Absorptive capacity and post-M&A performance: exploring role of absorptive capacity in post-deal firm profitability[1]

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Abstract. Declining post-M&A firm performance remains a popular topic of research. In a sample of 12581 European acquiring firms from 2007 to 2014 empirical analysis shows the effect of absorptive capacity on post-deal profitability. The results show a positive effect for absorptive capacity on post-deal profitability. For firms with lower degree of absorptive capacity a significant benefit is found. Absorptive capacity shows diminishing marginal return on post-deal profitability. Moreover, method of payment affects the moderating role of absorptive capacity in post-deal performance. The moderating role of absorptive capacity in cross-border M&A shows ambiguous results for the employed profitability indicators.

Keywords: absorptive capacity, innovation, M&A, profitability.
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Table of Contents

List of figures and tables

1. Introduction

Mergers and acquisitions (M&A) are the most popular growth and internationalization strategies for firms (Boateng, Qian, & Tianle, 2008; Junni & Sarala, 2013; Lynch, 2006). Nevertheless, despite their popularity, M&A often fail to meet expectations (King et al, 2004). While the motivations for M&A are often increased performance or profitability, the most common result of merger performance studies is that profitability and productivity do not improve as a result of merger (Schenk, 2006). The same goes for acquisitions. Dickerson et al. (1997) found that a permanent reduction in profitability often follows the acquiring firm.

One area of performance decline that has been the focus of several studies is the observed decline of innovation in mergers and acquisition (Ahuja & Katila, 2001; Capron et al., 1998; Cassiman et al., 2005; Chakrabarti et al., 1994; Hitt et al., 1991, 1996; Ornaghi, 2009). Technologically motivated acquisitions often fail in the sense that post-merger innovation performance declines (Hussinger, 2010). While the decrease in value from acquisitions is often explained by insufficient ex-ante planning and differences in corporate culture (Larsson & Finkelstein, 1999; Paruchuri et al., 2006), the role of absorptive capacity in the decline of innovation in knowledge acquisition is a subject that is relatively unexplored (Junni & Sarala, 2013). This is unexpected because absorptive capacity is one of the most important determinants of knowledge and innovation processes, since it defines the level to which the firm can obtain external knowledge from its environment (Junni & Sarala, 2013).

Absorptive capacity is defined as “the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends” (Cohen and Levinthal 1990, p. 128). The concept of absorptive capacity concept has emerged as an underlying theme in global strategy management to describe organizational phenomena as strategic alliances, organizational learning, knowledge acquisition and transfer, and business

performance (Lane et al., 2006). The level of absorptive capacity influences the effectiveness of organizational learning, assimilation and integration of new information, and the effectiveness of exploiting this information, it follows that firms with a higher level of absorptive capacity would have better performance in mergers and acquisitions deals.

In this thesis I will address the question: *How does absorptive capacity affect the acquiring firm's performance after acquiring a new company?* The answer will be addressed using empirical analysis of absorptive capacity on profitability. The goal of this research is to explore the construct of absorptive capacity in connection to M&A performance by focusing of the acquiring firm's post-deal profitability.

The results present a positive moderating effect of absorptive capacity with diminishing marginal returns on the acquiring firm's profitability. For firms with lower degree of absorptive capacity a significant benefit is found compared to firms with a high degree of absorptive capacity. Moreover, method of payment affects the moderating role of absorptive capacity in post-deal performance. Debt financing negatively influences the effect of absorptive capacity on post-deal profitability, whilst cash and share financing show positive effects. The moderating role of absorptive capacity in cross-border M&A shows ambiguous results for the employed profitability indicators ROA and profit margin.

Using panel data from 18386 European acquiring firms from 2007 to 2014 an spanning 21 industry cluster, six hypotheses are tested. In order to measure post-deal profitability, return on assets (ROA) and profit margin were used as dependent variables in separate regressions. Fixed effects models were used to determine the outcome of the regressions. Firm size and a quadratic term for absorptive capacity are explored in order find the effect of absorptive capacity on firm performance. The deal method of payment in the pre-deal stage is taken into account to find the burdening effect of mode of financing on profitability through absorptive capacity. Finally, a distinction is made between domestic and

cross-border acquisition to find the moderating effects of absorptive capacity on post-deal acquiring firm profitability.

The results show the importance for firms to not forgo on investments on internal innovation when deciding on a merger or acquisition. As post-deal firm profitability and performance is often weakened, this study provides an explanation of the antecedents important for maintaining a healthy post-deal performance.

2. Literature review

The capability to develop innovative new products, particularly in a high-technology industry, can be a key determinant of competitive advantage (Stock et al., 2001). Innovation is a subject in which a larger number of studies focused on the internal sources of innovation, through the innovation behavior of companies (e.g. size, mechanisms for coordination between departments, human resource procedures, etc.), or on the external sources of innovation (e.g. industry, stimulus of demand, the existence of technological opportunities, etc.) (Nieto & Quevedo, 2005). One way firms can stimulate innovation is through developing absorptive capacity. The concept of absorptive capacity has been a prominent topic of scientific study (Camisón & Forés, 2010; Jansen et al., 2005; Zahra & George, 2002). Since its initial publication by Cohen and Levinthal in 1990, absorptive capacity has become one of the most influential concepts in contemporary management literature (Junni & Sarala, 2013).

Cohen and Levinthal (1990) proposed that absorptive capacity is, for a large part, a function of the firm's level of prior related knowledge, since accumulated prior knowledge increases both the ability to put new knowledge into memory and the ability to recall this

knowledge and exploit it. In order to measure the prior related knowledge of a firm, the authors suggested that a firm's R&D intensity can be used (Cohen & Levinthal, 1990).

Absorptive capacity is gradually gaining recognition as a key component of competitive advantage (Lichtenthaler, 2009). Kostopoulos et al. (2010) found that external knowledge inflows are directly related to absorptive capacity and indirectly related to innovation. As innovation is a driver of competitive advantage, absorptive capacity therefore contributes to innovation and financial performance, directly and indirectly. However, firms may vary in their ability to identify and exploit external knowledge inflows; even those firms belonging to the same sector or experiencing the same amount of knowledge inflows (Escribano et al., 2009).

Hence, absorptive capacity can be a source of gaining increased competitive returns from external knowledge (Kostopoulos et al., 2010) and can be seen as the moderator between knowledge acquisition and innovation capability (Liao et al., 2009).

Absorptive capacity and M&A

In times of increasing technological competition the access to technological knowledge is one of the major objectives for M&A's (Chakrabarti et al., 1994; Capron et al., 1998; Puranam et al., 2003; Graebner, 2004). Surprisingly, given that absorptive capacity is of high importance in external knowledge acquisition, the role of absorptive capacity in acquisitions, however, remains relatively unexplored (Junni & Sarala, 2013).

Acquisitions create value when the competitive advantage of the firm is improved through the transfer of strategic capabilities (Haspeslagh and Jemison, 1991). Nevertheless, acquisitions do not automatically result in competitive advantage or increased performance, to exploiting the external knowledge it requires the capability to assimilate and integrate the acquired knowledge within the organization (Lane et al., 2001). This is where the role of absorptive capacity is imperative.

Cassiman and Veugelers (2006) emphasize that complementarities between internal and external R&D in M&A are crucial. Indeed, firms need both internal and external R&D in order to achieve a high rate of innovation performance. However, first firms need to invest in internal R&D to be able to successfully integrate and assimilate technology and knowledge bases produced outside the firm (Cohen and Levinthal, 1990). Thus, firms need to develop absorptive capacity before they can use externally sourced knowledge and technologies (Cefis, 2008). This argument is supported by Deng (2013), who found that firms with higher absorptive capacity tend to have a better foundation to create knowledge, assimilate and interpret opportunities, and develop and apply explicit knowledge more effectively.

In order for firms to M&A success rate and achieve a higher rate of knowledge absorption, they should therefore invest in absorptive capacity. Investing in absorptive capacity would establish a pre-deal related knowledge base effectively increasing the possibility for the amount of knowledge that can be transferred and exploited by the firm. With a base of prior related knowledge, firms increase their chance to select a takeover candidate that complements and extends its knowledge base.

From this, it follows that firms would benefit from M&A for a greater extent if they would to invest in absorptive capacity before performing the merger or acquisition. Moreover, firms with greater absorptive capacity would therefore profit more from external knowledge acquisitions. This argument is strengthened by Cohen and Levinthal (1994), who state that firms can benefit from investing in absorptive capacity to preempt changes in the environment.

Pre-M&A investments in absorptive capacity would therefore not only result in a higher degree of innovation, through sustainable performance differences (Todorova & Durisin, 2007), but also a better strategic fit and knowledge absorption. Indeed, post-merger productivity of acquired firms is significantly higher within acquiring firms with a developed

absorptive capacity. Therefore, absorptive capacity is a firm capability that enhances the integration of firms after firm takeovers (Hussinger, 2010), supporting the argument that absorptive capacity allows acquiring firms to better exploit the knowledge from the external source.

The base of the research is that absorptive capacity should influence the ease by which the target firm is selected and integrated. Firms with a higher absorptive capacity would have a better initial match. Subsequently, restructuring cost are lower when absorptive capacity is higher.

Firms with a higher degree of absorptive capacity will be able to better select a target company that complements their current knowledge base. Since the knowledge base of the target firm better complements the existing knowledge base of the acquiring firm, integration cost will be lower. However, as the absorptive capacity of a firm grows, it is expected that the rewards of additional absorptive capacity will decrease, signifying decreased diminishing marginal returns.

Hypotheses 1a. Absorptive capacity will have a positive effect on post-deal profitability for the acquiring firm.

Hypothesis 1b. Absorptive capacity will have a diminishing marginal effect on post-deal profitability for the acquiring firm.

Absorptive capacity and method of payment

To explain the often observed underperformance of firms in M&A, previous research has focused generally on examining the effect of financial and strategic factors at the pre-deal

stage, such as the method of payment (Junni & Sarala, 2013; King et al., 2004). However, opposing results have been found regarding the deal method of payment and its effect on post-deal performance. Where Datta et al. (1992) finds that method of payment impacts post-deal performance, King et al. (2004) finds conflicting results. Yet, both these meta analyses focused on shareholder value creation. This raises the question what effect method of payment would have on real value study on post-acquisition performance.

The deal method of payment can directly affect firm performance, i.e. if the deal is financed mainly by debt, the burden of debt can affect the free cash flow of the firm. In a sample of 191 acquisitions from 1970 to 1980, Hitt et al. (1998) show in a real value study that the majority of the top performing acquisitions had low-to-moderate post-deal debt, conversely 92 percent of the lowest performing acquisitions had large or high debt, strengthening the argument of the burden of debt (Hitt & Pinaso, 2003). Nevertheless, shares or cash may not always be available to a firm.

The financial burden that debt brings to a firm can affect its absorptive capacity. A firms prior related knowledge base can be affected by reduced investments in R&D, effectively reducing the pre-deal absorptive capacity.

The effect of absorptive capacity can be diminished by the choice of method of payment.

It is hypothesized that method of payment will affect the firm's post-deal performance.

Hypothesis 2a. Debt financing will burden the acquiring firm's free cash flow and subsequently its R&D intensity and will therefore have a negatively moderating effect through absorptive capacity on the acquiring firm's post-deal profitability.

Hypothesis 2b. Cash financing will not burden the acquiring firm's research intensity and will therefore have no negative moderating effect through absorptive capacity on the acquiring firm's post-deal profitability.

Hypothesis 2c. Share financing will not burden the acquiring firm's research intensity and will therefore have no negative moderating effect through absorptive capacity on the acquiring firm's post-deal profitability.

Absorptive capacity and cross-border acquisition

Cross-border acquisition is popular method for firms to grow, increase profitability and extend their capabilities. Yet, as with M&A, cross-border acquisitions do not always result in improved performance (Hastings, 1999; Peek et al., 1999; Vermeulen & Barkema, 2001; Zahra & Hayton, 2008). Cross-border acquisition may give firms new knowledge and capabilities that can stimulate their innovation output, however, some companies do not have the necessary absorptive capacity in place to identify, assimilate, integrate and effectively exploit this knowledge (Hamel, 1991).

The difficulties arising from cross-border acquisition have been widely recognized in M&A literature (Bhagat, et al. 2002; Bjorkman, et al. 2007). The role of absorptive capacity in mitigating these difficulties mainly come in the form of targeting the takeover candidate firm, acquiring the firm and assimilating its knowledge to benefit the acquiring firm.

Bjorkman et al. (2007) argues that three factors determine the extent of difficulties arising from cultural differences: knowledge-sharing possibilities, evaluating possible advantage, and costs arising from adapting organizational practices. Absorptive capacity could function as a moderator in overcoming these difficulties.

Zahra and Hayton (2008) found that absorptive capacity moderates the relationship between cross-border acquisition and firms' profitability and revenue growth. This again underlines the need for managerial action that builds and harvests a firm's absorptive capacity by, for example, building internal R&D and innovative capabilities and exploit the new knowledge acquired from foreign markets, thereby improving a firm's financial performance (Zahra & Hayton, 2008). Financial gains are therefore depended on the level of absorptive capacity. Firms that forgo investments absorptive capacity may only gain short-term advantages by exploiting in-house innovation activities but fail to reap long-term financial benefits (Zahra & Hayton, 2008). This is strengthened by the fact that cross-border knowledge acquisition strengthened and technological learning. This was however only the case for multinational firms that undertake cross-border acquisition, not necessarily within-border acquisition (Zahra, Ireland & Hitt, 2000).

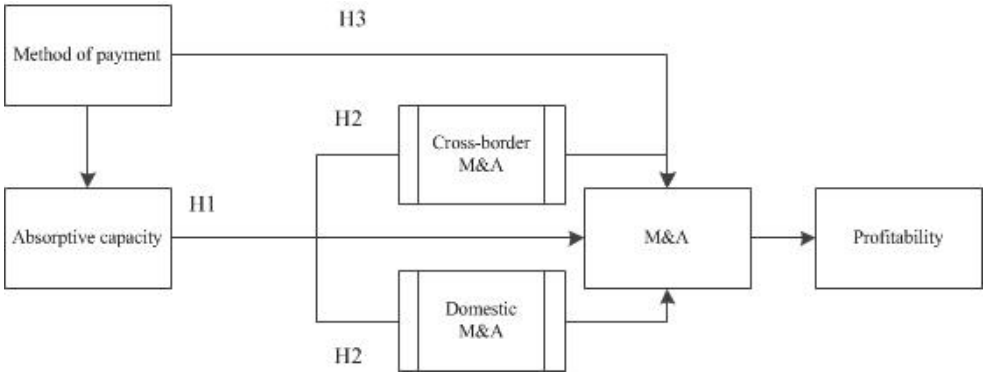
Firms from different countries could face increased complications in integrating their firms compared to firms from the same country. Cultural differences and differences in mother tongue can therefore impede the integration process and increase the restructuring cost. However, since absorptive capacity of a firm will sooth the integration process, it is expected that firms with greater absorptive capacity will have a burden from cultural differences.

Hypothesis 3. Absorptive capacity will function as a moderator in cross-border acquisitions by reducing the increased cost caused by cultural differences between the countries.

Where Zahra and Hayton (2008) focused primarily on cross-border acquisition, this research will look at the distinction between domestic and cross-border and the moderating effect of absorptive capacity on firm profitability.

Figure 1 summaries the connection of the different hypotheses to M&A and firm profitability.

Figure 1. Conceptual framework.



3. Data

This section will describe the dataset, the collection of the data and main dependent, independent and control variables used in the research.

3.1 Data description and preparation

For this research a panel dataset is composed. A total of 12581 listed acquiring companies that completed merger or acquisition in from 2007 to 2016 were included in the dataset. The data is limited to acquiring companies from the 28 European Union member states,[3] while target companies are not restricted to location. The countries included in the dataset can be found in appendix 2.

[3] Including the United Kingdom.

The data is retrieved from Zephyr and Amadeus, two databases by Bureau van Dijk Electronic Publishing. Zephyr is a database containing M&A, IPO and venture capital deals and supplies detailed financial company information. Amadeus is a database containing information on public and private companies in European countries. Since not all data could be retrieved from one database, data was retrieved from two databases. The M&A deal data was retrieved from Zephyr and later supplemented with data from Amadeus, which contained information on company financials, such as research expenditure. As Amadeus only collects information on European countries, the list of acquiring companies was limited to European member states. In order to match the acquiring companies in both datasets and since company names are open to name change during a merger or acquisition, Bureau van Dijk identifiers were used.

Only listed acquiring companies were included in the dataset since public financial information was needed to establish the variables for the research. Moreover, only deals classified as merger or acquisition were included in the dataset. Consequently, MBI's, MBO's joint ventures, share buybacks or any other form of ownership change were not included in the dataset.

The research question is whether absorptive capacity influences the post-M&A performance of the acquiring firm. In order to filter out the pre-M&A performance of the firm, all regressions will be done on firms that completed their acquisition. In total, 35,060 observations were dropped for firms with a majority ownership. In order to obtain a valid estimator for the model, post-deal firm performance needs to measured over a period exceeding one year. Therefore, observations that completed the deal in the year 2016 are omitted from the dataset. This increases the validity for post-deal performance estimators. In 2016 6,200 observations were dropped. In total 58,050 observations were dropped, leaving 125,810 observations.

3.2 Variables

Dependent variables

M&A performance is used as the dependent variable in this research. In order to increase the validity of the research, two performance measures will be used to measure post-deal firm performance. Return on assets (ROA) (using net income) and profit margin will be used to determine M&A performance in the period 2007 to 2016. ROA is a frequently used financial indicator of profitability that firms consider in evaluating their strategic decisions and goals (Kostopoulos et al., 2010). ROA embodies the profitability of the firm regarding the total assets under its control, namely, the resources that provide the firm with its competitive advantage (Barney, 1991). In recent studies on firm performance and absorptive capacity, Kostopoulos et al. (2010) and Bergh et al. (2008) both used ROA as a performance indicator. Profit margin shows the percentage of revenue that results in net income. Profit margin focuses on the income statement and measures the extent to which a company manages its costs per dollar of sales (Powers et al., 2011). It is calculated by the net income divided by net sales (or revenue). Both ROA and profit margin reflect multidimensional aspects of financial performance.

Independent variable

R&D intensity is used as a main independent variable as is used as a proxy for absorptive capacity. R&D intensity is used to determine absorptive capacity since the publication of the seminal paper by Cohen and Levinthal (1990). Moreover, it is also the most widely used measure of absorptive capacity in the literature (Lin, et al., 2012; Zahra & Hayton, 2008). Cohen and Levinthal (1990) argue that a firm's R&D capability as the foundation for knowledge creation, integration and exploitation. The authors show that a firm's ability to exploit external knowledge is often generated as a byproduct of its R&D and

therefore argue that R&D does not only generates new knowledge but also contributes to the firm's absorptive capacity. Besides the argument for knowledge creation, integration and exploitation, prior research has shown that one of the main reason firms invest in R&D is to be able to obtain and use external scientific and technical information (Allen, 1977; Stock et al., 2001; Tilton, 1971). By choosing the independent variable R&D intensity, I assume that R&D expense is a constant expense for R&D intensive firms. Firms with a R&D department incur structural R&D expenses. R&D expense is therefore not seen as a one-time expense.

Recent studies use R&D intensity calculated as R&D expenditure per year divided by total assets over the same year (Lane & Lubatkin, 1998; Lin, 2003; Nieto & Quevedo, 2005; Nooteboom et al., 2007; Oltra & Flor, 2003; Leahy & Neary, 2007; Stock et al., 2001; Tsai, 2001; Thérin, 2007; Veugelers, 1997; Zahra & Hayton, 2008). In order to increase the ease of interpretation of R&D intensity, R&D intensity will be multiplied by 100, so it can be interpreted as a percentage. This is in line with Lu and Karpova (2012) and Yeh et al. (2010). At the date of deal completion, the R&D expenses compile for the acquiring and the target firm, forming the newly formed firm. Since R&D expenses are divided by the firm sales, it controls for the increase in firm size.

Control variables

Size. The connection between company size and innovation capability has long been a debated issue in the strategy literature (Freeman and Soete, 1997; Lin, 2011). A firm's size can have different effects on the main dependent and independent variables. Size can indicate a firm's ability to provide resources, manage uncertainties, increased market power and support additional R&D investments (Acs & Audretsch, 1987; Cassiman & Veugelers, 2002; Lee & Chen, 2009), which may result in higher knowledge acquisition and exploitation (Autio et al., 2000; Reyoke, 2001). Moreover, compared to smaller firms, larger firms have

advantages in gaining headquarters' support for their investments and innovation activities (Tsai, 2001).

The increase in firm size due to the merger or acquisition is partly accounted for by the denominators of the independent variables ROA and profit; net income and net sales, respectively. Moreover, the main independent variable – R&D intensity – includes a control for firm size, namely net sales. However, as Stock et al. (2001) argue, to separate the additional effects of firm size on absorptive capacity a proxy for firm size is included in the form of a natural logarithm for the number of employees. Recent studies on absorptive capacity that applied the natural logarithm of number of employees as a proxy include Cefis (2008), Jansen et al. (2005), Kostopoulos et al. (2010), Reyoke (2001), Tsai (2001) and Zhao et al. (2012).

Country. The acquiring firm's country has been included as a control variable to control for differences in financial architecture per country and economic, political, technological and socio-cultural environments that differ per country (Minbaeva et al., 2003). Appendix 2 gives a detailed overview of the countries included in the dataset. Appendix 3 and 4, respectively, indicate the distribution of acquiring and target firms in the dataset.

Industry. Industry is used to control for industry specific variances. Knowledge acquisition, relationship with parties in the supply chain and exchange processes often vary per industry (Lane & Lubatkin, 1998). Furthermore, technical change within an industry is often closely related to a firm's on-going R&D activity (Cohen & Levinthal, 1990).
The Statistical classification of economic activities of economic activities in the European Community (NACE) are used to sort the firms using NACE Rev. 2 codes. The codes range

from 0 to 10000, these again are grouped in 21 overarching industry clusters. The industry clusters – including distribution – used in the dataset can be found in appendix 5.

Ownership. The dataset includes acquiring firms with a pre-deal ownership in the target firms. While some firms hold a minority ownership (below 50 percent ownership) in the target firms pre-deal, there are firms that already hold a majority stake (50 percent ownership or larger) in the target company and enlarge their stake by acquisition.

Firms with a pre-deal majority ownership in the target firm are, presumably, integrated to some extent. Absorptive capacity will therefore have a smaller role in post-deal company performance. Cantwell and Narula (2001) and Junni and Sarala (2013) confirm that a greater level of ownership may facilitate knowledge related activities, therefore decreasing the initial effect of absorptive capacity on deal completion. Firms with a pre-deal majority ownership are excluded from the models.

Time. To account for time trend in the analysis and to increase the validity of the model, time is taken into account in the model. Elapsed time can impact the knowledge transfer following the acquisition by affecting how the learning relationship develops between the acquiring and target firm (Bresman et al., 1999). Moreover, time trend needs to be included in merger analysis models to capture changes in legal framework, changes in market conditions or variances in the level of merger activity (Jarrell & Bradley, 1980; Rademarkers, 2011; Schipper & Thompson, 1981).

Table 1 summaries the dependent, independent and control variables discussed in this section.

Table 1. Summary of variable data.

Measure	Variable name / proxy	Description
Firm performance	Return on assets using net income	Acquiring firm return on assets using net income. Calculated as total assets divided by net income
Firm performance	Profit margin	Acquiring firm profit margin. The amount by which revenue from sales exceeds costs in a business. Calculated as net income divided by net sales (revenue).
Absorptive capacity	Research and development intensity	Absorptive capacity is measured by research and development expenses divided by net sales.
Size	Number of employees	Company size measured by the natural log of the number of employees
Country	Country code	A country code was assigned to each individual country. A more detailed description of the countries included in the dataset can be found in appendix 2.
Industry	Industry cluster	The industry variable is measured by the industry clusters assigned to their NACE2 codes. A more detailed description of the industry clusters can be found in appendix 5.
Time	Year	Time is measured in years; from 2007 to 2016. All observations possess a time variable.

Table 2. Correlation table.

	ROA	Profit margin	R&D intensity	Completed	Size	Country	Industry	Year
ROA	1							
Profit margin	0.7134	1						
R&D intensity	-0.1137	-0.1411	1					
Completed	-0.0986	-0.0463	0.0188	1				
Size	0.1538	0.1574	-0.0684	-0.0061	1			
Country	0.1797	0.0681	-0.0127	-0.1334	-0.0270	1		
Industry	-0.1029	-0.0085	-0.0405	0.0595	-0.0727	-0.2247	1	
Year	-0.1146	-0.0348	0.0475	0.5312	0.0672	-0.1505	-0.0002	1

The correlation table in table 2 shows no strong correlation between any of the independent variables or between the dependent and independent variables. The correlation of 0.7 between ROA and profit margin is neglected due to the fact that both variables are dependent variables to measure firm performance and will be placed in different models.

4. Method

The data in the dataset is strongly balanced, indicating that for each firm an identical number of time series observations are available; namely 10, from 2007 to 2016 (Adkins & Hill, 2011).

The base model has the following form:

$$\pi_{it} = X'_{it}\beta + a_i + u_{it}$$

$$X'_{it}\beta = \beta_0 + \beta_1 RDI_{it} + \beta_{2j} COMPLETEDj_{it} + \beta_3 RDC + \beta_4 Size_{it} + \sum_{j=1}^{150} \beta_{5j} COUNTRYj_{it} + \sum_{j=1}^{21} \beta_{6j} INDUSTRYj_{it} + \sum_{j=1}^{8} \beta_{7j} YEARj$$

π_{it} is the profitability of firm *i* at year *t* measured by ROA and profit margin. *RDI* is the proxy for absorptive capacity and captures the research and development intensity of the firm. The shift dummy *COMPLETEDj* takes a value of 1 after the acquisition has taken place, denoting the year in which the deal has been completed, hereby capturing the permanent effect of the deal (Dickerson et al., 1991). The interaction term, *RDC*, measures the treatment effect of the deal, namely the effect of post-deal R&D intensity, and thus the effect of post-deal absorptive capacity. Firm size, *SIZE,* is measured as the natural logarithm of the number of employees of the firm. *COUNTRYj* and *INDUSTRYj*, are categorical variables used to control for the individual effects of the firms home country and main industry, respectively. *YEARj*, is the dummy for the time used in the fixed effects model. For the random effects model *YEAR* is used as a continuous variable. In this base model a_i and u_{it} are firm-fixed and time-fixed respectively, where a_i captures (unobserved) firm heterogeneity and u_{it} captures time-specific factors.

Through the abovementioned model it will be deducted what the drivers for change are in the dependent variable firm performance. The main independent variable R&D intensity

will be tested in various models. The main independent variable will be supplemented with interaction terms of the shift dummy and, in later models, a quadratic term in order to find the potential effects of the independent variable on firm performance. The impact of the merger or acquisition on firm performance is measured by including a dummy variable for the completed deal.

It is important to note that the dataset includes numerous firms that went through more than one merger or acquisition in the ten-year timespan, it therefore does not capture the intensity of the merger and/or acquisition activity of the acquiring firm, while the intensity of merger and/or acquisition activity could significantly affect firm performance

A preliminary regression of the base model is shown in table 3.

Table 3. Prima facie regression.

	Fixed effects		Random Effects	
	ROA	PM	ROA	PM
RDI	-0.0015093***	-0.389651***	-0.0016522***	-0.3623032***
	(0.0002531)	(0.0704828)	(0.0003234)	(0.0524409)
Constant	4.072405***	9.121285***	3.963337***	8.484243***
	(0.0022608)	(0.2371332)	(0.1197796)	(0.2387682)
R-squared	Within: 0.0050	Within: 0.0275	Within: 0.0050	Within: 0.0275
	Between: 0.0145	Between: 0.0417	Between: 0.0145	Between: 0.0417
	Overall: 0.0108	Overall: 0.0222	Overall: 0.0108	Overall: 0.0222
Observations	23,798	23,568	23,798	23,568
Groups	2,952	2,937	2,952	2,937

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

From this prima facie regression, it can be concluded that absorptive capacity negatively influences both ROA on assets and profit margin.

The model is believed not to be strictly exogenous. Profit margin and ROA both include a term for net income. Since R&D investments depend for a large extent on the

profitability of a firm, the independent variable R&D intensity depends on the lagged value of the dependent variable, thereby signifying a feedback mechanism. This levels out the possibility to use random effects estimation, since this technique assumes strict exogeneity. Since the within-variation – i.e. the variation over time – is more compelling compared to the between-variation, a fixed effects model is a suitable course of action. Using the fixed effects model decreases omitted variable bias, but causes the categorical variables country and industry cluster will be omitted from the regression.

The outcome of the Hausman test shown in appendix 12 and 13 confirms the use fixed effect; with a value of 0.00 in both cases the null hypothesis is rejected, meaning that the fixed effects estimator should be used for the model.[4]

Since the fixed-effects estimator eliminates the variables that stay constant over time, the dummy variables for country and industry will not be included in the fixed effects analysis that follows. This will not affect the estimators significantly due to the fact that fixed effect estimators measure the impact of variables that measure over time. However, a random effects regression of the base model is included in appendix 13 in order to test the impact of the control variables on the base model.

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[4] $H_0 : E(a_i|x_{i1},..x_{iT}) = 0$

$H_0 : E(a_i|x_{i1},..x_{iT}) = 0$

5. Results

In this section I will elaborate on models used to answer the hypotheses and discuss the outcome of the regressions. The variables that are hypothesized to impact the dependent variable firm performance are regressed in order to test the three hypotheses. Using regression analysis, the models are tested operating the methodology described above. First, the base model including the interaction term will be tested, this is followed by two regression models that test the effect of R&D intensity size. Next, the model will be tested with quadratic terms of the independent variable. The results of the fixed effects base model will then be compared to a random effects model including several control variables. This is followed by the analysis of the base model including method of payment in order to determine the effect of the method of payment through absorptive capacity. All tables show the dependent variable on the first horizontal row and the dependent-and control variables in the first column. All models discussed in this section are separately available in the appendix.

Table 4. Absorptive capacity regression results for ROA.

Variables[5]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
RDI	**-0.0068*****	-0.3033	**-0.0066*****	**-0.02394*****	**-1.4609*****	**-0.0233*****	-0.0368	-0.0099	**-0.00673*****	**-0.0061*****	-0.0271
	(0.2338)	(0.1886)	(0.0023)	(0.7270)	(0.5513)	(0.0073)	(0.0643)	(0.0093)	(0.0023)	(0.0022)	(0.0175)
RDC	**0.0055****	**0.2940****	**0.00528****	**0.01613****	**1.9241*****	**0.0159****	**-0.1699****	0.0052	**0.0054****	**0.0048****	-0.0424
	(0.2338)	(0.1308)	(0.0023)	(0.6762)	(0.4517)	(0.0068)	(0.0680)	(0.0081)	(0.0023)	(0.0022)	(0.0392)
Completed	-0.1911	-0.2024	-0.5050	-0.2345	-0.3525*	-0.6525*	0.5821	-0.0255	0.4693	-0.2135	0.1328
	(0.1549)	(0.1893)	(0.3664)	(0.1539)	(0.1953)	(0.3616)	(0.5681)	(0.5525)	(1.6429)	(0.1832)	(0.2930)
Size	-0.5599***	-0.5099**	-0.2402	-0.5188**	-0.5037**	-0.0226	-1.1881**	-.0495	.0290	-0.8669***	-0.1186
	(0.2140)	(0.2106)	(0.6944)	(0.2136)	(0.2105)	(0.6929)	(0.4506)	(0.4423)	(0.6690)	(0.2684)	(0.3507)
RDI^2				0.0004***	0.4689**	0.0000036***					
				(0.0135)	(0.2085)	(0.00000135)					
RDC^2				**-0.00036*****	**-0.6993*****	**-0.0000035*****					
				(0.0134)	(0.1827)	(0.00000133)					
Year[6]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Constant	10.41566***	10.2045***	7.515	10.1310***	10.2736***	5.7933	16.29241***	5.130219	1.484408	13.3273***	7.1629***
	(1.844831)	(1.7748)	(6.2240)	(1.8399)	(1.7743)	(6.2006)	(4.3206)	(3.5687)	(4.0844)	(2.4888)	(2.5735)
R-squared											
Within	0.0431	0.0433	0.0499	0.0490	0.0445	0.0628	0.0588	0.0360	0.0690	0.0467	0.0502
Between	0.0194	0.0215	0.0122	0.0002	0.0195	0.0648	0.0233	0.0691	0.0666	0.0440	0.0058
Overall	0.0001	0.0002	0.0195	0.0042	0.0003	0.0921	0.0016	0.0458	0.0844	0.0038	0.0018
Observations	23,267	16,716	6,551	23,267	16,716	6,551	891	3,699	1,378	15,205	8,062
Groups	2,933	2,301	1,009	2,933	2,301	1,009	109	479	186	1,921	1,012

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

[5] Individual regressions models can be found in appendix 9 – 17.
[6] Year dummy included in the models.

Table 5. Absorptive capacity regression results for profit margin.

Variables[7]	1	2	3	4	5	6	7	8	9	10	11
RDI	-0.4406***	0.8417*	-0.4692***	-0.7585***	1.6715**	-0.9850***	-0.1236	-0.5364***	-0.4418***	-0.3450***	-0.6682***
	(7.4802)	(0.4961)	(0.08867)	(9.8711)	(0.6709)	(0.1108)	(0.1038)	(0.1315)	(0.1414)	(0.0773)	(0.1145)
RDC	0.0652	0.1755	0.0042	0.0746	**1.7761***	**-0.1701****	**-0.1589***	**0.1879****	-0.0280	-0.0063	**0.2169****
	(5.0400)	(0.2042)	(0.0806)	(5.0209)	(0.5180)	(0.0856)	(0.0901)	(0.0897)	(0.1348)	(0.0569)	(0.0821)
Completed	-0.4742**	-0.3230	-0.4720	-0.4477*	-0.4989*	1.1230	0.2644	-1.6153**	0.4227	-0.1378	-0.7792*
	(0.2367)	(0.2581)	(0.8520)	(0.2289)	(0.2656)	(0.7970)	(0.7144)	(0.6879)	(1.8945)	(0.2729)	(0.4263)
Size	-0.6651***	-0.9413***	0.3368	-0.5574**	-0.9584***	1.0056	-1.3330*	-0.4006	-0.3681	-0.6298**	-0.6505843
	(0.2487)	(0.2325)	(0.8658)	(0.2540)	(0.2326)	(0.9510)	(0.6962)	(0.5061)	(0.6471)	(0.2944)	(0.4289)
RDI^2				0.0031***	-0.3279	0.0042***					
				(6.170543)	(0.2522)	(0.0007)					
RDC^2				-0.0008	**-0.6678****	0.0007					
				(4.6653)	(0.2165)	(0.0006)					
Year[8]	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Constant	16.4418***	17.0033***	10.2073	16.3345***	17.04309***	8.5478	21.4525***	14.3256***	12.9067	16.30943***	15.86125***
	(2.1848)	(2.0350)	(7.9210)	(2.2141)	(2.0276)	(8.5363)	(6.8752)	(4.1080)	(4.0770)	(27.5995)	(3.3005)
R-squared											
Within	0.0547	0.0298	0.1346	0.0625	0.0309	0.1885	0.0588	0.0360	0.0690	0.0630	0.0602
Between	0.0096	0.0026	0.1647	0.0124	0.0023	0.1573	0.0233	0.0691	0.0666	0.0043	0.0407
Overall	0.0083	0.0000	0.1320	0.0084	0.0000	0.1296	0.0016	0.0458	0.0844	0.0079	0.0259
Observations	23,056	16,620	6,436	23,056	16,620	6,436	891	3,699	1,378	15,096	7,960
Groups	2,919	2,298	998	2,919	2,298	998	109	479	186	1,910	1,009

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

[7] Individual regressions models can be found in appendix 9 – 17.
[8] Year dummy included in the models.

The outcome of the regression of the base model (1) in table 4 confirms hypothesis 1a: absorptive capacity has a positive effect on post-deal firm performance for the acquiring firm. The interaction term for R&D intensity and completed deal is significant at a 5 percent level for ROA. The coefficient indicates that for a one percentage point increase in R&D intensity for a firm that completed the deal, ROA increases by 0.006.

The negative effect of R&D intensity on firm performance can be explained by the fact that, as R&D intensity grows, R&D expenditure increases or net sales decrease, thereby decreasing firm performance. Absorptive capacity remains an investment decision. While the literature describes significant benefits for a firm to invest in absorptive capacity, it remains an expense for the firm. However, in the case of a merger or acquisition, it can be observed that absorptive capacity has a positive effect on post-deal ROA.

The dummy variable for completed deal indicates that firm performance is generally lower for firms that completed a merger or acquisition. This can be explained by the loss of profitability caused by M&A related expenses, e.g. restructuring costs.

It should be noted that the R-squared of the within variation is low: 0.0431. Indicating that the current model only accounts for a small fraction of the variation.

Table 5 column (1) shows the results of the regression of the base model on profit margin. No significant result is found for the effectiveness of R&D intensity for post-deal firms on profit margin. However, it could be possible that the effect of R&D intensity will be observed on profit margin when the model is regressed using lagged independent variables. Appendix 12 shows the two-year lagged regression of the independent variables on firm performance. Post-deal R&D intensity is significant at a 10 percent level for profit margin for

a one-year lag, but shows no result for ROA. Given the amount of observations the 10 percent significance level for profit margin is to weak to hold.

The results of the base regression raise the question whether the size of R&D intensity would have any effect on the effectiveness of R&D intensity and thus absorptive capacity. The results suggest that a firm with a higher degree of R&D intensity would see a better post-deal firm performance relative to a firm with lower R&D intensity.

In column (2) and (3) the base models in table 4 and 5 are separately regressed by low and high R&D intensity, respectively: low R&D intensity being firms that invest less than 3 percent of total sales in R&D, high R&D intensity being firms that invest over 3 percent of their total sales in R&D (European Commission, 2008; Lu & Karpova, 2012; Yang et al., 2010).

For firms with low R&D intensity, R&D intensity shows a significant effect when undergoing an acquisition. For firms with lower R&D intensity investing in R&D has a significant effect on ROA post-deal: if R&D intensity increases by one percentage point ROA increases by 0.29. Similar to the base model in column (1), high R&D intensity firms show a significant effect of R&D intensity post-deal by decreasing in ROA, fueled by the cost of R&D investment. Again, R&D intensity post-deal has a significant positive effect on ROA. Again, no significant result can be found for profit margin.

Interestingly, R&D intensity for a firm that completed a deal is higher in the case of low R&D intensity firms compared to higher R&D intensity firms, suggesting a quadratic relationship between R&D intensity and firm performance. The quadratic model in column (5) shows the quadratic relation between the main independent variable and the dependent

variable, where *RDI2* is R&D intensity squared and *RDC2* is post-deal R&D intensity squared.

From the regression results of the standard model in column (5) in table 4 two separate quadratic effects can be interpreted. First of all, R&D intensity on itself is negative. However, when the quadratic term is taken into account a diminishing marginal decline can be observed, where the cost of an additional percentage point of R&D intensity decreases as R&D intensity grows. For post-deal R&D intensity a positive return is suggested. Taking into account the quadratic term for post-deal R&D intensity, diminishing marginal returns can be observed: the gain of an additional percentage point of R&D intensity declines as R&D intensity grows. Column (6) and (7) show the effect of the quadratic term for low and high R&D intensity firms, respectively. For both firms with low- and high R&D intensity the diminishing marginal decline for R&D intensity and diminishing marginal returns for post-deal R&D intensity can be observed. Interestingly, the results suggest that for firms with lower R&D intensity the effect is notably strengthened. This, together with the results of column (2), would imply that investing in absorptive capacity can be of significant importance for firms with lower absorptive capacity when undertaking a merger or acquisition. The results of column (1) to (7) confirm what was hypothesized, absorptive capacity positively affects post-deal firm profitability through ROA for the acquiring firm.

Column (5), (6) and (7) in table 5 show the results of the quadratic model for the base model, low- and high-R&D intensive firms for profit margin. Although less significant in the profit margin models, the same effects can be observed: diminishing marginal decline for R&D intensity in the standard model (4) and high R&D intensity model (6), and diminishing marginal returns for firm with low R&D intensity (5).

The models in table 4 and 5 have been estimated using fixed effects. However, in using the fixed effects model not all control variables can be applied to the models. In order to inspect the country and industry specific effects the appendix 13 shows the base model including control variables using random effects estimation. The random effects model similar results to the base model in column (1). For ROA, R&D intensity is negatively related, post-deal firm performance R&D intensity positively affects ROA. Again, for profit margin only a significant negative result can be found for R&D intensity, no significant result for the interaction term of R&D intensity and deal completion. Including the control variables for industry and country does increase the R-squared of the models to 0.2 for both the ROA and profit margin model.

Hypothesis 2 inspects whether the method of payment for a deal has effect on post-deal firm performance. It is based on the presumption that the method of payment can burden the free cash flow position of a firm and affect the capital available for investment in R&D intensity. Hypothesis 2a states that debt financing would burden the acquiring firm's free cash flow and subsequently its R&D intensity and will therefore have a negatively moderating effect through absorptive capacity on the acquiring firm's post-deal net profit. While, hypothesis 2b and 2c state that cash financing will not burden the acquiring firm's free cash flow and therefore not affect the moderating effect of absorptive capacity on firm performance.

Column (7), (8), and (9) of table 4 and 5 shows the results of the regression model for debt, cash and share financing, respectively. For both ROA and profit margin debt financing has a negative effect on the effectiveness of R&D intensity post-deal, as was hypothesized. This suggests that debt financing does influence the R&D intensity of a firm. As debt financing would burden the free cash flow of an acquiring firm, it would not necessarily affect

an acquiring firm's operating revenue. Appendix 14 shows the outcome of a regression of R&D intensity on operating revenue for debt financing. No significant effects are found for post-deal R&D intensity, strengthening the argument for hypothesis 2a.

Cash and share method of payment show results results similar to the base model: R&D intensity on itself lowers firm profitability, but in post-deal firm profitability it enhances firm performance. This again strengthens the presumption that debt financing burdens free cash flow and subsequently the absorptive capacity of a firm.

Lastly, I will test for the moderating effect of absorptive capacity in cross-border M&A compared to domestic M&A. Hypothesis 3 argues that absorptive capacity will function as a mediator in cross-border M&A by reducing the discrepancies caused by cultural differences between the acquirer and target firm. Column (9) and (10) shows the results for the regressions of absorptive capacity on firm performance for cross-border and domestic deals, respectively. Absorptive capacity appears to have a moderating role for post-deal ROA for cross-border M&A. However, for profit margin the post-deal performance is insignificant for cross-border deals. For domestic deals, R&D intensity does not show a significant effect on ROA, both for pre- and post-deal R&D intensity. However, for profit margin and domestic acquisition a significant result similar to the base model can be observed.

Table 6. Summary of results.

Hypothesis	Model	ROA	Profit margin
1a	1 – 3	Positive effect	No effect
1b	4 – 6	Diminishing marginal return for both low and high absorptive capacity firms	Diminishing marginal return of low absorptive capacity firms
2a	7	Negative effect debt	Negative effect debt
2b	8	No effect	Positive effect on profitability
2c	9	Positive effect	No effect
3	10	Positive effect cross-border M&A	No effect cross-border M&A
3	11	No effect domestic M&A	Positive effect domestic M&A

Conclusion

I started the regression with a base model of absorptive capacity on firm performance: R&D intensity – a proxy for absorptive capacity – is regressed in a model including a control variable for deal completion and an interaction term for R&D intensity and deal completion, in which the interaction term measures the effect of post-deal absorptive capacity on firm performance. As the model uses fixed effect estimators, further control variables time invariant control variables could not be used. The results of the base model (1) in table 4 confirmed the positive effect of absorptive capacity on post-deal firm profitability. Especially for firms with low R&D intensity, the added benefit in post-deal firm performance is significant. Where absorptive capacity in general exhibits diminishing marginal decline, the effect of absorptive capacity on post-deal firm performance exhibits a diminishing marginal return. Interestingly, the regressions for profit margin yield no significant effect for post-deal profitability. Only when the squared term is taken into account diminishing marginal return of low absorptive capacity firms shows significant results.

The deal method of payment is an important factor in the effect of absorptive capacity on post-deal firm performance. Where absorptive capacity in general has a positive effect on post-deal firm performance, deal financing by debt exhibits a negative result for absorptive capacity on post-deal firm performance. This can be explained by the debt burden on free cash flow.

A moderating effect of absorptive capacity was observed for cross-border post-deal ROA. This suggests that absorptive capacity has a soothing role for post-deal firm integration.

Overall, the effect of absorptive capacity on post-deal firm profitability seems to hold for ROA, for profit margin the results are ambiguous. Given the weaker relationship between absorptive capacity and profitability, it is hard to suggest a strong relationship, although some relationship clearly exists.

6. Discussion

While a strong relation is found between absorptive capacity and post-deal ROA, a weak relation was found between absorptive capacity and profit margin. Investments in absorptive capacity is shows a strong significant improvement for in post-deal profitability for firms with relatively lower degree of absorptive capacity. As the degree of absorptive capacity of a firm increases the benefit for post-deal profitability decreases, signifying a diminishing marginal returns for absorptive capacity. The findings show that as firms increase their prior related knowledge base, they are better able to choose a suitable takeover candidate, assimilate and integrate the knowledge and exploit the knowledge to the benefit of the firm. Hitt et al. (1991) found that acquisitive growth strategies have a negative effect on firm innovation. They argue that firms substitute acquisitions for internal innovation. All the while, acquisitions generally seem negatively affect profitability for the acquiring firm. It could be argued that absorptive capacity is the missing piece of the puzzle in this equation. The results show us that absorptive capacity has a moderating effect for post-deal profitability. Where managers generally seem to make a trade-off between investments in innovation – subsequently absorptive capacity – and acquisitions, a combination of the two is often neglected. When a firm decides to increase competitive advantage through innovation it can decide on internal investments in innovation, i.e. R&D investments, or external investments in innovation, i.e. external knowledge acquisitions. The moderating role of absorptive capacity in post-deal profitability, underline the importance of a combination of these two.

Moreover, the results show that debt has a negative effect on the moderating effect of absorptive capacity on post-deal profitability. In a comparable study, King et al. (2003) finds that method of payment does not affect post-acquisition profitability. Yet, they only account for cash and share financing. The dataset allowed me to separate cash, debt and share

financing, thereby allowing for the regression of three separate antecedents in post-deal profitability. Taking into account the effect of absorptive capacity, the results imply that the deal financing decision does have significant effect on post-deal profitability.

The moderating effect of absorptive capacity on cross-border M&A explored in hypothesis 3 shows significant results for post-deal profitability measured by ROA. For profit margin the no significant relation for cross-border M&A can be found. Zahra and Hayton (2008) find that significant moderating effect of absorptive capacity on post-deal ROE and revenue growth. While the results for ROA match those of Zahra and Hayton, profit margin appears to be only significant in domestic acquisitions.

This study employs R&D intensity as a proxy for absorptive capacity. While this proxy is a popular measure for the absorptive capacity of a firm several other measures for absorptive capacity exist. Future research on post-deal profitability could focus on the effect the combined effect of employee motivation and R&D intensity. Other proxies that have been employed by scholars include the number of scientific publications of the firm (Cockburn & Henderson, 1998) or the amount of doctorates within a firm (Veugelers, 1997).

While this research shows that the acquiring firm's absorptive capacity is of significant importance for post-deal profitability, absorptive capacity for the target firm can be of equal importance for post-deal profitability, especially in the case of a merger. The database restricted me to include data on target firm absorptive capacity. Future research research would benefit from including a control variable for the absorptive capacity of the target firm.

Since the dataset predominantly consists of acquiring it is difficult to refute the argument that performance by acquiring firms was not shared by similar non-acquiring firms (Ahuja & Kalita, 2001; Fowler & Schmidt, 1988). Acquisitions are processes that can take years to complete and firm performance can be affected accordingly. In a sample with firms that

exclusively include acquiring firms, estimators for post-deal performance can be affected. It is suggested that future research includes non-acquiring firm to include for the differences in performance.

7. Conclusion

While M&A is a costly endeavor, the positive effect of absorptive capacity on post-deal firm performance can diminish the costs, increase the firm performance and the success rate of the deal. Firms should not forgo building a base of knowledge prior to the merger or acquisition. Absorptive capacity is key to succeed in choosing a target that complements the firm's current knowledge base, thereby soothing the process of integration of the two firms and eventually increasing competitive advantage by exploiting the newly acquired knowledge.

The research question answered in this thesis was: *How does absorptive capacity affect the acquiring firm's performance after acquiring a new company?* The answer is addressed using empirical analysis of absorptive capacity on profitability. The results show that absorptive capacity has a positive effect on post-deal ROA, for post-deal profit margin indefinite results were found. Moreover, it was found that absorptive capacity functions through diminishing marginal returns: firms with low absorptive capacity experience larger post-deal benefits by investing in absorptive capacity compared to firm with a high degree of absorptive capacity, a finding that holds for both ROA and profit margin.

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9. Appendix

Appendix I: Glossary

Acquiring firm:	The firm that is taking over the target firm through acquisition.
Deal:	Merger or acquisition.
Post-deal:	The situation after the merger and/or acquisition has taken place.
Pre-deal:	The situation before the merger and/or acquisition has taken place.
Research intensity:	Research expenditure divided by total assets.
Target firm:	The firm being taken over by the acquiring firm.

Appendix 2: Table 7. List of countries in dataset. Countries include home country of acquiring and target firms.

Country	Abbr.	Code	Country	Abbr.	Code	Country	Abbr.	Code	Country	Abbr.	Code
Emirates	AE	1	Fiji	FJ	46	Macau	MO	91	Taiwan	TW	135
Albania	AL	2	France	FR	47	Mauritania	MR	92	Tanzania	TZ	136
Armenia	AM	3	Gabon	GA	48	Malta	MT	93	Ukraine	UA	137
Argentina	AR	4	United Kingdom	GB	49	Mauritius	MU	94	Uganda	UG	138
Austria	AT	5	Grenada	GD	50	Malawi	MW	95	USA	US	139
Australia	AU	6	Georgia	GE	51	Mexico	MX	96	Uruguay	UY	140
Azerbaijan	AZ	7	Ghana	GH	52	Malaysia	MY	97	St. Vincent	VC	141
Bosnia	BA	8	Gibraltar	GI	53	Mozambique	MZ	98	Venezuela	VE	142
Barbados	BB	9	Greece	GR	54	Namibia	NA	99	Virgin Islands	VG	143
Belgium	BE	10	Guatemala	GT	55	Nigeria	NG	100	Vietnam	VN	144
Burkina Faso	BF	11	Hong Kong	HK	56	Nicaragua	NI	101	South Africa	ZA	145
Bulgaria	BG	12	Honduras	HN	57	Netherlands	NL	102	Zambia	ZM	146
Bermuda	BM	13	Croatia	HR	58	Norway	NO	103	Zimbabwe	ZW	147
Brunei	BN	14	Haiti	HT	59	New Zealand	NZ	104	Iran	IR	148
Bolivia	BO	15	Hungary	HU	60	Oman	OM	105	Marshall Islands	MH	150
Brazil	BR	16	Indonesia	ID	61	Panama	PA	106			
Bahamas	BS	17	Ireland	IE	62	Peru	PE	107			
Botswana	BW	18	Israel	IL	63	Papua New Guinea	PG	108			
Belarus	BY	19	India	IN	64	Philippines	PH	109			
Belize	BZ	20	Iceland	IS	65	Pakistan	PK	110			
Canada	CA	21	Italy	IT	66	Poland	PL	111			
Congo	CD	22	Jamaica	JM	67	Puerto Rico	PR	112			
Switzerland	CH	23	Jordan	JO	68	Portugal	PT	113			
Cote D'Ivoire	CI	24	Japan	JP	69	Paraguay	PY	114			
Chile	CL	25	Kenya	KE	70	Qatar	QA	115			
China	CN	26	Cambodia	KH	71	Romania	RO	116			
Colombia	CO	27	Rep. Of Korea	KR	72	Serbia	RS	117			
Costa Rica	CR	28	Cayman Islands	KY	74	Russian Federation	RU	118			
Cape Verde	CV	30	Kazakhstan	KZ	75	Rwanda	RW	119			
	CW	31	Lao	LA	76	Saudi Arabia	SA	120			
Cyprus	CY	32	Sri Lanka	LK	77	Seychelles	SC	121			
Czech Republic	CZ	33	Liberia	LR	78	Sweden	SE	122			
Germany	DE	34	Lesotho	LS	79	Singapore	SG	123			
Djibouti	DJ	35	Lithuania	LT	80	Slovenia	SI	124			
Denmark	DK	36	Luxembourg	LU	81	Slovakia	SK	125			
Dominica	DM	37	Latvia	LV	82	Sierra Leone	SL	126			
Dominican Rep.	DO	38	Morocco	MA	83	El Salvador	SV	127			
Algeria	DZ	39	Monaco	MC	84	Syria	SY	128			
Ecuador	EC	40	Moldova	MD	85	Chad	TD	129			
Estonia	EE	41	Montenegro	ME	86	Togo	TG	130			
Egypt	EG	42	Madagascar	MG	87	Thailand	TH	131			
Spain	ES	43	Macedonia	MK	88	Tunisia	TN	132			
Ethiopia	ET	44	Mali	ML	89	Turkey	TR	133			
Finland	FI	45	Mongolia	MN	90	Trinidad and Tobago	TT	134			

Appendix 3: Table 8. Acquiring firm home country distribution top 5

Country	Number of deals	Percent
United Kingdom	4524	24,62%
France	2355	12,82%
Sweden	1961	10,67%
Germany	1675	9,12%
Poland	1530	8,33%

Appendix 4: Table 9. Target firm home country distribution top 5

Country	Number of deals	Percent
United Kingdom	3207	17,64%
Poland	1427	7,84%
USA	1408	7,75%
Germany	1404	7,72%
France	1290	7,10%

Appendix 5: Table 10. Industry cluster NACE Rev. 2 codes

Code	NACE2	Range	Industry	Percent
1	0	499	Agriculture, hunting and forestry	0,62
2	500	999	Mining & Quarrying	2,73
3	1000	3329	Manufacturing	29,41
4	3500	3599	Electricity, gas, steam and air conditioning supply	2,24
5	3600	3999	Water supply; sewerage, waste management and remediation activities	0,87
6	4000	4400	Construction	4,47
7	4500	4800	Wholesale and retail trade; repair of motor vehicles and motorcycles	7,13
8	4900	5400	Transportation and storage	1,86
9	5500	5700	Accommodation and food service activities	1,14
10	5800	6399	Information and communication	16,55
11	6400	6700	Financial and insurance activities	13,44
12	6800	6899	Real estate activities	2,37
13	6900	7599	Professional, scientific and technical activities	10,09
14	7700	8300	Administrative and support service activities	4,68
15	8400	8499	Public administration and defense; compulsory social security	0,02
16	8500	8599	Education	0,30
17	8600	8900	Human health and social work activities	0,82
18	9000	9399	Arts, entertainment and recreation	0,93
19	9400	9699	Other service activities	0,32
20	9700	9899	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0
21	9900	9999	Activities of extraterritorial organizations and bodies	0

Appendix 6: Table 11. Number of deals per year[9]

Year	Frequency	Percentage	Cum.
2007	1990	13,59%	13,59%
2008	1765	12,05%	25,63%
2009	1185	8,09%	33,72%
2010	1437	9,81%	43,53%
2011	1490	10,17%	53,71%
2012	1481	10,11%	63,82%
2013	1415	9,66%	73.48%
2014	1586	10,83%	84.31%
2015	1679	11,46%	95.77%
2016	6200	4,23%	100,00%

Appendix 7: Table 12. Method of payment

Method of payment	Deals
Debt	5610
Cash	35640
Shares	18120
Deferred payment	4760
Earnout	13130
Converted debt	350
Total	77610

[9] Firms deals are counted per year. Firms that completed multiple deals in one year are counted as one deal that specific year.

Appendix 8: Table 13. Within- and cross-border deal distribution.

Deal	Deals	Percent	Cum.
Within-border	61930	49.23	49.23
Cross-border	63880	50.77	100.00
Total	125810	100.00	

Appendix 9: Table 14. Regression of the base model.

	ROA	PROFIT MARGIN
RDI	-0.0068471***	-0.4405974***
	(0.2338703)	(7.480244)
COMPLETED	-0.1910843	-0.4742115**
	(0.1549311)	(0.23673)
RDC	0.005504676**	0.0651641
	(0.2337863)	(5.039969)
SIZE	-0.559905***	-0.6651175***
	(0.2140147)	(0.2487161)
YEAR		
2007	0.4581934***	0.6789304***
	(0.1373377)	(0.1463694)
2008	-1.621804***	-1.848841***
	(0.1690253)	(0.2393592)
2009	-2.533503***	-3.084169***
	(0.1580761)	(0.224599)
2010	-.9554195***	-0.6021285***
	(0.1893224)	(0.2291326)
2011	-0.6974192***	-0.0889184
	(0.178045)	(0.2448409)
2012	-1.059878***	-1.334948***
	(0.205129)	(0.289511)
2013	-2.237356***	-1.709298***
	(0.2549131)	(0.3100234)
2014	-2.064178***	-1.439422***
	(0.2549496)	(0.3262456)
2015	-1.479883***	-1.5897***
	(0.2402017)	(0.3706329)
CONSTANT	10.41566***	16.44183***
	(1.844831)	(2.184767)
R-SQUARED	Within: 0.0431	Within: 0.0547
	Between: 0.0194	Between: 0.0096
	Overall: 0.0001	Overall: 0.0083
OBSERVATIONS	23,267	23,056
GROUPS	2,933	2,919

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

Appendix 10: Table 15. Base model grouped by degree of R&D intensity.

	LOW RDI	HIGH RDI	LOW RDI	HIGH RDI
	ROA	**ROA**	**Profit margin**	**Profit margin**
RDI	-0.3033284	-0.0066238***	0.8416914*	-0.4691656***
	(0.1886598)	(0.0023004)	(0.496116)	(0.0886707)
COMPLETED	-0.2024281	-0.5049641	-0.323004	-0.4720257
	(0.1893516)	(0.36636)	(0.2581019)	(0.8520324)
RDC	0.2940131**	0.0052812**	0.1754942	0.0042372
	(0.1308337)	(0.0022971)	(0.20424)	(0.0806096)
SIZE	-0.5098662**	-0.2401922	-0.9413493***	0.3367823
	(0.2106582)	(0.6943759)	(0.2324831)	(0.8658061)
YEAR				
2007	0.356439**	0.4822347**	0.3149806**	2.337748***
	(0.1522952)	(0.231791)	(0.1471637)	(0.3987323)
2008	-1.336846***	-2.79201***	-1.817774***	-1.659644***
	(0.1903678)	(0.4006627)	(0.277203)	(0.4966282)
2009	-2.287932***	-3.30062***	-3.10383***	-2.79002***
	(0.1759513)	(0.33524)	(0.2650579)	(0.4626734)
2010	-0.7469295***	-1.742277***	-0.6357432**	-0.6002869
	(0.2145035)	(0.392853)	(0.2511127)	(0.5252495)
2011	-0.9128245***	-0.4689027	-0.8854519***	1.697378***
	(0.1825615)	(0.4234354)	(0.2833337)	(0.5450197)
2012	-1.261484***	-0.9767358*	-1.846011***	-0.1547137
	(0.2069178)	(0.4996403)	(0.3212014)	(0.6731959)
2013	-2.192191***	-2.63668***	-2.240053***	-0.1158819
	(0.2809266)	(0.5576553)	(0.3618668)	(0.6484289)
2014	-2.443245***	-1.394429***	-2.288006***	1.114136
	(0.2948407)	(0.5267289)	(0.3446589)	(0.7667213)
2015	-1.705163***	-1.403568***	-2.199371***	0.3864136
	(0.2707829)	(0.5050545)	(0.441903)	(0.7207029)
CONSTANT	10.20457***	7.515267	17.00334***	10.20732
	(1.774844)	(6.223978)	(2.034974)	(7.921026)
R-SQUARED	Within: 0.0433	Within: 0.0499	Within: 0.0298	Within: 0.1346
	Between: 0.0215	Between: 0.0122	Between: 0.0026	Between: 0.1647
	Overall: 0.0002	Overall: 0.0195	Overall: 0.0000	Overall: 0.1320
OBSERVATIONS	16,716	6,551	16,620	6,436
GROUPS	2,301	1,009	2,298	998

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

Appendix 11: Table 16. Quadratic model.

	ROA	PROFIT MARGIN
RDI	-0.02393413***	-0.7584693***
	(0.7269706)	(9.871143)
RDC	0.0161272**	0.0746396
	(0.6762161)	(5.020935)
COMPLETED	-0.2344889	-0.4476729*
	(0.1539099)	(0.2288793)
RDI2	0.000371***	0.0030535***
	(0.013542)	(6.170543)
RDC2	-0.0003552***	-0.0007599
	(0.0133663)	(4.665327)
SIZE	-0.5187636**	-0.5574113**
	(0.2135881)	(0.2540409)
YEAR		
2007	0.4697967***	0.6515905***
	(0.1367202)	(0.1457466)
2008	-1.595543***	-1.841016***
	(0.1677751)	(0.2411565)
2009	-2.506884***	-2.984349***
	(0.1571899)	(0.2245254)
2010	-0.9576334***	-0.5797781**
	(0.1885354)	(0.2284719)
2011	-0.699302***	-0.0957873
	(0.1784706)	(0.2466381)
2012	-1.078632***	-1.359517***
	(0.2044391)	(0.2903435)
2013	-2.248926***	-1.788873***
	(0.2558028)	(0.3110248)
2014	-2.0885***	-1.489242***
	(0.2552142)	(0.3273776)
2015	-1.509527***	-1.649236***
	(0.2407989)	(0.3702391)
CONSTANT	10.13096***	16.33448***
	(1.839882)	(2.214159)
R-SQUARED	Within: 0.0490	Within: 0.0625
	Between: 0.0002	Between: 0.0124
	Overall: 0.0042	Overall: 0.0084
OBSERVATIONS	23,267	23,056
GROUPS	2,933	2,919

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

Appendix 12: Table 17. Standard model including two-year lags.

	ROA	PROFIT MARGIN
RDI		
.	-0.0071373**	-0.3230251***
	(0.0028723)	(0.1097096)
L1.	-0.0022982	-0.2562599***
	(0.0039597)	(0.0851145)
L2.	0.0036999	0.0438255*
	(0.009221)	(0.0256549)
COMPLETED	-0.0864881	-0.3602799
	(0.1866899)	(0.3135021)
RDC		
.	0.0058079**	-0.0189998
	(0.0028799)	(0.0945344)
L1.	-0.0014795	0.1831197*
	(0.0016258)	(0.10583)
L2.	-0.0065596	-0.0908455
	(0.0044145)	(0.0590109)
SIZE	-0.4249428	-0.4204509
	(0.2736376)	(0.3436757)
YEAR		
2009	-1.014786***	-1.237642***
	(0.124903)	(0.239268)
2010	0.4584514***	1.154956***
	(0.1755857)	(0.2525522)
2011	0.5860566***	1.530913***
	(0.178439)	(0.2597311)
2012	0.2537275	0.3041825
	(0.1855665)	(0.2768027)
2013	-0.7955295***	-0.0587181
	(0.2408599)	(0.3299399)
2014	-0.6995805***	0.1674013
	(0.231175)	(0.3334904)
2015	-0.1182084	-0.0394625
	(0.232831)	(0.414108)
CONSTANT	7.846167***	13.08532***
	(2.438796)	(3.098137)
R-SQUARED	Within: 0.0242	Within: 0.0615
	Between: 0.0170	Between: 0.0142
	Overall: 0.0020	Overall: 0.0146
OBSERVATIONS	17,422	17,309

GROUPS	2,722	2,712

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

Appendix 13: Table 18. Random effects estimation of base model including control variables.

	ROA	**PROFIT MARGIN**
RDI	-.0090735***	-0.4065977***
	(0.0022099)	(0.0557566)
COMPLETED	-0.3766124***	-0.6702467***
	(0.1455571)	(0.2262814)
RDC	0.0077283***	0.0690153
	(0.0022114)	(0.0468759)
SIZE	0.7405719***	1.054405***
	(0.080789)	(0.1143475)
COUNTRY		
23	4.5022**	-4.935105***
	(1.822312)	(1.850742)
34	1.859102	-1.810069
	(1.726671)	(1.453148)
47	2.062282	-3.014138**
	(1.714621)	(1.370869)
102	7.20152***	-3.42148**
	(1.907426)	(1.664958)
122	4.468661***	-0.7197935
	(1.721937)	(1.34978)
INDUSTRYCLUSTER		
2	-0.8929555	-1.778.039
	(1.692747)	(1.602038)
3	-0.9272041	-2.821422**
	(1.646992)	(1.441848)
4	-4.296.899**	-6.487921***
	(1.79214)	(2.473516)
5	-3.236.585*	-5.16951***
	(1.882725)	(1.938144)
6	-1.682394	-4.048812**
	(1.675706)	(1.798266)
7	-2.072933	-6.655977***
	(1.683072)	(1.512478)
8	-2.149819	-8.417019***
	(1.704203)	(1.489809)
9	-1.78075	-6.472184***
	(1.688552)	(2.104529)

10	-0.2323189	-0.0361786
	(1.664222)	(1.45423)
11	1.059857	2.06434
	(1.889082)	(2.98212)
12	0.3730195	21.67496***
	(1.729233)	(2.798489)
13	-2.980372*	-2.213271
	(1.691086)	(1.468342)
14	-4.487295***	-10.13654***
	(1.665111)	(1.536015)
16	-8.542196***	-7.857391***
	(1.653297)	(1.382152)
17	-2.91707*	-3.619849**
	(1.640293)	(1.481906)
18	-3.825668***	-8.187564***
	(1.751382)	(2.578793)
YEAR	-0.2403507***	-0.2029546***
	(0.0240853)	(0.0350035)
CONSTANT	479.3662***	412.2459***
	(48.38888)	(70.2462)
R-SQUARED	Within: 0.0177	Within: 0.0319
	Between: 0.2226	Between: 0.2158
	Overall: 0.1186	Overall: 0.1168
OBSERVATIONS	23,267	23,056
GROUPS	2,933	2,919

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

Appendix 14: Table 19. Base model regressed on operating revenue using debt financing.

	OPREV
RDI	-81612.65
	(53596.82)
COMPLETED	1306376
	(917249.2)
RDC	-22209.99
	(103848.9)
SIZE	1469185
	(1048331)
YEAR	
2007	443180
	(296941.6)
2008	1049379***
	(318146.5)
2009	614893.9***
	(366042.5)
2010	1006785***
	(347987.1)
2011	1281847***
	(473525)
2012	2041524***
	(544128.6)
2013	1636308***
	(564702.5)
2014	1373943**
	(685286.8)
2015	2179338***
	(747753.7)
CONSTANT	-2221288
	(1.04e+07)

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

Appendix 15: Table 20. Base-, low-RDI, and high-RDI model including quadratic terms.

	STANDARD[10]	LOW RDI	HIGH RDI	STANDARD[11]	LOW RDI	HIGH RDI
	ROA			Profit margin		
RDI	-0.02393413***	-1.46091***	-0.0233322***	-0.7584693***	1.671531**	-0.9849631***
	(0.7269706)	(0.5513024)	(0.0072598)	(9.871143)	(0.6708798)	(0.1107924)
RDI2	0.000371***	0.4688976**	0.0000036***	0.0030535***	-0.3279162	0.0041743***
	(0.013542)	(0.2085298)	(0.00000135)	(6.170543)	(0.2522314)	(0.00068)
RDC	0.0161272**	1.924132***	0.0158657**	0.0746396	1.776111***	-0.1701139**
	(0.6762161)	(0.4517493)	(0.0067641)	(5.020935)	(0.5179516)	(0.0856491)
RDC2	-0.0003552***	-0.6993356***	-0.0000035***	-0.0007599	-0.6678247***	0.0007171
	(0.0133663)	(0.1826863)	(0.00000133)	(4.665327)	(0.2164699)	(0.000601)
COMPLETED	-0.2344889	-0.3524784*	-0.6525127*	-0.4476729*	-0.4988582*	1.123035
	(0.1539099)	(0.1952928)	(0.3616347)	(0.2288793)	(0.2655933)	(0.797014)
SIZE[12]	Y	Y	Y	Y	Y	Y
YEAR[13]	Y	Y	Y	Y	Y	Y
R-SQUARED	Within: 0.0490	Within: 0.0445	Within: 0.0628	Within: 0.0625	Within: 0.0309	Within: 0.1885
	Between: 0.0002	Between: 0.0195	Between: 0.0648	Between: 0.0124	Between: 0.0023	Between: 0.1573
	Overall: 0.0042	Overall: 0.0003	Overall: 0.0921	Overall: 0.0084	Overall: 0.0000	Overall: 0.1296
OBSERVATIONS	23,267	16,716	6,551	23,056	16,620	6,436
GROUPS	2,933	2,301	1,009	2,919	2,298	998

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parentheses.

[10] Extended regression output for ROA can be found in appendix 9.
[11] Extended regression output for profit margin can be found in appendix 9.
[12] Size, as measured by a natural logarithm of number of employees, is included in the models as a control variable.
[13] Year dummy included in the models

Appendix 16: Table 21. Absorptive capacity on firm performance grouped by deal method of payment.

METHOD OF PAYMENT	DEBT		CASH		SHARES	
	ROA	**PM**	**ROA**	**PM**	**ROA**	**PM**
RDI	-0.0368394	-0.123613	-0.0098632	-0.536463***	-0.0067256***	-0.4417681***
	(0.0643229)	(0.1038244)	(0.0093153)	(0.1315456)	(0.0022926)	(0.1413844)
COMPLETED	0.5820948	0.2644385	-0.0254523	-1.615294**	0.4692586	0.4227084
	(0.5680532)	(0.7144127)	(0.5525427)	(0.6878946)	(1.64287)	(1.894476)
RDC	**-0.1698559****	**-0.1588919***	0.0051776	**0.1879296****	**0.0053963****	-0.0280409
	(0.0679702)	(0.0901432)	(0.0080587)	(0.0896998)	(0.0022924)	(0.1347829)
SIZE[14]	Y	Y	Y	Y	Y	Y
YEAR[15]	Y	Y	Y	Y	Y	Y
CONSTANT	16.29241***	21.45254***	5.130219	14.3256***	1.484408	12.90669***
	(4.32064)	(6.875208)	(3.568651)	(4.108013)	(4.084381)	(4.076975)
R-SQUARED	Within: 0.0588	Within: 0.0362	Within: 0.0360	Within: 0.1002	Within: 0.0690	Within: 0.1149
	Between: 0.0233	Between: 0.0298	Between: 0.0691	Between: 0.1262	Between: 0.0666	Between: 0.1893
	Overall: 0.0016	Overall: 0.0243	Overall: 0.0458	Overall: 0.1262	Overall: 0.0844	Overall: 0.1893
OBSERVATIONS	891	889	3,699	3,632	1,378	1,273
GROUPS	109	109	479	3,632	186	179

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**
Robust standard errors are included in the parenthesis.

[14] Size, as measured by a natural logarithm of number of employees, is included in the models as a control variable.
[15] Year dummy included in the models

Appendix 17: Table 22. Absorptive capacity regressed on firm performance for domestic and cross-border deals.

	CROSSBORDER	DOMESTIC	CROSSBORDER	DOMESTIC
	ROA		Profit margin	
RDI	-0.0061159***	-0.0271882	-0.3450205***	-0.6681516***
	(0.0022325)	(0.0174581)	(0.077333)	(0.1144822)
COMPLETED	-0.2134728	0.132757	-0.1377744	-0.7792235*
	(0.1832138)	(0.2930251)	(0.2729218)	(0.4262768)
RDC	**0.0047796****	-0.0423603	-0.0062656	**0.2169352*****
	(0.0022315)	(0.0391984)	(0.0569473)	(0.0821781)
SIZE	-0.8669354***	-0.1186302	-0.629823**	-0.6505843
	(0.2684208)	(0.350711)	(0.2944266)	(0.4288619)
YEAR				
2007	0.9784574***	-0.5812747**	0.9763849***	0.0831907
	(0.1554093)	(0.2661867)	(0.163895)	(0.292289)
2008	-0.8924363***	-3.063331***	-0.8142643***	-3.911944***
	(0.177995)	(0.3531096)	(0.2082411)	(0.575928)
2009	-1.84269***	-3.881339***	-2.393898***	-4.450982***
	(0.1742222)	(0.3155955)	(0.2245419)	(0.4966526)
2010	-0.1681603	-2.479914***	-0.0073686	-1.860334***
	(0.1885813)	(0.4108427)	(0.241152)	(0.4804111)
2011	-0.0179534	-2.039546***	0.4979015*	-1.345981***
	(0.1889616)	(0.367486)	(0.2674534)	(0.5030154)
2012	-0.1983251	-2.739049***	-0.3127268	-3.384726***
	(0.2210898)	(0.4115591)	(0.2951325)	(0.6236927)
2013	-1.320323***	-4.027814***	-1.018724***	-3.214315***
	(0.2844958)	(0.4968812)	(0.3403954)	(0.6209172)
2014	-1.134112***	-3.886484***	-0.5913481	-3.281837***
	(0.2724276)	(0.5134955)	(0.3853152)	(0.6050835)
2015	-0.7210264***	-2.937175***	-1.205746***	-2.459965***
	(0.2628241)	(0.4907268)	(0.4181628)	(0.7427305)
CONSTANT	13.3273***	7.162874***	16.30943***	15.86125***
	(2.488825)	(2.573522)	(27.5995)	(3.3005)
R-SQUARED	Within: 0.0467	Within: 0.0502	Within: 0.0630	Within: 0.0602
	Between: 0.0440	Between: 0.0058	Between: 0.0043	Between: 0.0407
	Overall: 0.0038	Overall: 0.0018	Overall: 0.0079	Overall: 0.0259
OBSERVATIONS	15,205	8,062	15,096	7,960
GROUPS	1,921	1,012	1,910	1,009

***** = significant at 1% level ** = significant at 5% level * = significant at 10% level**

Robust standard errors are included in the parenthesis.

Appendix 18: Table 23. Hausman test on ROA.

	Coefficients (b) fe	(B) re	(b−B) Difference	sqrt(diag(V_b−V_B)) S.E.
RDintensity	**−.1489991**	**−.1699112**	**.0209122**	**.0050175**
lnNOE	**−.64562**	**.7017743**	**−1.347394**	**.1057654**
year	**−.1981741**	**−.2612703**	**.0630962**	**.0051156**

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(**3**) = (b−B)'[(V_b−V_B)^(−1)](b−B)
= **176.39**
Prob>chi2 = **0.0000**

Appendix 19: Table 24. Hausman test on profit margin.

	Coefficients (b) fe	(B) re	(b−B) Difference	sqrt(diag(V_b−V_B)) S.E.
RDintensity	**−24.67594**	**−25.21066**	**.534713**	**.6049365**
lnNOE	**−.8073085**	**.9737177**	**−1.781026**	**.1555321**
year	**−.1742321**	**−.2508762**	**.0766441**	**.0076358**

b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(**3**) = (b−B)'[(V_b−V_B)^(−1)](b−B)
= **144.44**
Prob>chi2 = **0.0000**