encourage mergers between domestic firms and to strictly control foreign take-overs. Beyond arguments of national security and sovereignty,

[4] As explained later, the matching method creates the missing counterfactual of a merging partner had it not been involved in the acquisition process. The difference-in-difference estimation methodology then enables to isolate changes due to the M&A event only.

the objective of this discriminatory policy is to foster local innovation and improve the competitiveness of domestic companies on global markets.

We come to the conclusion that foreign acquisitions do not seem to be harmful to the research activity of the local target firm or the national innovation system of the host country. On the contrary, we first observe a positive long-run impact on R&D inputs. Acquisitions are followed by an increase in R&D expenditures and the skilled-intensity of R&D staff. In addition, they do not modify the share of basic R&D and therefore the R&D horizon as expected usually. Besides, in high-technology intensive sectors, we detect a positive impact on innovative output, measured by the number of patents. In addition, while exploring the extent and the type of relationship between the target firm and its research environment, two main results stand out: after its acquisition, foreign partners finance more the R&D activity of the target firm. Its R&D is also more contracted out to local public laboratories and universities. These main findings which are robust across sectors and the country origin of the buyer suggest that efficiency gains could be predominant over market power motives and that international mergers are driven by technology sourcing and overseas R&D development. Buyers access new R&D capabilities from firm knowledge assets and country environment that they strengthen and develop further. In contrast, domestic acquisitions appear to be led by defensive motivations and the seek of market power or followed by a redeployment of R&D resources from the target firm to the parent company.

The article proceeds as follows: section 2 presents the literature review and section 3 describes data. Section 4 reports the econometric model, while section 5 discusses empirical findings. Conclusions are drawn in the last section.

2 Theoretical Background

The theoretical literature examining the relationship between mergers and R&D presents mitigated findings. It usually identifies two main channels through which M&A might alter R&D: anti-competitive effects and efficiency gains, the latter being conceived in their broadest meaning. On the one hand, M&A could enhance R&D efficiency, pushing firms to develop their innovative capabilities. The spreading of fixed costs over more output increases the incentive to invest in R&D and leads to a rise in the scale of investments. Some more promising and costly R&D programs are likely to be launched; the Schumpeterian literature traditionally stresses efficiency gains in R&D due to market concentration and firm size.[5] In addition, M&A might serve as a means of diffusing knowledge across research units. The complementarity of technology assets and knowledge of merging partners could improve R&D efficiency, once more making them increase their R&D expenditures. M&A also internalize R&D externalities among firms; R&D investment is increasing in the level of spillovers when firms cooperate (Katz, 1986; D'Aspremont and Jacquemin, 1988). More generally, M&A enable merging firms to reallocate and reorganize their R&D efforts among their different research centres; they offer them the opportunity to redefine their R&D programs, then deciding to specialize in some technological fields, divest or outsource in others. Finally, M&A allow them to rethink their relationship with the different R&D institutes with whom they could collaborate. On the other hand, the elimination of R&D competition might generate the reverse effect; a decrease in technology competition might reduce the incentives to innovate (Kamien and Schwartz, 1982; Reinganum, 1983). Similarly, greater market power in goods markets tends to discourage merging firms from spending on R&D activities.[6] Furthermore, M&A could allow firms to save duplicated input goods in terms

[5] Financing of R&D investment could be facilitated if internal financing become more abundant and the access to financial markets easier as a result of the merger.

[6] In addition to unilateral anticompetitive effects, M&A are also likely to facilitate collusion among competing firms.

of personnel or equipment. It might enhance the efficiency of the R&D process, but also reduces the level of R&D spending in the short run.[7] Besides, M&A are likely to be accompanied by larger bureaucracy costs (Hannan and Freeman, 1984). Larger firms could be confronted with longer delays and higher costs of information transmission or for instance a lower capacity to attract high-skill researchers (Zenger, 1994). If M&A generate organizational problems and internal conflicts, merging firms might also be unable to achieve planned efficiency gains (Caves, 1989). Finally, M&A might divert the attention and efforts of managers, as well as financial resources, from innovation.

These main effects are not particularly specific to domestic acquisitions only. There could also be prevalent with cross-border M&A. At this point, it is important to point out that the theoretical and empirical literature has still little to say about cross-border mergers and their distinct effects as compared to domestic operations. The literature on international acquisitions is still in the infant stage. It is unfortunately beyond the scope of this paper to elaborate a formalized model examining the impact of domestic and international mergers on all external and internal dimensions of innovation. However, it could be expected that the extent of gains or costs related to cross-border mergers differ. In comparison to purely domestic mergers, they could bring higher efficiency gains. Indeed, they might represent a stronger source of complementarities, creating a larger one-way or two-way diffusion of know-how within the firm. Merging partners are indeed more likely to be different in terms of technological characteristics when initially being located in distinct countries.[8] On the other hand, cross-border M&A might entail higher organizational costs of firm integration. Cultural and geographical distance, in addition to distinct corporate cultures, might certainly hamper technology transfer by making communication, assimilation

[7] Asset rationalization could be more important when firms are in the same technology field and are close rivals in the product market (Cassiman *et al.*, 2005).

[8] Since the economic context shapes firm innovation capabilities, the heterogeneity of merging firms might reflect country disparities in terms of capital and labor endowment, judicial and institutional environment, etc.

and application of new knowledge more difficult (Kogut and Zander, 1992). Certainly, organizational changes are also more difficult to implement for cross-border M&A than for domestic operations. This could be amplified by the fact that foreign buyers are less well-informed on target characteristics than domestic buyers (Gioia and Thomson, 2004). Moreover, cross-border M&A are likely to be associated with lower R&D duplications if technology assets are less substitutable. Regarding anti-competition effects, these are probably more important for domestic M&A. They are more likely to predominate and have a negative effect on R&D, since there was a more direct competition between merging firms.[9]

Therefore, there is no clear-cut prediction as to whether technology-pushing effects are stronger (or lower) for cross-border M&A. Empirical investigations could help to give some guidance. Furthermore, even if a cross-border merger increases the joint-R&D investment of merging firms, buyer and target firms might not benefit equally from M&A gains. This would be the case if there is a unilateral resource redeployment from target firms to buyers, or the other way round (Capron *et al.*, 1998). If the technological knowledge of merging partners is substitutable and merging firms are searching for scale economies in R&D activities, only one merging partner could take advantage of gains in R&D efficiency.[10] Also, the foreign buyer could decide to centralize R&D in its home country to avoid technologies from being dissipated and costly duplicated measures of knowledge protection. Moreover, technological motives behind cross-border M&A are of importance. Firms could go abroad not only to exploit its technology capabilities and knowledge assets, but also to access and source foreign technology (Kuemmerle, 1999).[11]

[9]Geographical proximity by removing some barriers to trade reinforces competition and thus, the incentives to merge for anti-competition purposes (see the spatial economics literature as e.g. Levy and Reitzes, 1992). Nevertheless, contrary to domestic operations, cross-border M&A might facilitate collusive pricing behaviour across markets by increasing multi-market contacts among firms (Bernheim and Whinston, 1990).

[10]External technology and internal R&D efforts might be complementary or not according to different factors such as the firm ability to appropriate innovation and knowledge flows, their size and R&D orientation, etc. (Cassiman and Veugelers, 1999 and 2003).

[11]The literature on multinational firms explores the complex relation between R&D and foreign direct invest-

3 Data Description

M&A covered by our empirical study occurred during the fifth wave from 1995 to 2001. They are identified from the French LiFi database (Enquêtes Liaison Financière). This database indicates the ownership structure of firms of more than 500 employees located in France. Data are collected each year by the French ministry of industry (SESSI). For the purpose of our study, we examine a specific subset of acquisitions in manufacturing industry. First, we keep majority M&A only. By doing it, we are more certain that there exists a long-term strategic relationship between acquirors and target firms. Second, we want to capture the impact of a single acquisition on target firms and to avoid confounding effects from multiple events. We thereby remove all firms which were acquired several times and those which were both a target and a buyer over the given period. Finally, we need to evaluate the effects of take-overs comprehensive information on target firm characteristics at least one year before and three years after the acquisition. Innovation activity very certainly takes time to be reorganized and reconfigured by their new owners. Eventually, our sample includes 123 cross-border M&A after the selection process (see the next section). This number is satisfactory as regards to our sample selection method and to the sample size of previous accounting-data studies.

Furthermore, we stress the following points. First, our sample does not comprise merger operations where the buyer fully integrates the assets of the target firm. We strictly analyze acquisition strategies: the buyer takes the control of the target firm but keep it going as a separate entity.[12] Second, the great majority of M&A in our sample are horizontal (around 85%). Horizontal M&A are defined as operations between firms within the same industry at a 4-digit

ment (e.g. Petit and Sanna-Randaccio, 2000; Norbäck, 2001). See also a new theoretical literature in trade separating FDI into greenfield investments and international acquisitions (Nocke and Yeaple, 2006; Norbäck and Persson, 2006).

[12] In general, cross-border acquisitions strongly predominated over mergers in the 1990's (UNCTAD, 2000). Mergers represented less than 3% of M&A in number. Most of them consisted in friendly operations.

level. Finally, it seems that none of these acquisitions involved a state-owned company. The variable providing information on the public status of the firm however contains a significant share of missing values. The sector composition of target firms and the effective date of acquisitions are described by the table 3 and 4 respectively in appendix B. The country origin of buyer firms is provided by table 5.

This LiFi database is coupled with two other firm-level datasets called EAE and R&D enquiry. These two censuses are also undertaken each year by the French ministry of industry. They give information on general and innovative characteristics of firms from 1994 to 2004 (see table 6 in appendix for some descriptive statistics). All monetary variables contained in these databases are expressed in French currency (in thousands of francs) and are deflated using 1995 prices as a benchmark. More precisely, the EAE database includes accounting information on productive inputs and outputs of individual firms. The R&D database provides very rich details on the R&D activity of French firms. It displays both the internal and external dimension of research activity. We however limit our study to the analysis of several variables. The first series of variables broadly depicts the quantity and quality of R&D inputs and outputs:

- Total R&D expenditures (variable denoted *RD Exp*): it corresponds to the sum of external and internal R&D spending.

- Share of basic R&D (variable *RD Basic*): it is equal to basic R&D expenditures divided by internal R&D expenditures. Basic research advances scientific knowledge without immediate commercial objective. It contributes to firm research capabilities and absorptive capacity on the long run.

- Average wage of the research team (variable *RD Skill*): it is calculated as total wages of R&D workers divided by their number. It gives indication on the skill-intensity of R&D

labor force employed in the innovative process.

- Total number of patents (variable *Patent*): this variable that is supposed to reflect the output of R&D is used with parsimony because of data restraint. Patents are recorded only from the year 1999, which precludes us from assessing long-term effects for a large sample of acquisitions.

The rest of the variables exhibits the inflows and outflows of R&D resources between the firm R&D laboratory and its economic environment:

- Share of R&D expenditures financed by external partners (variable *RD Fin*): it represents the sum of external private and public fund divided by total R&D expenditures. This variable describes the share of R&D that is financed either by the parent company or by other private companies and public institutes in France and abroad. It could consist in subsidies from State or financial transfers from the foreign parent company without compensation. It could also take the form of contracts and the delegation of a research project to the firm research centre. Note that we take into account intra-firm flows from parent company because we are focusing on the national innovation system of the host country and its total financial resources flows from abroad.[13]

- Share of R&D expenditures financed by French public fund (variable *RD Fin-Public*): it is equal to French public fund divided by total R&D expenditures.

- Share of R&D expenditures financed by foreign fund (variable *RD Fin-Foreign*): it corresponds to foreign fund divided by total R&D expenditures.

- Share of R&D expenditures outsourced to external R&D institutes (variable *RD Ext*): it is equal to external R&D divided by total R&D expenditures. This indicator accounts for

[13] We tried another measure without intra-firm flows. Main results were similar.

firm decisions of R&D outsourcing. It describes the extent to which R&D projects are delegated to either the foreign parent company or to a private and public R&D institute. It reflects vertical linkages between the target firm and local suppliers. The presence of vertical linkages is likely to promote the generation of spillovers from the foreign parent company (WIR, 2005).

- Share of R&D expenditures outsourced to French public R&D institutes (variable *RD Ext-Public*): it corresponds to external French public R&D divided by total R&D expenditures.

- Share of R&D expenditures outsourced to foreign R&D institutes (variable *RD Ext-Foreign*): it is equal to external foreign R&D divided by total R&D expenditures.

Finally, note that our database has one main limitation. As most accounting studies in this field, we are not able to collect information on foreign buyers at the firm-level. Nevertheless, from the perspective of a host country welfare, on which we focus, analyzing the performance of target firms only could be sufficient.

4 Econometric Methodology

The effect of an acquisition on the outcome (here the different dimensions of the research activity alternatively) of a target firm is defined as the difference between the outcome of the firm involved in this merger and the outcome that this firm would have reached otherwise. The impact of this strategy is therefore measured by the variation in the outcome which is attributable to the acquisition event only. However, assessing this specific change requires to know what the outcome would have been if the target firm had not been participated to the acquisition process. The difference-in-difference (hereafter *DID*) approach is well adapted to deal with this question (Meyer, 1994; Heckman *et al.* 1997). The idea that it develops is simple: comparing the outcome of a company before and after an acquisition is not satisfactory. Indeed, we could

wrongly attribute to a M&A a variation in the outcome that is actually due to a change in the economic environment, as unobserved industry or macroeconomic shocks. To control for this skew, and by supposing that a modification of the economic situation affects all firms in an identical way, the *DID* method compares the difference in the outcome before and after the acquisition for a target firm to that in the outcome before and after this operation for a control group composed of non-target firms. We present more formally this method in appendix A.

Yet, it remains to explain the choice of the comparison group. Intuitively, the *DID* method does not conduct to valid estimations if the comparison group already differs greatly from target firms over the pre-acquisition period. To remedy it, we combine the *DID* estimation to the matching method (Blundell and Costa Dias, 2000). Propensity scores matching techniques identify a control group without markedly differences in characteristics compared to target firms. They control for endogeneity and ex-ante observable firm characteristics (Dehejia and Wahba, 2002). Failure to account for the selection issue could bias the estimated impact of M&A when using a simple OLS method.[14] The propensity score method allows us to control for selection based on observed firm characteristics. It consists in evaluating the probability that a firm be involved in an acquisition according to a vector of its firm variables (Rosenbaum and Rubin, 1983).[15] The estimation of this probability value is as follows:

$$Pr(ACQ = 1) = F(Z) \tag{1}$$

where ACQ is a dummy variable taking the value 1 for target firms and 0 otherwise. The vector

[14] It may lead to a correlation between being involved in a merger and the error term in the outcome equation. It will be the case if acquisition decision is not a random process, but is due to observable firm characteristics which are also influencing the post-merger outcome.

[15] Indeed, matching firms directly could require comparing target and non-target firms across a too large number of observable pre-acquisition characteristics. The propensity score method reduces the dimensionality issue by capturing all information from these characteristics on a single basis.

Z represents a set of firm characteristics. Once propensity scores are calculated, observations from target and non-target firms are matched. Each target firm is associated with a control firm endowed with a similar propensity score.

To conclude this section, it is necessary to discuss the choice of this method. There exist indeed several ways of dealing with selection bias and endogeneity. None of them is without drawbacks. The advantages of our methodology are clearly exposed by Arnold and Smarzynska Javorcik (2005). First, contrary for instance to a Heckman two-step procedure, this method does not require the selection of instrumental variables influencing the variable of outcome but not the acquisition decision. The selection of such variables is crucial, but unfortunately never obvious. Second, it allows us to follow the trajectory of R&D activity rather than just estimating the average effect. Third, it enables to track changes in various dimensions of R&D without having to model them explicitly. There is nevertheless a limitation of this methodology. It relies on the assumption (called conditional independence) that the decision of acquisition is completely determined by observable firm characteristics. In our study, to reduce the bias due to unobservable factors affecting both strategy choice and outcome, target firms are paired with non-target firms within the same industry and year. Moreover, the use of the *DID* estimation also attenuates the bias due to unobservable factors. The combined methodology of *DID* and matching propensity allows us to control for observable and unobservable but constant differences between target and non-target firms.

5 Econometric Estimation

5.1 The Propensity Score Matching

The first stage of our econometric strategy consists in finding a well-suited control group. To this aim, we evaluate the probit estimation of the equation 1 in section 4 for target firms involved in a cross-border operation.[16] Each acquired firm is then matched with the closest non-acquired firm within the same industry and year in term of its propensity score. We use the caliper option to select the control firm. By doing it, we reduce the possible bias caused by unobservable temporal and sectoral determinants. Besides, we impose a common support (overlap condition) by removing treatment observations for which the propensity score is higher than the maximum or less than the minimum of the score of control firms. Furthermore, to both avoid some problems of endogeneity and take into account anticipatory effects, all independent variables Z are lagged one year. We express variables taking non-zero values in logarithm.

We select different determinants of acquisition. We first control for non-technological motivations. Since the propensity of a firm to be taken over basically depends on its broad performance, we include firm home market shares (variable *MS*).[17] Market shares are calculated at the four-digit level of industry. This indicator reflects firm performance at home. It gives indication on revealed competitive strengths from technological or managerial firm-specific assets. It is also a proxy of firm relative size. Then, we add the export intensity of firms as measured by the ratio exports on total sales (variable *Export*). It captures firm performance abroad. At this point, two remarks are necessary. We have preferred the variable *MS* to a direct measure of firm size (as em-

[16] We replicate the same procedure for domestic acquisitions. See in appendix B tables 10 and 11.

[17] However, the relation between performance and M&A could be not straightforward. For example, M&A could act as a managerial disciplining device to remove bad managers. By taking-over a low-performing firm, an investor may expect to implement his more efficient organizational and technological practices, thereby generating efficiency gains. However, M&A are an ambivalent phenomenon. They could also reflect personal interests of managers. Furthermore, some investors might be incited to take over high-performing firms to benefit from their technological knowledge or superior management resources.

ployment level or turn-over) because of a too high level of correlation between firm size variables and some technological indicators. Besides, to control for the robustness of this first stage, we have tested different estimations where we have added or substituted for other non-technological variables, like labor productivity or financial indicators such as cash-flows. Specifications look either less relevant (although results from the second stage are most often similar) or are not satisfying regarding the test of matching that we describe just later.

Second, we take into account the different dimensions of firm research activity that could influence the likelihood of acquisition (see section 3): the quantity of R&D spending (variable *RD Exp*) ; the quality of R&D (variable *RD Skill*, variable *RD Basic*); the intensity of linkages between the firm R&D laboratory and its economic environment (variable *RD Fin* and *RD Ext*). Since all these different aspects are likely to be affecting by the acquisition process and subject to a post-merger firm reorganization, they could also play a role in the choice of the target firm and their probability of being acquired. Note that we do not select the variable *Patent* in the regression because of data limitation. Introducing it at this stage would oblige us to dramatically restrict our sample. In addition, we have tried specifications including it but without noticing a major variation in the sign and significance of the variable *Patent*. Finally, we have checked that there is neither excessive statistic correlation (see table 7 in appendix B), nor multi-collinearity among selected variables.

Based on pooled cross-section data, table 8 in appendix B displays the efficiency of the matching procedure.[18] As observed, there is a dramatic reduction in bias for all variables when pairing target firms to their respective control firms.[19] Once reduced, the remaining bias is very low. This method thus provides a valid group of firms to which we will compare changes in target

[18] For each independent variable, the difference between target and control firms is checked, employing T-test on the differences within bands of the propensity score.

[19] The bias is calculated as the difference of the sample mean in sub-samples of the target and non-target firms divided by the square root of the average of the sample variances in groups of the target and non-target firms.

firm performance. Finally, as seen in table 9 in appendix B, the probability of being a target firm reacts positively to the variable *Market Share*. Firms holding a high market share have a greater likelihood to be acquired. Besides, there appears an inverted U-shaped relationship between the variable *Export* and the propensity of being taken-over. Concerning technological determinants, the variables *RD Exp*, *RD Skill* and *RD Ext* display a positive and significant sign. Firms endowed with technological assets both in quantity and quality are more likely to be subject to an acquisition. The acquisition probability could also depend positively upon the extent to which firms outsource their R&D activity. It could signal an already-etablished strong relationship with other R&D centers whose the buyer could take profit. The other technological factors (variable *RD Basic* and *RD Fin*) are non-significant.

5.2 Impact of cross-border M&A

In the second part of our estimation strategy, we compute and then track over time the average difference in outcome between acquired firms and their counterfactual firms relative to the year for which firms are paired. In the different tables that we are going to expose, the variable ACQ_{T+x} with x=$\{0,1,2,3\}$ refers to the effect of take-overs x years after the acquisition.

Table 1 displays estimations for cross-border acquisitions. The different columns exhibit econometric results for each of technological variables that we analyze. As it could be seen, there is first no evidence of a reduction in R&D spending (column *RD Exp*). On the contrary, there is a positive impact of acquisition on the level of R&D expenditures undertaken by the target firm. Nevertheless, effects only start two years after the acquisition; the amplitude of the impact seems to be increasing over time. In addition, we observe that acquisitions improve the skill-intensity of R&D staff, but again on the long run (column *RD Skill*). It suggests that firms after their acquisition manage to keep their key researchers and even to attract higher productive

R&D employees. Acquisitions could be not done to the detriment of staff motivations. Finally, variables ACQ_{T+x} for columns *RD Basic* and *Patent* are non-significant. Acquisitions do not influence the share of fundamental R&D; they do not drive to a more conservative and short-run firm view. They do not affect the number of patents that target firms register either. The latter finding should however be mitigated given the dramatic decrease in sample size.

From this first set of variables, it could be concluded that contrary to usual fears, there is some evidence that foreign take-overs could allow domestic target firms to develop more their R&D capacity and improve their R&D technology on the long run.[20] These first findings also converge to say that efficiency gains could be predominant over market power effects and that these international mergers might be motivated by technology sourcing and overseas R&D development. Parent companies do not appear to centralize their R&D activity at home. In the perspective of the buyer, acquisition might represent a quick and less risky strategy to access a new technology, as expected from the previous probit estimation.

Now, we turn to technological variables that proxy the extent and type of relationship between the target firm and its research environment. For a host country, the performance of the target firm but also its linkages with the local economy matter. It is found that acquisitions increase the share of R&D that is financed by external partners two years after the acquisition (column *RD Fin*). The impact is more substantial over year. Foreign partners seems to finance more the R&D activity of the target firm (column *RD Fin-Foreign*). In the opposite, the variable ACQ_{T+x} for *RD Fin-Public* is never significant. Besides, there is a rise in the share of R&D that is outsourced three years after the acquisition. The variable ACQ_{T+3} for the column *RD*

[20] Very often along this paper, effects occur only on the long run. The lack of short-run effects could be explained by several factors. It could be interpreted as evidence of merging firms failing to perform efficiency gains in R&D or an increase in market power during the first post-merger years. In addition, even if there were some positive effects from M&A, gains could be outweighed by the costs of integration of the new entity. In this context, when restructuring the R&D process takes time, all planned gains could be not effective and achieved immediately after the ownership change.

Ext is positive and significant. When looking at the column *RD Ext-Public*, it is seen that R&D is contracted out to local public laboratories and universities. In contrast, ACQ_{T+x} for *RD Ext-Foreign* is not significant. As explained in section 2, mergers present the unique occasion to redefine firm boundary and renegotiate contracts: through the acquisition, the foreign investor might gain access to the innovative capabilities and external expertise of the local economy.[21] If linkages with local environment are viewed as efficient, they could be interesting not only in retaining it but also in developing it further (UNCTAD, 2005).[22]

To conclude, this second group of technological variables tends to question the assumption that foreign acquisitions are harmful for the national innovation system of the host country. It is shown that target firms could use local sources and cooperate more with local partners, especially local public institute. The presence of stronger vertical linkages may thereby create favorable conditions to the generation of R&D spillovers from the foreign parent company and its newly affiliate to the benefit of the host country (UNCTAD, 2005). Besides, findings confirm that foreigner investors could go abroad to access advanced technologies and research capabilities of the host country.

We now proceed to further assessment.[23] It is first possible that the impact of cross-border mergers varies with the level of technology intensity. The extent of market power and efficiency gains could be not uniform across sectors. To this aim, we split our sample according to whether

[21] Geographic proximity may explain the preference for local supplier. It decreases the cost of uncertainty and monitoring due to incomplete contracts.

[22] This result could however be also interpreted as a lower priority of the target firm to internal R&D project. This assumption is not very likely since we observe a rise in the average wage of R&D staff and that internal R&D is increasing following the merger. This last result is available upon request. Our results could therefore mean that target firms strengthen their technology core competencies while divesting operations lying outside their core business. Note that from the firm perspective, the solution of outsourcing might entail some additional costs due to supplier selection, negotiation and control. Moreover, it increases the risk of dependence and loss of know-how.

[23] We do not decomposed our sample into horizontal and non-horizontal acquisition since the great majority of these operations are horizontal.

firms belongs to low and middle or high-technology intensive sectors.[24] In table 12 in appendix B, we observe no significant change or any difference between these two groups of industries, with the notable exception of the variable *Patent*. Interestingly, this variable has a positive and significant effect in high-technology intensive sectors. Positive effects due to an increase in R&D inputs or an improvement of the R&D production function could be likely. As already noticed, this result should however be attenuated regarding the reduction of our sample. Note also that in low and middle technology intensive sectors the variable *RD Ext* takes a negative and significant sign. Acquisitions tend to lower the share of R&D that is outsourced the year of acquisition and the following year. Nevertheless, this does not persist on the long run, since this variable becomes non-significant two years after the ownership change.[25]

Furthermore, we test the robustness of our findings by decomposing our sample according to the country origin of the buyer. We divide cross-border mergers depending on whether the buyer country is a member or not of the European Union. Economic as well as cultural and institutional proximity of French companies should be higher with other European firms. Nevertheless, we do not remark from table 13 in appendix B any real qualitative difference compared to pooled regression. It could just be pointed out that the variable *RD Fin* becomes non-significant for non-European mergers.[26]

Finally, we run regression for domestic acquisitions. Over this period, our database includes 157 domestic M&A after the selection process. Around 75% are horizontal. As seen in table 2, temporary negative effects are observed for R&D spending following the acquisition: inefficiencies generated by the acquisition or an increase in market power might lead to lower R&D spending. However, on the long run, acquisitions do not affect R&D efforts (column *RD Exp*). Besides, there is a decrease three years after the acquisition in the skill-intensity of R&D staff (column

[24] We follow criteria held by the OECD for manufacturing industries (OECD, 2001; Hatzichronoglou, 1997).

[25] Variables *RD Ext-Foreign* and *RD Ext- Public* are also non-significant in the long run. Results are available upon request.

[26] Variables *RD Fin-Foreign* and *RD Fin-Public* are non-significant too. Results are available upon request.

RD Skill). It is also the case for the share of R&D that is devoted to basic R&D (column *RD Basic*). There is a permanent negative effect one year after the acquisition; R&D horizon becomes shorter. Eventually, the variable ACQ_{T+x} is never significant for the column *Patent*. Concerning the external dimension of R&D, there is no permanent effects on the share of R&D financed by foreign partners. There is only a significant and positive but transitory impact for *RD Fin-Public*. In addition, contrary to international acquisitions, domestic mergers lower the share of R&D which is outsourced, in particular the R&D activity which is delegated to French public institutes (see columns *RD Ext* and *RD Ext-Public*). Target firms become less integrated with public institutes after acquisition. It could confirm the lower interest in fundamental R&D since public institutes are probably more oriented towards basic R&D activity. These findings tend to suggest either that national acquisitions are more driven by defensive motivations and the seek of market power or that the acquisition is followed by a redeployment of resources from the target to the parent company. This last point is beyond the scope of this paper but will deserve further investigation.

Table 1: Effect of cross-border acquisitions

	ln RD Skill	ln RD Exp	RD Fin	RD Fin-Public	RD Fin-Foreign	RD Basic	RD Ext	RD Ext-Public	RD Ext-Foreign	Patent
ACQ_{T+0}	0.057	0.060	0.052	0.010	0.027**	0.003	0.026	0.003	0.001	0.667
	(0.042)	(0.069)	(0.072)	(0.017)	(0.012)	(0.014)	(0.025)	(0.003)	(0.010)	(0.866)
ACQ_{T+1}	-0.018	0.044	0.204	0.014	0.071	0.007	0.014	-0.002	-0.003	0.540
	(0.042)	(0.066)	(0.130)	(0.014)	(0.042)	(0.007)	(0.021)	(0.015)	(0.011)	(0.566)
ACQ_{T+2}	0.117	0.310*	0.236*	0.023	0.102**	0.022	0.036	0.018	0.008	0.940
	(0.094)	(0.170)	(0.115)	(0.023)	(0.048)	(0.015)	(0.027)	(0.022)	(0.016)	(0.597)
ACQ_{T+3}	0.269*	0.536**	0.311*	0.002	0.188**	0.009	0.089**	0.070**	0.006	-1.160
	(0.150)	(0.251)	(0.145)	(0.031)	(0.077)	(0.021)	(0.041)	(0.033)	(0.027)	(0.948)
Constant	-0.484**	0.261	-0.380**	0.055	-0.186**	0.086*	0.065	-0.101	0.029	0.910
	(0.202)	(0.534)	(0.137)	(0.066)	(0.077)	(0.046)	(0.039)	(0.165)	(0.028)	(1.170)
Observations	984	984	984	984	984	984	984	984	984	488

Sector and year fixed effects are included.
Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%;*** significant at 1%

Table 2: Effect of domestic acquisitions

	ln RD Skill	ln RD Exp	RD Fin	RD Fin-Public	RD Fin-Foreign	RD Basic	RD Ext	RD Ext-Public	RD Ext-Foreign	Patent
ACQ_{T+0}	-0.059	-0.013	-0.017	0.067*	-0.006	0.006	-0.007	0.013	-0.008	1.775
	(0.047)	(0.074)	(0.048)	(0.031)	(0.005)	(0.008)	(0.019)	(0.009)	(0.008)	(1.991)
ACQ_{T+1}	-0.054	-0.142*	-0.137	0.024*	-0.014	-0.032*	-0.002	-0.002	-0.003	1.083
	(0.045)	(0.083)	(0.090)	(0.013)	(0.008)	(0.016)	(0.002)	(0.002)	(0.003)	(1.058)
ACQ_{T+2}	-0.083	-0.111	-0.241	0.024	-0.020	-0.039***	-0.002	-0.003	-0.002	2.083
	(0.057)	(0.157)	(0.212)	(0.023)	(0.014)	(0.007)	(0.002)	(0.004)	(0.004)	(2.119)
ACQ_{T+3}	-0.141**	-0.149	-0.281	0.009	0.001	-0.047**	-0.009*	-0.009*	-0.002	1.774
	(0.060)	(0.190)	(0.330)	(0.041)	(0.018)	(0.022)	(0.005)	(0.004)	(0.006)	(1.914)
Constant	0.054	-0.369*	0.190	0.010	-0.029	-0.025*	0.009	-0.002	-0.010	0.083
	(0.048)	(0.221)	(0.384)	(0.006)	(0.019)	(0.014)	(0.010)	(0.012)	(0.013)	(0.439)
Observations	1256	1256	1256	1256	1256	1256	1256	1256	1256	640

Sector and year fixed effects are included.
Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%;*** significant at 1%

6 Conclusion

This paper examines the causal effect of international acquisitions on the different dimensions of R&D activity of target firms over the period 1994-2004. Using accounting data on French manufacturing firms, we implement appropriate difference-in-difference estimation techniques associated to a matching propensity score procedure.

We come to the main following conclusions: first, foreign acquisitions are followed by an increase in both the quantity and quality of R&D inputs as measured by total R&D spending and the skilled-intensity of R&D staff. We also display some potential effects on the innovation output in high-technology intensive industries. Second, we observe a rise in the share of R&D that is financed by foreign partners. Furthermore, R&D is more contracted out to local public laboratories and universities after acquisition. Findings therefore suggest that efficiency gains could be predominant over market power effects and that international mergers might be motivated by technology sourcing and overseas R&D development. They also question the assertion according to which foreign acquisitions should be detrimental to local target firms or to the national innovative system of the host country. In contrast, domestic acquisitions appear to be led by defensive motivations and the seek of market power or followed by a redeployment of R&D resources from the target firm to the parent company.

As a final comment, we discuss one limitation of our analysis. Our data do not allow us to investigate the impact of M&A across different countries and national innovation systems or to take into account the R&D behavior of foreign owners abroad. This problem is unfortunately not specific to our study, although the richness of our data in terms of internal and external R&D indicators makes any kind of replication harder. This is a clear challenge for researchers since to our knowledge, it has been so far practically impossible to get exhaustive and harmonized data for a large sample of firms from different countries. It is left for a future and probably very

fruitful research on globalization, restructuring and R&D.

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A Difference-in-difference Estimation

Formally, let Y_{it}^1 be the outcome variable in period t of a target firm i. We denote Y_{it}^0 the outcome of this firm i if it does not participate to this acquisition. The effect of the acquisition is then measured by $Y_{it}^1 - Y_{it}^0$ and the average impact of acquisition is described by $E(Y_{it}^0/ACQ = 1)$. The variable ACQ is equal to 1 for target firms and 0 otherwise. Unfortunately, missing data do not allow us to evaluate it directly: we cannot observe the firm i both as a participant and as a non-participant to a merger. In other words, we cannot know the outcome of a target firm if it was not involved in an acquisition, and conversely. To solve this difficulty, we compare the evolution of target and non-target firms assuming that they would have been identical in the absence of mergers:

$$E(Y_{it}^0/ACQ = 1, t = 1) - E(Y_{it}^0/ACQ = 1, t = 0) = E(Y_{it}^0/ACQ = 0, t = 1) - E(Y_{it}^0/ACQ = 0, t = 0) \tag{2}$$

The terms $t = 0$ and $t = 1$ designate the period before and after the acquisition respectively. Thereby, the missing counterfactual value could be replaced by the state of the target firm before the acquisition, adjusted for the growth in aggregate outcome:

$$E(Y_{it}^0/ACQ = 1, t = 1) = E(Y_{it}^0/ACQ = 1, t = 0) + m_t \tag{3}$$

where $m_t = E(Y_{it}^0/ACQ = 0, t = 1) - E(Y_{it}^0/ACQ = 0, t = 0)$. This expression indicates the *DID* estimator. It assesses the impact of acquisitions on target firms.[27] This *DID* estimator is also frequently expressed as follows:

$$\alpha_{DID} = (Y_{i,t=1}^1 - Y_{i,t=1}^0) - (Y_{i,t=0}^1 - Y_{i,t=0}^0) \tag{4}$$

[27] The *DID* estimation enables to control for unobservable common macro effects as well as individual-specific effects which are constant over time.

B Further Tables

Table 3: Number of target firms by sector (1995-2001)

Sectors	Target firms
Pharmaceutical, perfumes and cleansing/polishing	28
Household durable	2
Automobiles	2
Shipbuilding, aerospace and railway products	8
Mechanical capital goods	27
Electrical and electronic equipment	10
Chemicals, rubber, plastics	25
Metal products and metal processing	17
Electrical and electronic components	4
Total	123

Table 4: Number of acquisitions by year (1995-2001)

Year	Acquisition
1995	13
1996	14
1997	15
1998	20
1999	30
2000	17
2001	14
Total	123

Table 5: Number of target firms by acquiror nation (1995-2001)

Acquiror Nation	Target firms
Belgium	8
Canada	3
Germany	22
Italy	4
Japan	8
Netherlands	11
Norway	2
Spain	4
Sweden	10
Switzerland	3
United Kingdom	16
United States	32
Total	123

Table 6: Statistics on French firms (EAE and Innovation enquiry)

	Mean	SD
MS	0.0587	0.1288
Export	0.3530	0.2616
RD Basic	0.0228	0.0903
RD Exp	60066	369544
RD Skill	335.90	151.33
Patent	4.1935	53.018
RD Ext	0.0970	0.1642
RD Ext-Public	0.0066	0.0379
RD Ext-Foreign	0.0149	0.0696
RD Fin	0.0741	0.1849
RD Fin-Public	0.0340	0.1091
RD Fin-Foreign	0.0233	0.1099

Table 7: Statistic Correlations

	MS	Export	RD Basic	RD Exp	RD Skill	RD Ext	RD Fin
MS	1.0000						
Export	0.0949	1.0000					
RD Basic	0.0194	0.0379	1.0000				
RD Exp	0.2673	0.0601	0.0283	1.0000			
RD Skill	0.1405	0.1111	-0.0047	0.0991	1.0000		
RD Ext	0.1074	0.0065	0.0026	0.1150	0.1020	1.0000	
RD Fin	0.0025	0.0209	0.0003	0.1214	0.0319	0.0825	1.0000

Table 8: For cross-border acquisitions: comparison between target firms and the control group

Variable	Sample	Mean		Bias	Reduction in bias
		Treated	Controls		
ln MS	Unmatched	-4.1157	-4.6390	33.2	
	Matched	-4.1129	-4.2140	6.4	80.7
Export	Unmatched	0.3826	0.3212	24.0	
	Matched	0.3812	0.4057	-9.6	60.2
$Export^2$	Unmatched	0.2157	0.1635	23.1	
	Matched	0.2143	0.2332	-8.3	63.9
ln RD Exp	Unmatched	9.2489	8.7981	29.4	
	Matched	9.2451	9.2084	2.4	91.9
ln RD Skill	Unmatched	5.8246	5.7092	32.5	
	Matched	5.8222	5.8690	-13.2	59.4
RD Basic	Unmatched	0.0138	0.0165	-3.4	
	Matched	0.0149	0.0158	-1.1	66.5
RD Fin	Unmatched	0.0812	0.0709	6.4	
	Matched	0.0761	0.0828	-4.2	34.4
RD Ext	Unmatched	0.1009	0.0812	14.3	
	Matched	0.1026	0.0918	7.8	45.4

Table 9: For cross-border acquisitions: propensity score step

determinants	Target Firms
ln MS	0.145***
	(0.050)
Export	2.312**
	(0.919)
$Export^2$	-2.353**
	(1.088)
ln RD Exp	0.0897**
	(0.046)
ln RD Skill	0.5307**
	(0.213)
RD Basic	-0.251
	(0.912)
RD Fin	0.121
	(0.601)
RD Ext	1.053**
	(0.428)
Constant	0.439
	(0.331)
Observations	1846
Standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%	

Table 10: For domestic acquisitions: comparison between target firms and the control group

Variable	Sample	Mean		Bias	Reduction in bias
		Treated	Controls		
ln MS	Unmatched	-3.878488	-4.60629	46.0	
	Matched	-4.019188	-4.002918	-1.0	97.8
Export	Unmatched	0.3741641	0.3107488	25.6	
	Matched	0.3657225	0.3360118	12.0	53.1
$Export^2$	Unmatched	0.2016415	0.1570019	21.0	
	Matched	0.1964961	0.1644253	15.1	28.2
ln RD Exp	Unmatched	9.183131	8.841325	20.7	
	Matched	9.12525	9.100845	1.5	92.9
ln RD Skill	Unmatched	5.751366	5.713868	10.8	
	Matched	5.749632	5.765307	-4.5	58.2
RD Basic	Unmatched	0.0261487	0.0171307	9.8	
	Matched	0.0295367	0.0217234	8.5	13.4
RD Fin	Unmatched	0.0772898	0.075273	1.3	
	Matched	0.0775912	0.0781336	-0.3	73.1
RD Ext	Unmatched	0.0911849	0.0869546	3.0	
	Matched	0.0896656	0.0908448	-0.8	72.1

Table 11: For domestic acquisitions: propensity score step

determinants	Target Firms
ln MS	0.164***
	(0.040)
Export	1.895**
	(0.845)
$Export^2$	-1.657*
	(1.006)
ln RD Exp	0.081**
	(0.037)
ln RD Skill	0.185
	(0.175)
RD Basic	0.535
	(0.631)
RD Fin	-0.546
	(0.655)
RD Ext	1.044**
	(0.433)
Constant	0.249
	(0.217)
Observations	2068
Standard errors are in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%	

Table 12: Effect of cross-border acquisitions in low-medium vs. high-intensive technology industries

	Targets - *Low-Medium IT industries*						Targets - *High IT industries*					
	ln RD Skill	ln RD Exp	RD Fin	RD Basic	RD Ext	Patent	ln RD Skill	ln RD Exp	RD Fin	RD Basic	RD Ext	Patent
ACQ_{T+0}	0.054	0.055	0.039	0.005	-0.025*	-0.500	0.041	-0.032	0.060	0.019	0.007	2.185
	(0.040)	(0.059)	(0.062)	(0.006)	(0.015)	(0.563)	(0.053)	(0.144)	(0.056)	(0.011)	(0.020)	(1.738)
ACQ_{T+1}	-0.067	0.028	0.323	0.007	-0.026*	-1.200	0.028	-0.069	0.100	0.001	0.001	2.520
	(0.046)	(0.068)	(0.179)	(0.007)	(0.015)	(2.656)	(0.087)	(0.067)	(0.079)	(0.001)	(0.019)	(1.730)
ACQ_{T+2}	0.219***	0.240***	0.318**	0.023	-0.005	-5.200	0.157	0.082	0.308**	0.010	0.004	3.690*
	(0.072)	(0.07)	(0.115)	(0.016)	(0.022)	(4.155)	(0.105)	(0.110)	(0.122)	(0.016)	(0.030)	(1.537)
ACQ_{T+3}	0.151*	0.491*	0.389**	0.009	0.039	3.800	0.235*	0.291**	0.588***	-0.012	0.061*	4.908*
	(0.083)	(0.246)	(0.138)	(0.021)	(0.030)	(2.678)	(0.123)	(0.139)	(0.123)	(0.022)	(0.035)	(2.469)
Constant	0.048	0.852	-0.516**	0.086*	-0.007	-2.200	0.281	-0.079	0.165	-0.036	-0.009	-1.113***
	(0.052)	(0.703)	(0.146)	(0.046)	(0.011)	(1.737)	(0.188)	(0.075)	(0.061)	(0.047)	(0.024)	(0.125)
Observations	560	560	560	560	560	278	424	424	424	424	424	210

Sector and year fixed effects are included.
Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%;*** significant at 1%

Table 13: Effect of cross-border acquisitions for European vs. non-European buyers

	Targets - *non-European Buyers*						Targets - *European Buyers*					
	ln RD Skill	ln RD Exp	RD Fin	RD Basic	RD Ext	Patent	ln RD Skill	ln RD Exp	RD Fin	RD Basic	RD Ext	Patent
ACQ_{T+0}	0.031	0.056	0.072	-0.008	0.037	3.160	0.037	0.496*	0.049	0.029	0.003	4.801
	(0.050)	(0.147)	(0.058)	(0.010)	(0.027)	(3.950)	(0.053)	(0.265)	(0.084)	(0.026)	(0.003)	(4.907)
ACQ_{T+1}	0.027	0.164	0.027	-0.001	-0.027	4.814	0.029	0.771*	0.285	0.001	-0.002	-6.056
	(0.040)	(0.191)	(0.037)	(0.002)	(0.030)	(4.811)	(0.042)	(0.383)	(0.160)	(0.001)	(0.014)	(5.716)
ACQ_{T+2}	0.083	0.046	0.039	-0.005	0.048*	3.360	0.096	1.662*	0.334**	0.005	0.028	2.250
	(0.095)	(0.165)	(0.021)	(0.005)	(0.027)	(3.980)	(0.088)	(0.876)	(0.100)	(0.014)	(0.023)	(1.452)
ACQ_{T+3}	0.124*	0.694*	0.029	-0.030	0.039***	-5.542	0.126*	1.284***	0.420***	-0.014	0.078**	2.091
	(0.069)	(0.357)	(0.034)	(0.020)	(0.014)	(3.306)	(0.066)	(0.351)	(0.114)	(0.022)	(0.030)	(2.094)
Constant	0.053	-0.548	-0.052*	-0.006	0.017*	3.958	-0.804***	0.100	-0.480***	-0.030	0.009	4.010
	(0.193)	(0.372)	(0.004)	(0.007)	(0.009)	(4.089)	(0.225)	(0.709)	(0.119)	(0.038)	(0.014)	(2.536)
Observations	384	384	384	384	384	191	600	600	600	600	600	297

Sector and year fixed effects are included.
Robust standard errors are in parentheses.
* significant at 10%; ** significant at 5%;*** significant at 1%