



Evaluating the instantaneous and medium-run impact of mergers and acquisitions on firm values[☆]



Marcelo Bianconi^{a,*}, Chih Ming Tan^b

^a Tufts University, USA

^b University of North Dakota, USA

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ABSTRACT

This paper contributes to the literature investigating the impact of mergers and acquisitions (M&A) activity on an acquirer's firm value. To do so, we exploit a large sample of 65,521 M&A deals globally from the Communications, Technology, Energy and Utilities sectors in the years of 2000–2010. We focus on an enterprise value multiple, the ratio of EV/EBITDA, as a measure of firm value. Using the difference-in-differences (DID) strategy with and without propensity score matching, we find significant evidence of negative medium-run M&A effects and positive instantaneous M&A impact on firm value potentially because EV moves faster relative to a slow moving EBITDA.

1. Introduction

Mergers and acquisitions (M&A) is a general term used to refer to the consolidation of companies. A merger is a combination of two companies to form a new one, while an acquisition is the purchase of one company by another in which no new company is formed. Either structure can result in the economic and financial consolidation of two entities. M&A activity may also be construed as a type of restructuring in some entity reorganization with the aim of providing growth and value. Consolidation of an industry or sector occurs when widespread M&A activities concentrate the resources of many small companies into a few larger ones. For example, a large wave of M&A deals occurred in the automotive industry in the U.S. between 1910 and 1940, and a turbulent time for the airlines M&A was between 1970's and 1980's. Most importantly, the great revolution of information and telecommunications between 1985 and 2000 pushed global M&A activities in the technology and communication sectors to hit a highest level in the 21st century. In the beginning of 2014, Comcast Corporation and Time Warner Cable engaged in friendly merger talks which would have created a worldwide technology and media company. The agreement was for a stock-for-stock transaction in which Comcast would acquire 100 percent of Time Warner Cable's 284.9 million shares outstanding for shares of CMCSA amounting to approximately \$45.2 billion in equity value in February of 2014, but the deal was eventually abandoned. Also, Facebook announced in February 2014 that it had reached a definitive agreement to

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* Corresponding author.

E-mail addresses: marcelo.bianconi@tufts.edu (M. Bianconi), chihming.tan@business.und.edu (C.M. Tan).

acquire WhatsApp, a rapidly growing cross-platform mobile messaging company, for a total of approximately \$19 billion, in cash, shares and vested restricted stock.¹

In this paper, we investigate whether or not M&A have an impact on an acquirer's firm value and how they influence value instantaneously and in the medium-run. We define the instantaneous effect as the impact on value in the year of the implementation of the deal, and the medium-run effect as the impact on value in the subsequent three years after the implementation of the deal. Specifically, we analyze a large sample consisting of global M&A deals for 65,521 firms over the period between the years of 2000 and 2010. We choose an enterprise value multiple; i.e., the ratio of enterprise value over earnings (before interest, taxes, depreciation and amortization), EV/EBITDA, as the metric for firm value since it takes debt into account, which the acquirer will have to assume, and eliminates the potential influence of inflation and tax policy.² We also control for other financial fundamental ratios, such as the price-to-sale ratio, debt-to-equity ratio, market-to-book ratio, financial leverage and total debt obligations. Thus, we can compare the results on firm value across countries and across time periods.

We are also cognizant of the fact that an enterprise multiple may vary depending on the industry type. Hence, we examine the Communications, Technology, Energy and Utilities sectors individually in order to understand the differences in the impact of M&A on firm value in technology-intensive versus resource-intensive firms.³ The top-value global M&A deals in all sectors in our sample period are listed in Table 1. Table 2 presents a classification of the sectors and subsectors examined in this paper. In our sample, the correlation between market-to-book ratios and the enterprise multiple is positive across the universe of firms engaging in M&A in all four company sectors. Price-to-sales ratio has a similar correlation but the correlation is only significant in some cases. In the case of leverage, the debt-to-equity ratio has a significant negative correlation with EV/EBITDA in the Energy and Utilities sectors. A lower market-to-book ratio and a higher debt-to-equity ratio decrease the EV/EBITDA ratio thus indicating an undervalued firm.

Our key empirical evidence comes from analysis employing treatment effect models including differences-in-differences (DID) with propensity score matching to estimate the causal effect of M&A on firm value as measured by EV/EBITDA.⁴ We find that the medium-run and instantaneous effects of M&A on the EV/EBITDA are much different. A potential higher increase in firm's earnings relative to enterprise value in the longer horizon gives one effect but, by contrast, the instantaneous effect may be in the opposite direction since the enterprise value via the stock market moves much faster in response to the M&A activity while the enhancement in firms' earnings is slow moving. Furthermore, we find that whether in periods of crisis, or calm, new M&A deals can cause an instantaneous net increase in firm value potentially incentivizing short termism in the universe of M&A activity. One of our key contributions is to provide evidence of a potential abnormal instantaneous gain in firm's EV/EBITDA caused by the implementation of the M&A. Our evidence sheds light on the Agrawal, Jaffe, and Mandelker (1992, 2000) "post-merger performance puzzle" since we find medium-run decline in firm value, but instantaneous gains.⁵

The rest of the paper is organized as follows. Section 2 provides a literature review. Section 3 then outlines the definition and descriptive statistics of the variables in sample dataset. Section 4 provides details on our identification strategy and estimation approach, and also discusses our findings. Section 5 summarizes the major findings and gives recommendations for future research work. An appendix provides results from placebo tests.

2. Literature review

The key hypothesis tested in this paper is the medium-run versus the instantaneous impact of M&A on firm value measured by EV/EBITDA in the Communications, Technology, Energy and Utilities sectors thus capturing the differences in the impact of the implementation of M&A on firm value in technology-intensive versus resource-intensive firms. In the vast literature, the large number of M&A deals has raised questions related to why M&A occur and how M&A affect the outcome of corporations in terms of financial performance, research and development, productivity and market share. Since the late 1990s, the literature has focused on the theory of mergers and acquisitions, providing insights into the success or failure of M&A activities. The issues ranged from theories of the firm

¹ Historically, we can identify roughly six waves of M&A activities. The first wave of horizontal mergers occurred in 1897–1904; the second wave of vertical mergers in 1916–1929; the third wave of diversified conglomerate mergers in 1965–1969; the fourth wave of congeneric mergers, hostile takeovers and corporate raiding in 1981–1989; the fifth wave of cross-border mergers in 1992–2000; and the sixth wave of shareholder activism, private equity and leveraged buyouts (LBO) in 2003–2008.

² The literature proposes many different motives for conducting M&A as well as investigates in great detail how acquirer and target firms fare in M&A transactions. For example, in studying the value creation aspects of M&A, one may focus at acquirer, target and combined acquirer and target abnormal announcement returns, long run stock returns of the acquirer after the deal completion and the operating performance of the combined firm measured by return on assets (ROA). See e.g. the surveys of Golubov et al. (2012), Menapara et al. (2012), Deyoung et al. (2009), Schulz (2007), Abellán (2004). Alternatively, here our focus is on the impact of the implementation of the M&A on EV/EBITDA and we address endogeneity concerns using a differences-in-differences approach.

³ Technically it translates into industry fixed effects.

⁴ To our knowledge, there are very few papers that use a DID strategy to address endogeneity problems in the M&A literature. Hall (1990) investigates whether or not financial markets discriminate against long-term investments in R&D and thus ignore the returns to such investment while encouraging financial restructurings; Szücs (2013) evaluate the impact of M&A activity on the growth of R&D spending and R&D intensity; and Blonigen and Pierce (2016) study of the impact of mergers and acquisitions (M&As) on productivity and market power.

⁵ In a recent paper, Edmans et al. (2018) show that short-term stock price concerns induce CEOs to take value-reducing actions. One of the manifestations of this effect is M&A activity in the sense that stock returns are more positive in the two quarters surrounding M&A activity, but more negative in the four years following M&A. Authors such as Erel et al. (2012) emphasize the mitigation of financial frictions as a driver for M&A, see King et al. (2004) for an opposing view. See also Lin, Lin, and Cheng (2011) on the potential market misvaluation as a driver of post-acquisition underperformance, and Wu (2009) for the case of China.

Table 1

Top-value M&A global deals in 21st century.

	Rank	Year	Acquirer	Target	Transaction value (in billion USD)
2000's	1	2000	AOL Inc. (America Online)	Time Warner	164.75
	2	2000	Glaxo Wellcome Plc.	SmithKline Beecham Plc.	75.96
	3	2004	Royal Dutch Petroleum Company	Shell Transport & Trading Co.	74.56
	4	2006	AT&T Inc	BellSouth Corporation	72.67
	5	2001	Comcast Corporation	AT&T Broadband	72.04
	6	2009	Pfizer Inc.	Wyeth	68
	7	2000	Nortel Networks Corporation	(*)	59.97
	8	2002	Pfizer Inc.	Pharmacia Corporation	59.52
	9	2004	JPMorgan Chase & Co	Bank One Corporation	58.76
	10	2008	ImBev Inc.	Anheuser-Busch Companies, Inc.	52
2010-	1	2014	Comcast Corporation	Time Warner Cable	45.2
	2	2012	Deutsche Telekom	MetroPCS	29
	3	2013	Berkshire Hathaway	H. J. Heinz Company	28
	4	2013	Softbank	Sprint Corporation	21.6
	5	2014	Facebook	WhatsApp	19
	6	2011	Google	Motorola Mobility	9.8
	7	2011	Berkshire Hathaway	Lubrizol	9.22
	8	2011	Microsoft Corporation	Skype	8.5

(*) Several acquisitions in the year 2000.

Table 2

Company sectors classification.

Company Sectors	COMMUNICATIONS	ENERGY	TECHNOLOGY	UTILITIES
Sub-sectors	Advertising Internet Media Telecommunications	Coal Energy-Alternate Sources Oil & Gas Oil & Gas Services Pipelines	Computers Office/Business Equip Semiconductors Software	Electric Gas Water

conceptualized into the motives for merger, their empirical investigation, performance measurement of merged firms using share price data and accounting data, empirical examination of financial characteristics of acquirer and target firms and the determinants of aggregate merger activity. Despite the large literature, there is no agreement about either the motives or the effects of M&A (Chapman, 2003; Chen & Findlay, 2003; Deyoung, Evanoff, & Molyneux, 2009; Golubov, Petmezas, Nickolaos, & Travlos, 2012; Kwoka, 2002; Menapara & Pithadia, 2012; Schulz, 2007).

A key motivation for M&A is to provide growth of the company or positive shareholder value. The general motivations come from financial performance, technology innovation and market trend. The acquiring firm seeks improved financial performance (Erel, Jang, & Weisbach, 2012). A more traditional view is that M&A take place to lower the costs of the company relative to the same revenue stream and increase profit margins, thus maximizing stockholder wealth (Bradley, Desai, & Kim, 1988; Manne, 1965). The acquisitions serve as a means to seize the efficiency gain potentially stemming from economies of scale and scope, managerial and financial synergies, and superior management. Also, a company is more competitive as it increases its market share. The acquirer firm can obtain a group of target markets for actual and potential products to be sold in those markets; meanwhile it absorbs a major competitor and thus increases its market power by capturing increased market share to set prices (Abellán, 2004). Moreover, many M&A activities provide an opportunity for corporations and their shareholders to receive some tax benefits, in a small minority of cases these benefits are larger in comparison to the value of the acquired company, suggesting tax provided motivation. But, even in cases where there are significant tax benefits, there is no strong evidence that they were the driving factors in the takeovers (Auerbach & Reishus, 1987, pp. 69–86).

On average and across the most commonly studied variables, the acquiring firms' financial performance does not positively change as a function of their acquisition activity (King, Dalton, Daily, & Covin, 2004). M&A activities appear to occur in different extents across different sectors. In technology-intensive firms (i.e. Communications and Technology sectors), M&A appear to be strongly associated with R&D intensity and innovation. Due to fast growing technological change, an acquirer can take advances of a target's product capability, patents and brand recognition by their customers (Kallunki, Pyykkö, & Laamanen, 2009; Sevilir & Tian, 2012). The transfer of technologies and capabilities results in faster growth of acquirers (Ranft & Lord, 2002). More recent literature also suggests that corporate managers conduct M&A to expand the power of their companies so as to facilitate their empire-building (Ravenscraft & Scherer, 1987).

In the resource-intensive firms, i.e. Energy sector and Utilities sector, the focus is on geographical expansion, resource transfer and diversification. A non-financial merger motivator has long been believed to be geographic diversification. It is an attempt to expand market share, decrease risk, and in the long run increase profits (Frohlich & Kavan, 2000). Many others (Baker, Jensen, & Murphy, 1988; Conyon & Gregg, 1994; Firth, 1991) find that executive rewards increase with firm size in the wake of acquisitions. Also, resource and nonperforming assets are unevenly distributed across firms (Barney, 1991) and the interaction of target and acquiring firm resources can create value through either overcoming asymmetry or by combining scarce resources (King, Slotegraaf, & Kesner, 2008). The experience

of M&A of European utility sectors shows that the combined post-acquisition companies suffered losses in the long run thus triggering a negative signal for investors in utilities overall (Datta, Kodwani, & Viney, 2013).

Our results indicate that the medium-run effect of M&A activity on firms' EV/EBITDA is negative. For technology intensive acquirer firms could apply the new technology immediately and become more productive resulting in the raise of total revenue and profit in a short time period. Concurrently, firms are not required to largely expand total assets and market capitalization. Thus, the increase of enterprise value could be less than that of firm's earnings during the three years after the M&A deal, which results in a fall of EV/EBITDA. However, Energy and Utilities firms may show a different pattern since the main incentive for M&A in those sectors should be tangible advantage and the payoff from M&A may take longer than three years in resource-intensive firms. Alternatively, the instantaneous treatment effect analysis shows that the impact on EV/EBITDA is positive, which means the ratio of EV/EBITDA goes up at the time when mergers and acquisitions take place. While both the numerator and denominator raise so does the ratio, and we conjecture that instantaneously the EV in the numerator increases more than EBITDA in the denominator. In other words, enterprise value grows faster than firm's earning in the year of M&A overall.

Besides the motivations from the company's perspective, the boom in M&A is also a general phenomenon generated by new global conditions, such as trends linked to the transformation of markets, e.g. the flourishing of regulatory shifts; and technology, e.g. the emergence of new business and market opportunities, the rise of technological interrelatedness, and the establishment of new communications and cross-border restructuring (Cassiman & Colombo, 2006). M&A have been used as tools for firm growth for many years. Engaging in M&A represents an important commitment for any company as it affects every facet of its organization. Studies of this approach for emerging markets like China and India were undertaken in Menapara and Pithadia (2012), and cross-border M&A deals were examined in Chapman (2003), Chen and Findlay (2003) and Jongwanich, Brooks, and Kohpaiboon (2013). In order to best measure pre- and post- M&A effects, we can examine synergy realization, absolute performance, and relative performance. Analytical methods include, but are not limited to, mean and standard deviation, ratio analysis, paired sample *t*-test, which involves the use of accounting measures like size, growth, profitability, risk and leverage to analyze the performance characteristics of the acquirer and target (merging and merged) firms in the pre- and post-takeovers periods (Vanitha & Selvam, 2007); and difference-in-difference estimation to single out the causal effect of M&A (Hall, 1990, pp. 85–124; Szűcs 2013; Blonigen & Pierce, 2016). But, none to our knowledge examine the impact of M&A on firm value with the appropriate causal methods we apply here.

The economic advantages of M&A have been examined at length. Caves (1989) and Röller, Stennek, and Verboven (2000) provided support for the thesis that firms achieve or strengthen market power and obtain efficiency gains by being able to exploit economies of scale and scope. Kumar and Singh (1994)'s case study concluded that rehabilitation of a troubled company by merging with a healthy company is one of the most effective way for their rehabilitation.

Agrawal et al. (1992, 2000) called attention to “The Post-Merger Performance Puzzle,” where they examined the literature on long-run abnormal returns following mergers, and also examined explanations for any findings of underperformance following mergers, see also Edmans, Fang, and Huang (2018). Agrawal and Jaffe (2000) concluded that the evidence does not support the conjecture that underperformance is specifically due to a slow adjustment to merger news and rejected the earnings-per-share myopia hypothesis, i.e. the hypothesis that the market initially overvalues acquirers if the acquisition increases EPS, ultimately leading to long-run underperformance. The success of merger and acquisitions depends on proper integration of employees, organization culture, IT, products, operations and service of both the companies. Proper integration in mergers plays a critical role in determining how effectively merged organizations are able to integrate business processes and people and deliver products and services to both internal and external customers of the organization. Our results have implications for the “post-merger performance puzzle” since we find medium-run decline in firm value, but instantaneous gains.

Despite the many advantages M&A could offer, the statistical evidence supporting the hypothesis that profitability and efficiency increase following M&A is at best weak (Berkovitch & Narayanan, 1993; Jensen & Ruback, 1983; Lichtenberg, 1992; Mueller, 1980; Ravenscraft & Scherer, 1987). The problem with most existing studies is that they disregard the issue of how value is created through M&A and hence fail to identify the conditions that should hold for M&A to positively contribute to firm's performances (Caves, 1989).

Some notable and seminal empirical studies show a negative impact of M&A on the financial and economic performance of companies. Vanitha and Selvam (2007) analyzed the pre- and post-merger financial performance of manufacturing sector during 2000–2002; they found that the overall financial performance of merged companies in respect of 13 variables were not significantly different from the expectations. Mantravadi and Reddy (2007, 2008) conducted research to study the impact of M&A on the operating performance of the acquiring corporation in different periods in India, by examining some pre- and post-merger financial ratios with chosen sample firms and mergers between 1991 and 2003. Their results suggest that there are minor variations in terms of impact on operating performance following merger in different intervals of time in India. Kumar (2009) also examined the post-merger operating performance of a sample of 30 acquiring companies involved in merger activities during 1999–2002 in India; the study attempted to identify synergies, if any, resulting from mergers and found that post-merger profitability, asset turnover and solvency of the acquiring companies, on average, showed no improvement when compared with pre-merger values. Other studies link M&A and R&D (Hall, 1990, pp. 85–124). Hitt, Hoskisson, Ireland, and Harrison (1991) and (1996) find that M&A seem to shift the innovative strategy more towards external sourcing. Szűcs (2013) used different matching techniques to construct separate control groups for acquirers and targets to single out the causal effect of mergers on R&D growth and intensity. They found that M&A have a direct significant negative impact on internal R&D inputs, as well as ex-post R&D output compared to competitors.

Despite the goal of performance improvement, results from M&A are sometimes disappointing compared with what is predicted or expected. Numerous empirical studies show high failure rates of M&A deals. They develop a comprehensive research framework that bridge different perspectives and promote understanding of factors underlying M&A performance in business research and scholarship (Straub, 2007).

To sum, our main original contribution to the literature investigating the impact of M&A activity on firm value focusing on an enterprise value multiple, the ratio of EV/EBITDA, as a measure of firm value and using the difference-in-differences (DID) strategy with and without propensity score matching. Our focus is on causal identification using a worldwide sample of deals from four sectors; i.e., Communication, Technology, Energy and Utilities, thus contrasting technology intensive versus resource intensive sector which had M&A activities during the year of 2000–2010.

3. Data and descriptive statistics

3.1. M&A data

In this paper, we measure the effect of M&A activities on firm value using an enterprise value multiple as the metric for firm value. We examine whether mergers and acquisitions have an impact on firm value; which factors have a significant effect, and how they influence firm value instantaneously (in the year the deal is completed and implemented) and in the medium-run (in the three subsequent years after completion).

Our study employs a large sample of firm-level financial data collected from the Bloomberg database consisting of global M&A deals. We looked for worldwide M&A completed activities during the years from 2000 to 2010. The M&A deals were both domestic and cross-border. For each deal, we focused on the acquirer firm's financial fundamentals data for a time period of seven years: three-years before the M&A, the year when the M&A took place, and three-years after the M&A occurred. Our raw sample includes 65,521 firms with 458,647 observations in total. To reduce the weight of outliers, we trim the dependent variable, EV/EBITDA (described in the next subsection), at the 1st and 99th percentiles by setting extreme values to the 1st and 99th percentile values, respectively. The M&A deals which have only one year of data available were also eliminated from the panel.

Moreover, because an enterprise multiple may vary depending on the industry type, we also separately examine the Communications, Technology, Energy and Utilities sectors, in order to understand the differences in the impact of M&A activities across technology-intensive and resource-intensive firms. As a result, the unbalanced panel dataset consists of 31,284 M&A deals with 165,660 observations: 67,608 from Communication sector, 46,419 from Technology sector, 30,088 from Energy sector and 21,545 from Utilities sector; the time dimension is evenly distributed in seven years, as listed in Table 3 and Tables 4a and 4b.

3.2. Enterprise value multiple (EV/EBITDA)

The outcome variable is the firm enterprise value over earnings before interest, taxes and depreciation. Enterprise value (EV) is an economic measure reflecting the market value of a whole business. Enterprise value is calculated as market capitalization plus debt (both long-term and short-term), minority interest and preferred shares, minus total cash and cash equivalents. It is more comprehensive than market capitalization, which only includes common equity. Enterprise value differs significantly from simple market capitalization in several ways, and many consider it to be a more accurate representation of a firm's value. One may think of enterprise value as the theoretical takeover price. In the event of a buyout, an acquirer would have to take on the target's debt, but would pocket its cash. The value of a firm's debt would need to be paid by the buyer when taking over a company, thus EV provides a much more accurate takeover valuation because it includes debt in its value calculation.

Earnings before interest, taxes, depreciation and amortization (EBITDA) is an indicator of a company's financial performance. It is computed by revenue minus expenses (excluding interest, taxes, depreciation and amortization). EBITDA is essentially net income with interest, taxes, depreciation and amortization added back to it, and can be used to analyze and compare profitability between companies and industries because it eliminates the effects of financing and accounting decisions. Many companies, especially in the technology sector, now commonly quote it. EBITDA gives a good metric to evaluate a business' current operational profitability, but not cash flow. It also leaves out the cash required to fund working capital and the replacement of old equipment, which can be significant.

Although EBITDA is not a financial metric recognized in generally accepted accounting principles, it is widely used when assessing

Table 3
M&A deal volume by sector and year.

Year	Sector				Total
	Communication	Technology	Energy	Utilities	
2000	4583	2421	1046	538	8588
2001	3109	1718	973	471	6271
2002	2115	1320	780	417	4632
2003	1809	1312	887	345	4353
2004	2333	1437	1051	406	5227
2005	2588	1588	1203	404	5783
2006	2928	1821	1345	490	6584
2007	3008	1913	1656	548	7125
2008	2535	1718	1489	632	6374
2009	1907	1372	1264	496	5039
2010	2160	1525	1392	468	5545
Sum	29075	18145	13086	5215	65521

Table 4a
Data distribution in sectors.

Sector	Group (sector)				Total
	1	2	3	4	
Communication	67,608				67,608
Energy		30,088			30,088
Technology			46,419		46,419
Utilities				21,545	21,545
Total	67,608	30,088	46,419	21,545	165,660

Table 4b
Data distribution in years.

Dt	Frequency	Percent
−3	18,573	11.21
−2	21,123	12.75
−1	23,865	14.41
0	26,081	15.74
1	26,184	15.81
2	25,690	15.51
3	24,144	14.57
Total	165,660	100

Note: Dt refers to the timing of the M&A deal.
where 0 is the year the deal takes place.

the performance of companies. It is intended to allow a comparison of profitability between different companies, by canceling the effects of interest payments from different forms of financing (by ignoring interest payments), political jurisdictions (by ignoring tax), collections of assets (by ignoring depreciation of assets), and different takeover histories (by ignoring amortization). A negative EBITDA indicates that a business has fundamental problems with profitability. A positive EBITDA, on the other hand, does not necessarily mean that the business generates cash. This is because EBITDA ignores changes in working capital (usually needed when growing a business), capital expenditures (needed to replace assets that have broken down), taxes, and interest.

The enterprise multiple (EV/EBITDA) is a ratio used to determine the value of a company. It is calculated as enterprise value divided by its earnings. It's useful for transnational comparisons because it ignores the distorting effects of individual countries' taxation policies. Enterprise multiples can vary depending on the industry. It's important to compare the multiple to other companies or to the industry in general. Expect higher enterprise multiples in high growth industries (like biotech) and lower multiples in industries with slow growth (like railways). The EV/EBITDA multiple is a better metric than market capitalization for takeovers. It looks at a firm as a potential acquirer would, and used to find attractive takeover candidates. Compared to other multiples like the P/E, this ratio may be preferred because it is normalized for differences between companies: using EBITDA normalizes for differences in capital structure, taxation and fixed asset accounting; meanwhile, using enterprise value also normalizes for differences in a company's capital structure. A company with a low enterprise multiple might be undervalued, and thus can be viewed as a good takeover candidate. Broadly speaking, a company's assets are financed by either debt or equity. The weighted average cost of capital (WACC) is the rate that a company is expected to pay on average to all its security holders to finance its assets. The inverse of enterprise multiple, EBITDA/EV, is also a financial ratio that measures a company's return on investment. The company directors can compare their return with how much interest they have to pay for every dollar it finances, then determine the economic feasibility of expansionary opportunities and mergers.

3.3. Control variables

We include four standard financial fundamental ratios as controls in the models for the EV/EBITDA outcome: price-to-sales ratio, debt-to-equity ratio, market-to-book ratio, and financial leverage.⁶ The price-to-sales ratio (P/S) is a valuation ratio that compares a company's stock price to its revenues. It is an indicator of the value placed on each dollar of a company's sales or revenues. This ratio can be calculated either by dividing the company's market capitalization by its total sales over a 12-month period, or on a per-share basis by dividing the stock price by sales per share for a 12-month period. Like all ratios, the price-to-sales ratio varies greatly from sector to sector, so it is most relevant when used to compare companies within the same sector.

The debt-to-equity ratio (D/E) is a measure of a company's financial leverage calculated by dividing its total liabilities by stockholders' equity. It also depends on the industry in which the company operates. For example, capital-intensive industries tend to have a D/E ratio above 2, while technology-intensive companies have a D/E ratio of under 0.5. Debt to equity ratio indicates what proportion of shareholders' equity and debt a company is using to finance its assets. A high D/E ratio generally means that a company has been aggressive in financing its growth with debt, i.e. the company could potentially generate more earnings than it would have without this

⁶ The set of controls are standard in the financial analysis literature, e.g. Altman (1968). The definitions and interpretations of these variables and a complete list of terms describing M&A activity are available upon request.

outside financing.

The market-to-book ratio (M/B) is a financial ratio used to find the value of a company by comparing the current market value of a firm to its book value. Market value is determined in the stock market through its market capitalization. Book value is calculated by looking at the firm's historical cost, or accounting value. The ratio can be calculated in two ways, either divide the company's market capitalization by its total book value, or use the book value per-share to divide the company's current share price, but the result should be the same in each way. As with most ratios, it varies a fair amount by industry. Industries that require more infrastructure capital (e.g. Utilities firms) will usually trade at P/B ratios much lower than, for example, technology firms. This ratio attempts to identify overvalued or undervalued securities by taking the market value and dividing it by book value.

Financial leverage (FL) is the degree to which a company uses fixed-income securities such as debt and preferred equity. The more debt financing a company uses, the higher its financial leverage. A high degree of financial leverage means high interest payments, which negatively affect the company's bottom-line earnings per share. Businesses leverage their operations by using fixed cost inputs when revenues are expected to be variable. An increase in revenue will result in a larger increase in operating income. Financial leverage can be calculated by the ratio of total assets to shareholders' equity, or equivalent to a ratio of return on equity to return on assets. The financial crisis of 2007–2009, like many previous financial crises, was blamed in part on excessive leverage. Thus, we also include short plus long term total debt as a measure of the firm's liabilities in the balance sheet.

3.4. Sectors

Our data consists of worldwide firms from four sectors; i.e., Communication, Technology, Energy and Utilities, which had M&A activities during the year of 2000–2010. In Table 3, the total volume of M&A activities per year within these four sectors varied between 4000 and 9000 for the first 10 years of the 21st century. The cyclical nature of the market and the economy suggests that every strong economic growth bull market in history has been followed by a sluggish low growth bear market. As shown in Fig. 1, the trend of the number of M&A deals follows the macroeconomic cycle in general, the largest amount of deals was observed in the year 2000, followed by a fast decline during the trough years of 2001–2003. As financial markets turn better, the number of deals climb from approximately 2004 and kept increasing to another peak in 2007. After the subprime crisis of 2008, the number of deals falls through 2010.

Comparing the four sectors, more M&A deals emerge in the Communications sector followed by the Technology sector and the trend follows the macroeconomic cycle closely. In the resource-intensive industries of Energy and Utilities, we observe less M&A activity, and it does not cycle closely with the market. This is because Communications and other service sectors are most involved in the major change of liberalization in international capital movements and investments. Regulatory reforms in these sectors are playing an important role in the dramatic increase in M&A. Also, the pace of technological change has generated new business and markets. Due to the time and cost constraints, companies may experience difficulties in developing in-house R&D, so they may opt for M&A as a means of acquiring technological and human resources in order to remain internationally competitive. The drastic decline in communications and transportation costs has also been identified as a major factor behind the latest M&A wave.

3.5. Descriptive statistics

The descriptive statistics of the trimmed data are summarized in Table 5. First, we note that the enterprise value multiple is in the range of 1–150 with mean of 18.22 and standard deviation 18.49 and Fig. 2 presents the distribution of EV/EBITDA, and by sector. The

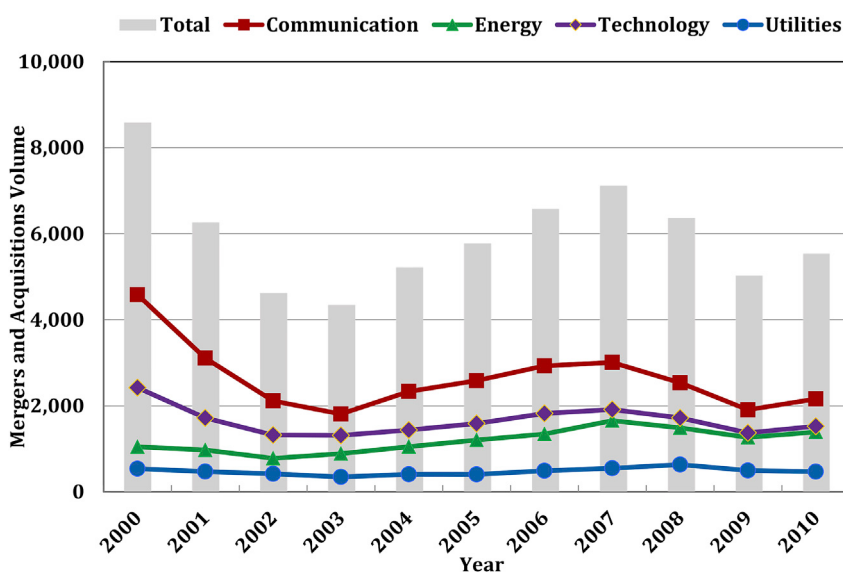


Fig. 1. M&A deal volume by sector and year.

Table 5
Descriptive statistics of winsorized data.

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
enterprise multiple (EV/EBITDA)	165660	18.22	18.49	1.00	149.71
enterprise value (EV)	165572	3.58E+05	5.20E+06	−1108.40	2.34E+08
Earning	153959	3.43E+04	5.91E+05	−3.59E+06	2.88E+07
market capitalization	164645	3.14E+05	4.94E+06	0.0012	2.24E+08
total debt	158680	5.10E+04	6.17E+05	−225	2.69E+07
price to sale	164725	4.13	63.31	0	9606.70
debt to equity	156381	114.5116	2942.81	0	4.47E+05
market to book value	164937	3.43	157.40	−1171.59	4.48E+04
financial leverage	156834	2.69	48.24	−10215.23	1635.59

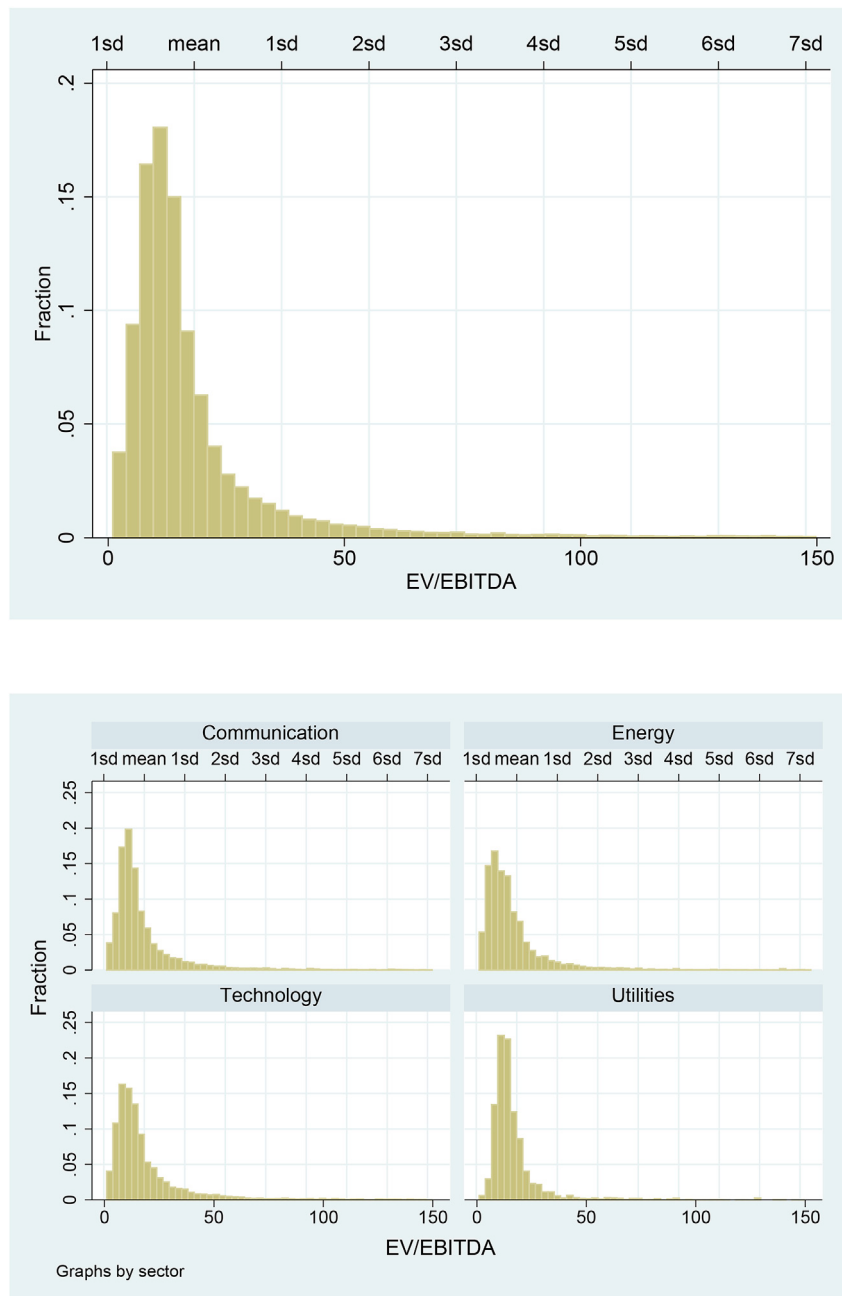


Fig. 2. Distribution of EV/EBITDA.

average P/S ratio is 4.13, the average D/E ratio is 114.51, the average M/B ratio is 3.43, the average FL is 2.69 and the average D is 5.10. In Table 6, we also present pair-wise correlations between the five control variables; they are not correlated at 1% significant level, except for financial leverage and market to book ratio.

4. Econometric models and empirical results

The logic of our empirical strategy is that for each firm i , we observe the firm for 7 years and the treatment is M&A with 3-years pre-treatment, 1-year during treatment, 3-years post-treatment. The time periods are staggered across firms and satisfy the overlap assumption so that, in each period, some firms are in the treatment and some firms are not because M&A occurs in different years.

4.1. Panel data (linear difference-in-differences) findings

Our first set of regressions aim to characterize the value of M&A on firm value across different time horizons. To do so, we implement difference-in-differences (DID) with and without matching. Under linearity, the DID approach in our context maps into a linear panel data regression of firm value on time dummy variables thus allowing us to estimate the impact of M&A on a firm relative to its value 3-years prior to- and 3-years after the M&A occurring. Specifically, we consider the following panel regression,

$$\left(\frac{EV}{EBITDA}\right)_{it} = \alpha + \beta_1 \left(\frac{P}{S}\right)_{it} + \beta_2 \left(\frac{D}{E}\right)_{it} + \beta_3 \left(\frac{M}{B}\right)_{it} + \beta_4 FL_{it} + \beta_5 D_{it} + \sum_{j=-3}^3 \delta_j dt_{ij} + \text{year fixed effects} + \text{nonlinear terms} + \varepsilon_{it} \quad (1)$$

where i indexes the firm and t denotes the year of the observation. Our focus is on the set of relative year dummy variables, dt_{ij} ; for $j = -3, -2, -1, 0, 1, 2, 3$, defined as the lagged or forward period to the year during which M&A occurred for firm i . Hence, for example, $dt_{i,-3}$, would equal to 1 if, at time t , firm i is 3-years before the time it experienced M&A; 0 otherwise. The coefficients, δ_j ; for $j = -3, -2, -1, 0, 1, 2, 3$, are then interpreted as the average treatment effect on the treated (ATET). We also include the set of covariates described in Section 3.3 and also include nonlinear terms such as the squared covariates and interactions among covariates in the panel regression exercises.

The identifying assumption for the ATET under DID (i.e., the common trend assumption) allows for firms that experienced M&A later (i.e., the Control group) to have systematically different firm value outcomes from those who experienced M&A earlier (i.e., the Treatment group) after controlling for the set of covariates. However, the common trend assumption requires that the *trends* in firm values for those in the latter group would have been the same as for those in the former had the M&A not occurred, hence allowing the observed firm values for the Control group to function as legitimate counterfactual outcomes for those firms in the Treatment group thereby allowing the identification of the treatment effect of M&A possible.

The defense for the common trend assumption rests on the fact that we are ultimately comparing firms that all experienced M&A but just a few years apart. We are essentially just comparing firms that experienced M&A up to 3 years earlier with those that experienced them a few years later. We are not comparing these firms to, for example, firms for which M&A never took place (which may have very different, potentially unobserved characteristics from those firms in our sample). If M&A deals take time to negotiate and the realization of any M&A within any given year depends on random elements, then, these firms are potentially statistically indistinguishable (ignorable) from one another in terms of their outcomes except for the fact that some firms experienced M&A earlier and some later. This

Table 6
Pairwise correlations.

	enterprise multiple (EV/EBITDA)	enterprise value	earning	market capitalization	total debt	price to sale	debt to equity	market to book	financial leverage
enterprise multiple (EV/EBITDA)	1								
enterprise value	−0.0147*	1							
	0.0000								
earning	−0.0272*	0.9033*	1						
	0.0000	0.0000							
market capitalization	−0.0151*	0.9887*	0.913*	1					
	0.0000	0.0000	0.0000						
total debt	−0.0059	0.6662*	0.649*	0.5977*	1				
	0.0196	0.0000	0.0000	0.0000					
price to sale	0.0241*	−0.0022	−0.0021	−0.0020	−0.0	1			
	0.0000	0.3816	0.4102	0.4283	0.20				
debt to equity	0.0035	−0.0013	−0.002	−0.0015	−0.0	−0.0006	1		
	0.1671	0.6172	0.5586	0.5471	0.73	0.8082			
market to book	0.0031	−0.0001	−0.000	0.0000	−0.0	0.0002	0.002	1	
value	0.2060	0.9800	0.9429	0.9902	0.80	0.9347	0.356		
financial leverage	0.0045	−0.0002	−0.001	−0.0005	−0.0	−0.0007	0.005	0.0233*	1
	0.0780	0.9236	0.7780	0.8318	0.96	0.7945	0.039	0.0000	

*p < 0.01.

assumption may be even more plausible when considering firms sector-by-sector. We note that the common trend assumption that underlies identification under DID actually requires a weaker argument than ignorability; that is, even if it was the case that firms that experienced M&A earlier had (fixed) characteristics that made them different from those that experienced them later, it is plausible, especially within the context of a sector-by-sector analysis, that the counterfactual *trends* in their firm values would have remained the same in the absence of the M&A.

The panel regression (DID) results with time dummy variables are shown in Table 7 where we present the key coefficients on the time dummies for the cases with and without nonlinear terms. Suppressing the *i* subscript, we set the value at the year of M&A (dt_0) as the benchmark. Hence, the reported results indicate differences in firm values relative to the value of the firm in the year when M&A occurred. For example, a positive coefficient for dt_{-3} , dt_{-2} , or dt_{-1} indicates a higher firm value during the respective lagged period (year) before M&A; similarly, a negative coefficient for dt_1 , dt_2 , or dt_3 indicates a lower firm value for the respective forward period (year) after M&A.

We note that the magnitude of the effect of M&A on firm value is different for each relative year. First, the coefficients of dt_{-3} , dt_{-2} and dt_{-1} are mostly negative in sign, except for Utilities. Second, the coefficients of dt_1 , dt_2 and dt_3 are negative in all cases, and almost all are statistically significant. This result indicates that the firm value at a specific year depends critically on the period relative to the M&A activity. For Communications and Energy, there is a clear instantaneous gain in the year of the M&A but it then fades quickly. Fig. 3 describes the trend of firm value in each of the four sectors over relative years (*dt*). The difference of firm value between pre- and post-M&A can be easily observed, and the year of M&A is the changing point.

Overall, our panel regression (DID) results appear to indicate that M&A has a significant positive instantaneous impact on firm values, and a negative impact on medium run firm values. Firm values are significantly different and lower before the M&A relative to firm values at the time of M&A, and firm values in the years after M&A then trend lower. The magnitude of the negative impact on future years appear to strengthen as the years progress up to 3 years out from the time of M&A.

4.2. Differences-in-differences with propensity score matching

We next implement essentially a robustness check for our DID findings in the above section. Following Heckman et al. (1997) and Heckman et al. (1998) who find that implementing propensity score matching in DID results in substantial reductions in evaluation bias in the estimation of treatment effects, we implement DID with matching by employing the set of covariates including nonlinear and interactions among these controls (as described in Section 4.1) in estimating the propensity score.

To implement DID with propensity score matching, we first organize the data into partitions of two consecutive years. Taking the years of 1999 and 2000 as an example, the experiment is designed as shown in Table 8A. That is, the Control group is formed by firms that will experience M&A, but a little later (after 2000, in this example), while the Treatment group is formed by firms who will experience M&A in the treatment period (2000), but, of course, not before (1999). In Table 8B we note that for 1999–2000, the sample includes 10,391 observations, in which 5861 of them are from the control group (no M&A activity in both years of 1999 and 2000) and the other 4530 are from the treated group (no M&A in year 1999 but M&A in year of 2000). The treatment units are then matched to the

Table 7

Regression results with time dummy variables: Dependent variable: $EV/EBITDA$. Panel regression, $\left(\frac{EV}{EBITDA}\right)_{it} = \alpha + \beta_1 \left(\frac{P}{S}\right)_{it} + \beta_2 \left(\frac{D}{E}\right)_{it} + \beta_3 \left(\frac{M}{B}\right)_{it} + \beta_4 FL_{it} + \beta_5 D_{it} + \sum_{j=-3}^3 \delta_j dt_{ij} + \text{year fixed effects} + \text{nonlinear terms} + \varepsilon_{it}$ where *i* indexes the firm and *t* denotes the year of the observation.

Time Dummies	Overall	Sector			
		Communication	Energy	Technology	Utilities
	Coefficient	Coefficient	Coefficient	Coefficient	Coefficient
Including all covariates					
dt_{-3}	−0.895***	−1.217***	−2.099***	−0.264	0.633
dt_{-2}	−0.834***	−1.232***	−1.517***	−0.277	0.368
dt_{-1}	−0.301+	−0.394	−1.146**	−0.178	0.452
dt_1	−0.695***	−0.938***	−0.788*	−0.0776	−0.497
dt_2	−1.322***	−1.261***	−1.578***	−0.644+	−1.245***
dt_3	−1.906***	−1.973***	−1.860***	−1.146**	−1.445***
N	153,256	61,972	28,101	42,964	20,219
R-sq	0.0268	0.0557	0.0633	0.0709	0.046
F	148	138.8	34.56	59.9	45.79
Including all covariates, squared and interaction terms					
dt_{-3}	−0.929***	−1.250***	−1.728***	−0.334	0.204
dt_{-2}	−0.851***	−1.236***	−1.275***	−0.372	0.134
dt_{-1}	−0.338+	−0.431	−1.103**	−0.36	0.363
dt_1	−0.669***	−0.920***	−0.434	0.268	−0.625+
dt_2	−1.299***	−1.255***	−1.146**	−0.0953	−0.964**
dt_3	−1.883***	−1.974***	−1.263**	−0.508	−1.226***
N	153,256	61,972	28,101	42,964	20,219
R-Sq	0.0308	0.0587	0.142	0.136	0.119
F	164.2	214.5	83.76	104.2	46.19

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.025$, *** $p < 0.001$ Note: All covariates in z-scores. Year fixed effects included in each regression.

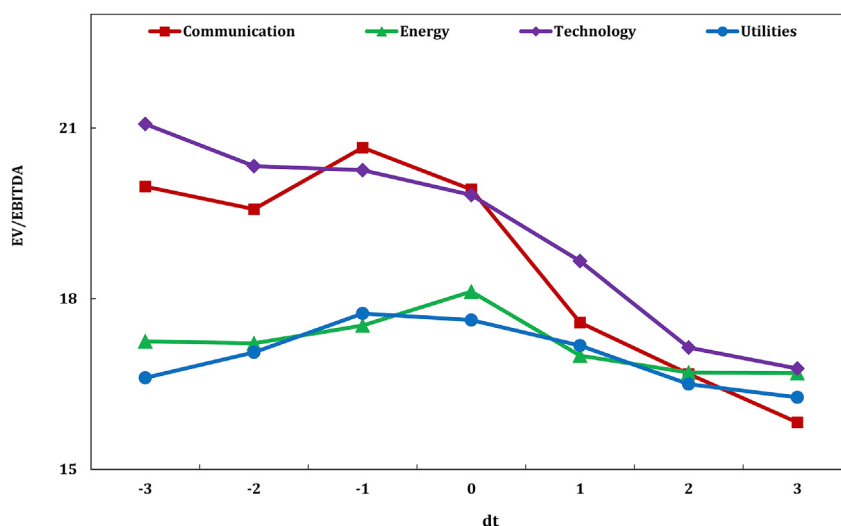


Fig. 3. Trend of enterprise multiple by sector.

Table 8A
DID design.

	Control group	M&A treated group
Year 1999	(no M&A in 1999) Deal at 2001, dt = -2 Deal at 2002, dt = -3	(no M&A in 1999) Deal at 2001, dt = -1
Year 2000	(no M&A in 2000) Deal at 2001, dt = -1 Deal at 2002, dt = -2	(with M&A in 2000) Deal at 2000, dt = 0

Table 8B
Data sample for DID.

Year2000	M&A2000		Total
	0	1	
0	2214	1763	3977
1	3647	2767	6414
Total	5861	4530	10,391

control units using the propensity score and a kernel weight.⁷

Table 9a shows the DID (with matching) results for 1999–2000. The coefficient of *DiD2000* is 2.395 with a statistically significant *p*-value of 0.021. This result indicates that the firm's EV/EBITDA value after M&A would be higher than those without M&A activities. Hence, M&A activities in the year of 2000 increase the firm's EV/EBITDA when accounting for covariates and nonlinearities.⁸ Tables 9b and 9e, provide similar results for the time periods of 2002–2003, 2003–2004, 2005–2006, 2006–2007, and 2007–2008.

Table 9b shows the results for 2002–2003. The coefficient of *DiD2003* is 1.934 with a significant *p*-value of 0.008. This result indicates that the firm's EV/EBITDA value after M&A would be higher than those without M&A activities in the year of 2003 increase the firm's EV/EBITDA when accounting for covariates and nonlinearities. Table 9c repeats the estimation for 2003–2004 and adding nonlinearities gives a coefficient for DID of 1.953 and a significant *p*-value of 0.002 thus mergers and acquisitions activities in the year of 2004 increase the firm's EV/EBITDA when accounting for covariates and nonlinearities. Table 9d presents similar results for 2006–2007 with a coefficient for DID of 1.613 and a significant *p*-value of 0.009. Finally, the result in the 2007–2008 pair is in Table 9e. It shows a statistically significant positive effect of M&A on firms' EV/EBITDA in all three cases. In the case including covariates and nonlinearities, the effects is of the order of magnitude of 1.38 with a *p*-value of 0.026.

Overall, the evidence DID with matching affirms the conclusions from Section 4.1 above. However, our results also further highlights the finding of a short-run increase in firm's EV/EBITDA when M&A takes place. The results for the sequence of two consecutive years

⁷ Our approach is designed to address endogeneity concerns and the difference-in-difference approach in portions of two consecutive years gives the needed exogenous variation from the M&A.

⁸ In the appendix, we provide placebo tests for the DID models. Our results are robust to the placebo tests where in virtually all cases, the false treatments have statistically insignificant effects as expected.

Table 9a
Difference-in-differences estimations – 1999–2000.

Diff-in-Diff accounting for covariates and nonlinearities							Number of observations: 8255
Outcome	Base Line			Follow Up			DIFF-IN-DIFF
	Control	Treated	Diff (BL)	Control	Treated	Diff (FU)	
EV/EBITDA	27.341	27.96	0.619	21.544	24.558	3.014	2.395
Std. Error			0.756			0.705	1.034
T			0.82			4.28	2.32
P> t			0.413			0.000***	0.021**

*P < 0.05, **p < 0.01, ***p < 0.001.

Note: All [Tables 9a](#) and [9e](#) refer to the pattern of research design in [Tables 8a](#) and [8b](#)

Table 9b
Difference-in-differences estimations – 2002–2003.

Diff-in-Diff accounting for covariates and nonlinearities							Number of observations: 9518
Outcome	Base Line			Follow Up			DIFF-IN-DIFF
	Control	Treated	Diff (BL)	Control	Treated	Diff (FU)	
EV/EBITDA	17.483	18.262	0.823	17.661	20.368	2.757	1.934
Std. Error			0.515			0.516	0.729
T			1.6			5.35	2.65
P> t			0.11			0.000***	0.008***

*P < 0.05, **p < 0.01, ***p < 0.001.

Table 9c
Difference-in-differences estimations – 2003–2004.

Diff-in-Diff accounting for covariates and nonlinearities							Number of observations: 11432
Outcome	Base Line			Follow Up			DIFF-IN-DIFF
	Control	Treated	Diff (BL)	Control	Treated	Diff (FU)	
EV/EBITDA	18.68	18.796	0.116	16.975	19.044	2.069	1.953
Std. Error			0.457			0.449	0.64
T			0.25			4.61	3.05
P> t			0.8			0.000***	0.002***

*P < 0.05, **p < 0.01, ***p < 0.001.

Table 9d
Difference-in-differences estimations – 2006–2007.

Diff-in-Diff accounting for covariates and nonlinearities							Number of observations: 14216
Outcome	Base Line			Follow Up			DIFF-IN-DIFF
	Control	Treated	Diff (BL)	Control	Treated	Diff (FU)	
EV/EBITDA	18.271	19.263	0.992	18.093	20.669	2.606	1.613
Std. Error			0.433			0.435	0.614
T			2.29			5.99	2.63
P> t			0.022**			0.000***	0.009***

*P < 0.05, **p < 0.01, ***p < 0.001.

Table 9e
Difference-in-differences estimations – 2007–2008.

Diff-in-Diff accounting for covariates and nonlinearities							Number of observations: 13033
Outcome	Base Line			Follow Up			DIFF-IN-DIFF
	Control	Treated	Diff (BL)	Control	Treated	Diff (FU)	
EV/EBITDA	19.894	19.641	−0.253	12.141	13.269	1.128	1.38
Std. Error			0.439			0.44	0.622
T			−0.58			2.56	2.22
P> t			0.565			0.010**	0.026*

*P < 0.05, **p < 0.01, ***p < 0.001.

shows a statistically significant and robust positive effect of M&A activity on firm value in 2000 (relative to 1999), 2003 (relative to 2002), 2004 (relative to 2003), 2007 (relative to 2006) and 2008 (relative to 2007). This is an important finding because it confirms the

result that new M&A deals impacts positively on firm value from a short-term perspective across several consecutive years. First, 2000 relative to 1999 is the period of the burst of the internet bubble. The years 2003 and 2004 are relatively financial calm, but relative to 2007, 2008 represents the impact of the financial crisis. Our evidence shows that during crisis or calm, new M&A activity or new deals activity can have a distinct positive short-term impact on the value of firms at the year-by-year timeframe, even though, on average, the long-term effect of each M&A deal decreases firm value.

4.3. Overall medium-run effects of M&A

Instead of looking at the year-by-year effects, we also consider the overall medium-run impact of M&A on firm values. Note that each observation in our data contains a valuation outcome for a firm either before or after M&A activity. Hence, M&A can be considered a treatment to some firms and those firms that do not receive the M&A treatment can be seen as controls. We separate all the observations into two groups: one is the treated group with dummy “ $treat = 1$ ” for all the data after M&A (i.e., for dt_0 , dt_1 , dt_2 , or dt_3 equals 1); the other is the untreated/control group with dummy “ $treat = 0$ ” for the data before M&A (i.e., for dt_3 , dt_2 , or dt_1 equals 1). We then estimate the treatment effect of M&A on firm values using standard tools in the impact evaluation literature; specifically, regression adjustment, propensity score matching, nearest neighbor matching and inverse probability weighting.⁹ Table 10 summarizes the overall average treatment effect of M&A in aggregate and in each sector separately.

In the first row of Table 10, we present results for the regression adjustment method. First we note that the potential outcome mean is 19.21 for the treated group and 21.02 for the untreated group, thus the statistically significant average treatment effect is -1.81 , thus a decline in EV/EBITDA of about 10% relative to the average of the sample in Table 5. The results for the other columns indicate that the magnitude of the treatment effect on EV/EBITDA varies from sector to sector, but they are all negative, and are statistically significant so for Communication and Technology. The second row presents the results using propensity score matching. While the effects are all negative, only the effect for the Communication sector is statistically significant. The third row presents the results for matching using the nearest neighbor, the results for the overall sample and the Communication sector are significant and negative, but the novelty is that for the Utility sector the treatment effect is positive and statistically significant. The last row of Table 8 shows the results using inverse probability weighting. We find that the treatment effect is negative and statistically significant for the Communication and Technology sectors.

In sum, our findings using alternative methods applied to a broader definition of treatment and control groups are broadly consistent with what we obtained for DID exercises in the above two subsections. With the exception of the Utility industry, M&A activities appear to be bad for future firm values.

4.4. The M&A “bump”

Finally, we revisit a feature suggested by the results in the previous subsections; i.e., that M&A potentially has a positive short-run impact (“bump”) on firm values. This “bump” can be seen visually for some sectors in Fig. 4. We specifically test the hypothesis of an M&A “bump” that pushes firm values higher in the year of the M&A compared to values either before or after that year by separating all the observations into two groups but with different assignments: one is the treated group with dummy “ $M\&A = 1$ ” just for the data at the year of M&A ($dt = 0$); the other is the untreated group with dummy “ $M\&A = 0$ ” for all the rest of the data at the years with no M&A happening ($dt = -3, -2, -1$ and $1, 2, 3$). We proceed to estimate the instantaneous, short-term effect of M&A using the same impact evaluation approaches employed in Section 4.3.

Table 11 presents the instantaneous treatment effects results for the overall sample and in each sector separately using regression adjustment, propensity score matching, nearest neighbor matching and inverse probability weighting. First, we note that in the regression adjustment case the potential outcome mean is 17.86 for the treated group and 16.34 for the untreated group, thus the average treatment effect is $+1.52$. The potential outcome mean of EV/EBITDA for firms being experiencing M&A is higher than those having no M&A activity during that year, this difference is statistically significant and represents a rough 8% gain relative to the outcome sample average. The effect is also positive and significant and relatively large for the Communication sector, but not others. The propensity score matching results also shows positive and significant effects for the overall sample and the Communication sector. The results for nearest neighbor matching, however, shows only a marginally significant positive effect for the Communication sector only. Under inverse probability weighting all effects are positive and statistically significant.

Overall, therefore, there is some evidence that a firm generally does experience an M&A “bump” (especially one in the Communication sector); i.e., it has a higher instantaneous EV/EBITDA ratio during the year that M&A takes place.¹⁰

4.5. Discussion

In contrasting our results for the medium-run (Section 4.3) with those that also consider the instantaneous impact of M&A (Sections 4.1 and 4.4), we find that the medium-run effect of M&A activity on firms' EV/EBITDA is different from the instantaneous effect. The

⁹ We refer the reader to Imbens and Rubin (2015) for detailed discussions of these methods and Abadie, Drukker, Herr, and Imbens (2004), Abadie and Imbens (2006, 2011, 2016), Rubin, 1973, Rubin, 1977, Cameron and Trivedi, 2005, Rosenbaum and Rubin, 1983. The models include all covariates (as z-scores), price to sales ratio, debt to equity ratio, market to book ratio and financial leverage, and the nonlinear squared covariates and interactions among the covariates.

¹⁰ Covariance balance tests for the models estimated are available in an additional appendix to this paper.

Table 10

Overall treatment effect of M&A for aggregate sample and by sector: Outcome variable: EV/EBITDA; Medium-Run effect with dummies equal to one for the year of implementation and all 3 years after implementation.

ATE	Overall	Communication	Technology	Energy	Utility
Treatment effects	Coef. (Std. Err)	Coef. (Std. Err)	Coef. (Std. Err)	Coef. (Std. Err)	Coef. (Std. Err)
regression adjustment	−1.8135*** (0.1501)	−13.2210*** (4.905)	−1.0502*** (0.2349)	−0.2057 (0.2056)	−0.0169 (0.2235)
propensity score matching	−0.0810 (0.0796)	−0.5893*** (0.1191)	−0.0730 (0.1546)	−0.3165 (0.1920)	0.2475 (0.1470)
nearest neighbor matching	−0.1866* (0.0755)	−0.3344*** (0.1162)	−0.2320 (0.1699)	0.02300 (0.1673)	0.4090*** (0.1309)
inverse probability weighting	1.080 (2.7538)	−2.6429*** (0.5790)	−0.7558*** (0.2431)	−0.1650 (0.2055)	0.03562 (0.1976)

*p < 0.05, **p < 0.01, ***p < 0.001.

Notes: All columns include covariates, squared of covariates and interactions among covariates. All covariates in z-scores.

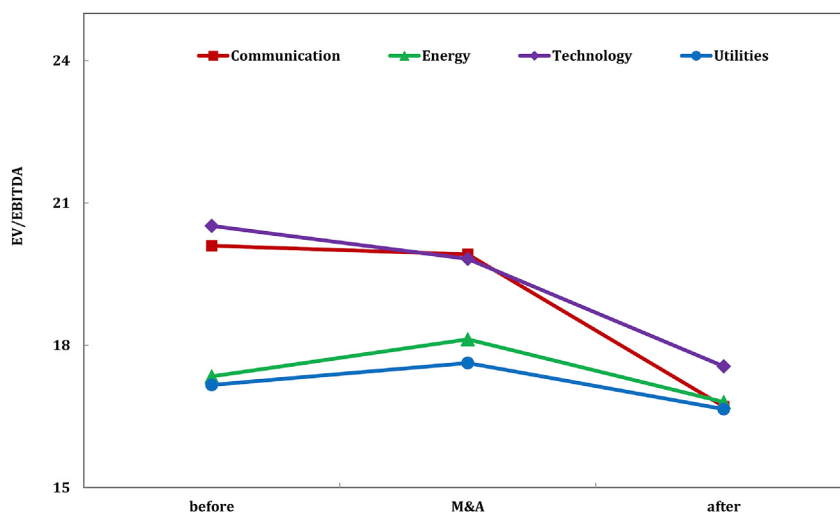


Fig. 4. Enterprise multiple of pre- and post- M&A by sector.

enterprise value ratio multiple is defined as ratio of enterprise value to the earning. In general EV and EBITDA increase over time, but the ratio may go up, down or even stay flat depending on the relative changes. In the medium-run treatment effect analysis, the impact on the enterprise multiple is negative, which means the ratio EV/EBITDA falls after M&A. While both the numerator and denominator may rise, when the ratio falls one possible explanation is that EBITDA in the denominator increases faster than EV in the numerator. In other words, during the three years after M&A activity, earnings grow farther than the corresponding enterprise value. This result may be valid in technology-related firms, but not in energy-related companies. From the perspective of high-tech business, including

Table 11

Instantaneous treatment effect of M&A overall sample and by sector - Outcome variable: EV/EBITDA Instantaneous effect with dummies equal to one in the year of implementation and zero otherwise.

ATE	Overall	Communication	Technology	Energy	Utility
Treatment effects	Coef. (Std. Err)	Coef. (Std. Err)	Coef. (Std. Err)	Coef. (Std. Err)	Coef. (Std. Err)
Regression adjustment	1.5200*** (0.2656)	4.0966*** (1.1190)	1.4928 (1.5992)	−5.6202 (4.5237)	0.8284*** (0.2940)
propensity score matching	0.3828*** (0.1162)	0.7258*** (0.1866)	0.0914 (0.2300)	0.2276 (0.2300)	0.0080 (0.2788)
nearest neighbor matching	0.0523 (0.1099)	0.3845* (0.1601)	−0.0988 (0.2051)	−0.1402 (0.2462)	−0.1729 (0.2305)
inverse probability weighting	1.2185*** (0.1314)	1.7494*** (0.2127)	0.5574* (0.2389)	0.5307* (0.2705)	0.6439* (0.2705)

*p < 0.05, **p < 0.01, ***p < 0.001.

Notes: All columns include covariates, squared of covariates and interactions among covariates. All covariates in z-scores.

communication, the motivation of mergers and acquisitions are clear, to seek innovation in technology and acquire intellectual property. Acquirer firms could apply the new technology immediately and become more productive resulting in the raise of total revenue and profit in a short time period. Concurrently, firms are not required to largely expand total assets and market capitalization. Thus, the increase of enterprise value could be less than that of firm's earnings during the three years after the M&A deal, which results in a fall of EV/EBITDA. Also, a lower EV/EBITDA means the firm is more valuable. Therefore, M&A is good for technology-intensive companies because of the enhancement in firms' development.

However, Energy and Utilities firms may show a different pattern. The main incentive for M&A in those sectors should be tangible advantage. Firms get geographic expansion and occupy more resources after a deal, especially in a cross-border deal. Firm's earnings increase at the same pace as enterprise value or even slower, thus the EV/EBITDA ratio fluctuates much less during the post-merger three-year period. The payoff from M&A may take longer than three years in resource-intensive firms. Therefore, the EV/EBITDA of Energy and Utilities sector does not dramatically change during that period.

In the instantaneous treatment effect analysis, the impact on EV/EBITDA is positive, which means the ratio of EV/EBITDA goes up at the time when mergers and acquisitions take place. While both the numerator and denominator raise so does the ratio, and we conjecture that instantaneously the EV in the numerator increases more than EBITDA in the denominator. In other words, enterprise value grows faster than firm's earning in the year of M&A. When a deal is announced or completed, the acquirer expects greater gains from the combination or reconstruction as well as shareholders expect a profitable outcome. The stock price becomes very sensitive and responds fast, e.g. the first 7-day change or first 30-day change is much higher than normal. Thus, enterprise value has an upward tick at the moment of the M&A. But firm's earnings cannot respond as quickly as the stock market, it responds in a much slower fashion. Therefore, we observe stimulation on EV/EBITDA ratio just at the year of the M&A, and firm value temporarily goes up.

5. Conclusions

We provide extensive empirical evidence of mergers and acquisitions (M&A) effects on firm value using a variety of econometric models and design. We use a large sample of 65,521 firms from the sectors of Communications, Technology, Energy and Utilities. It includes worldwide M&A deals during the years 2000–2010. We use an enterprise value multiple, the ratio of EV/EBITDA, as a measure of firm value, and other financial fundamental ratios as controls, specifically price to sale ratio, debt to equity ratio, market to book ratio and financial leverage.

Our findings suggest that the medium-run and instantaneous effects on the EV/EBITDA are much different. In the medium-run, three years pre- and post-the deal, M&A gives a net decrease in EV/EBITDA. This is because of a potential higher increase in firm's earnings relative to enterprise value in the longer horizon. The time effects are significant in technology-intensive firms while not in resource-intensive firms. By contrast, the instantaneous effect of M&A on firm value is more uniform in all four sectors. The firm value gets an instantaneous increase at the time of the M&A deal, since the EV via the stock market moves much faster in response to the M&A activity while the enhancement in firms' earnings is slow moving.

This is an important finding because the evidence points to a phenomenon where new deal-making can increase firm value in the short-term (and, in our analysis, this is the case under either conditions of economic calm or crisis), even though the medium-run prospect of each deal is for the firm value to decline. The conclusion from our evidence leads to the possibility that activism or short-termism may be a potential driving force behind M&A, see for example [Edmans et al. \(2018\)](#). In terms of the [Agrawal et al. \(1992, 2000\)](#) “post-merger performance puzzle” we conjecture that the long-term underperformance is specifically due to a slow adjustment of EBITDA relative to a much faster adjustment of enterprise value in the stock market.

Overall, we find that the treatment effects approach to measurement of M&A is very promising. Future research should include the longer run effects and the crucial paradox that if M&A does not create value in the medium and potentially longer term, why engage then.

Appendix. Placebo tests

Are there unobservables correlated with EV/EBITDA at the year of the M&A deal that could drive the results? We may perform a falsification exercise *a la* [Heckman and Joseph Hotz \(1989\)](#).

The exercise consists of identifying a set of pre-treatment outcomes, say outcomes prior to the M&A deal completion, which could be related to these unobservables. If outcomes are measured prior to the treatment (M&A), they cannot possibly be affected by the treatment (the M&A deal) unless there remains some selection bias not properly accounted for by the PSM method. Therefore, for the methodology used to be valid, the results should indicate that the placebo outcome is not influenced by the treatment variable.¹¹ Suppose we have a simple setup:

$$Y(t) = a + b \cdot D(t) + c \cdot X(t) + e$$

Where $D(t)$ is the treatment (M&A in our case), $X(t)$ is a set of covariates including nonlinear terms, and b not equal to zero. The placebo test is

¹¹ [Imbens and Wooldridge \(2009\)](#) argue that if the variables used are closely related to the outcome of interest, the test has more power.

$$Y(t - g) = a + b \cdot D(t) + c \cdot X(t - g) + e$$

where typically, $g = 1$, but could be larger. Note that the treatment is still dated at time t . The null hypothesis is that $b = 0$.

The covariates used are price-to-sales ratio, debt-to-equity, market-to-book, financial leverage and short-medium-run debt, their squares and interactions. Table A1 presents the results.

Table A1
Placebo Tests

Deal year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Dep Vble: EV_Ebitda (t-1)										
MA2000	0.33									
MA2001		1.695**								
MA2002			1.643***							
MA2003				0.747						
MA2004					−0.183					
MA2005						0.172				
MA2006							0.0684			
MA2007								0.116		
MA2008									−0.241	
MA2009										0.31
Constant and all covariates and nonlinear terms included										
All covariates in z-scores										
N	5598	6170	6508	7080	8488	9956	11250	11156	9976	7420
adj. R-sq	0.385	0.229	0.149	0.08	0.078	0.086	0.062	0.074	0.236	0.301

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We reject the null that $b = 0$ in M&A deals in 2001 and 2002. We do not reject the null in all other years. Results are the same if nonlinear terms are not included.

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