



## Do high technology acquirers become more innovative?

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### ABSTRACT

Drawing on organizational, managerial and financial theories, we explore whether acquirers become more innovative and the factors that can enhance their absorptive and financial capacity to benefit from acquisition. Over a 3-year post-acquisition window, our sample of 2624 high technology US acquisitions records early reverses followed by positive R&D-intensity changes and insignificant R&D productivity changes. Controlling for acquisition endogeneity and deal-specific effects, significant acquirer characteristic effects emerge. In related acquisitions, a large knowledge base tends to increase R&D productivity, consistent with an enhanced capacity to select and absorb targets. In unrelated acquisitions, however, this relationship becomes increasingly negative as knowledge base concentration increases, consistent with arguments for an impaired peripheral vision and core rigidities. High leverage levels raise R&D productivity gains, consistent with enhanced monitoring induced efficiency. However, high leverage growth reduces R&D-intensity, consistent with increased financial constraints and short-termism.

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### 1. Introduction

There has been an impressive record of global acquisition activity involving high technology firms, i.e. R&D-intensive firms whose investments are characterised by long time horizons (Chandler, 1994). In the 1990s alone, the value of high technology acquisition activity surpassed \$1.93 trillion spread across 8058 deals worldwide. This paper explores the extent to which managers' apparent enthusiasm for acquisitions is justified by examining whether the high technology acquirers improve their post-acquisition innovation performance. We focus on two performance aspects: innovation inputs proxied by R&D spend relative to assets which we refer to as R&D-intensity and innovation productivity proxied by successful patent applications relative to R&D spend which we refer to as R&D productivity.

There are theoretical arguments for expecting a beneficial acquisition effect on both aspects of innovation performance. For example, within the resource-based approach of the firm, acquisitions can be regarded as an important strategic weapon through which a firm can enhance its asset base, while avoiding the time-consuming internal accumulation of innovation enhancing resources (Barney, 1991; Dierickx and Cool, 1989; Teece et al., 1997). Equally, acquisitions can be employed as a means of renew-

ing and revitalizing the existing knowledge base of a firm and of avoiding the inertia and simplicity that result from its repeated exploitation (Capron and Mitchell, 1998; Vermeulen and Barkema, 2001). According to traditional economic approaches, acquirers, by becoming larger, can benefit from R&D related economies of scale. Thus, a larger firm may benefit by overcoming indivisibilities in R&D projects (Calderini and Garrone, 2003; Cassiman et al., 2005), or because it has a larger and more stable internal stream of resources to finance R&D (Himmelberg and Petersen, 1994). A larger firm can improve its R&D productivity by the spreading of the fixed R&D costs over larger production output, better capacity utilization, and increased specialization of management and scientists (Cassiman et al., 2005). Finally, it may be argued that a larger firm can benefit from economies of scope by exploiting opportunities for cost savings and risk-sharing when it carries out numerous R&D projects under the same roof (Baumol et al., 1982; Henderson and Cockburn, 1996).

However, the evidence on the impact of acquisitions on the acquirers' innovation performance does not accord with these positive predictions. Studies looking at the acquisition effect on proxies for the inputs to the R&D process report a neutral effect (Danzon et al., 2007; Hall, 1988, 1999; Healy et al., 1992) or a negative effect (Hall, 1990a; Hitt et al., 1991, 1996; Ornaghi, 2009a; Ravenscraft and Scherer, 1987). Similarly, studies looking at the acquisition effect on proxies for the acquirers' R&D output report a neutral effect (Prabhu et al., 2005) or a negative effect (Hitt et al., 1991; Ornaghi, 2009a).

Scholars studying the relationship between acquisition activity and innovation performance have attempted to reconcile theory

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and evidence by developing a number of process-based arguments. A negative effect of acquisition on innovation performance has been attributed to the diversion of managerial time and energy from the R&D process (Hitt et al., 1991, 1996); to disruptions to the R&D process and organizational routines (Haspeslagh and Jemison, 1991; Puranam et al., 2006; Ranft and Lord, 2002); to a low retention rate of the acquired firms' key employees, or to a lack of effective motives for the acquired firm's inventors (Calderini et al., 2003; Chaudhuri and Tabrizi, 1999; Ernst and Vitt, 2000; Ranft and Lord, 2000). Others have put the blame for disappointing acquisition outcomes on organizational, market and technological dissimilarities between the acquiring and acquired firms (Ahuja and Katila, 2001; Cassiman et al., 2005; Chakrabarti et al., 1994; Cloodt et al., 2006; Hagedoorn and Duysters, 2002; Prabhu et al., 2005).

In this paper, we advance the debate on the relationship between acquisition activity and innovation performance in three ways. First, we offer an analysis of the acquisition effect on an acquirer's innovation performance by studying both the impact of acquisition on R&D-intensity (measured by the ratio of R&D expenditure to total assets) and on R&D productivity (measured by the ratio of successful patent applications per \$million of R&D expenditure) of the acquirers. Most previous studies focus on only one of these dimensions. Studying the impact on both dimensions allows us to distinguish input from output effects in the same sample of acquisitions and to examine the extent to which performance is affected to the same way by the acquisition event.

Second, we seek to explain the variance of the acquisition outcomes on innovation inputs and outputs by focusing on the characteristics of the acquirer. This is consistent with recent work (Sorescu et al., 2007), which emphasizes the importance of the characteristics of the acquirer as a key determinant of acquisition outcomes, over and above the deal-specific characteristics of the acquirer and acquired taken as a pair in terms, for example, of their market relatedness or technical similarities (e.g. Ahuja and Katila, 2001; Cassiman et al., 2005; Cloodt et al., 2006; Ornaghi, 2009a). Our approach is based on the view that whatever the deal-specific characteristics or motivation of an acquisition may be, its exploitation will be affected by the ability of the acquirer to identify and exploit those opportunities. In developing our approach to relevant acquirers' characteristics we draw from organizational learning (Cohen and Levinthal, 1989; Makadok, 2001; Zahra and George, 2002) and managerial and financial economics (Jensen, 1986; Jensen and Meckling, 1976; Laverty, 1996; Marginson and McAulay, 2008). We use these approaches to develop arguments, in particular, about the factors that are likely to enhance the acquirers' absorptive and financial capacity to select appropriate acquisition targets and benefit from acquisitions. Thus, our theoretical framework conditions acquisition outcomes on the size and concentration of the acquirer's knowledge base across different technology fields and on the leverage level and growth that an acquirer experiences at the time of acquisition. We include for completeness variables to control for a number of deal-specific characteristics.

Finally, our empirical analysis adopts the increasingly popular propensity score approach (Rosenbaum and Rubin, 1983, 1984) in order to account for the possible endogeneity of the decision to carry out an acquisition to acquirer characteristics that are also correlated with post-acquisition innovation performance. In this way, we address the problem of potential acquisition endogeneity to observable firm characteristics in the creation of the acquirers' counterfactual innovation performance (i.e. the performance consequent on the non-occurrence of an acquisition). Our empirical design enables us to examine whether and which acquirers report changed innovation performance for a very large sample of 2624 acquisitions. This allows the analysis to include the hundreds of acquisitions of small private targets and former

subsidiaries for which little is known from the extant literature. We focus on acquirer performance rather than on comparisons of changes in the combined performance of the acquirer and acquired firms pre- and post-acquisitions (see e.g. Ornaghi, 2009a, 2009b). The latter requires detailed pre-acquisition innovation characteristics which are typically not available for private sector and small firms.<sup>2</sup>

The remainder of this paper is organized as follows. The next section develops the theoretical background and hypotheses of the paper. It is followed by a section describing the dataset and the methodology employed. Then, the empirical results from the analysis are presented. The final section highlights the key findings of the analysis, draws out their implications and discusses the main limitations of the study.

## 2. Theoretical background and hypotheses

### 2.1. The acquisition effect on acquirer innovation performance

We are concerned with the question of whether and how acquisitions affect an acquirer's innovation performance in terms of inputs and productivity and the factors affecting those changes. The extant acquisition/innovation literature offers a number of insights. Hitt et al. (1991) contemporaneously study the acquisition effect on R&D-intensity (R&D/sales) and patent intensity (patents/sales), using a sample of 191 US manufacturing acquisitions from 1970 to 1986, and find a significantly negative effect on both metrics. A negative effect on both R&D-intensity and the new products/sales ratio is also found by Hitt et al. (1996), who use information collected from questionnaires from a sample of 250 manufacturing US firms for the period 1985–1991. Cassiman et al. (2005), using interviews with managers in 31 international technology-based horizontal acquisitions, condition post-deal R&D inputs (R&D personnel, lab equipment), output (technological knowledge, patents, new processes/products) and performance (returns to R&D expenditures) on the technological and market relatedness of the merging firms. However, their study, focuses on relatedness, and does not offer evidence on the overall acquisition effect on innovation performance. Recently, Ornaghi (2009a), using a sample of 27 large pharmaceutical mergers during the period 1988–2004, finds that merged companies have worse innovation inputs (R&D and R&D-intensity growth), output (patent growth) and productivity (patents over R&D growth) compared with a matched sample of non-merging firms, although the negative merger effect on R&D-intensity growth becomes insignificant when the author controls for acquisition endogeneity. A number of other studies have enhanced our understanding of the relationship between acquisition and innovation performance but they have focused their analysis on proxies for R&D inputs alone (Danzon et al., 2007; Hall, 1988, 1990a, 1999; Healy et al., 1992; Miller, 1990; Ravenscraft and Scherer, 1987) or on R&D output alone (Ahuja and Katila, 2001; Calderini et al., 2003; Chakrabarti et al., 1994; Cloodt et al., 2006; Ernst and Vitt, 2000; Hagedoorn and Duysters, 2002). We investigate both in a framework which conditions the possible outcomes in terms of the pre-acquisition characteristics of the acquirer whilst including controls to capture some key deal-specific characteristics which have featured in previous work (e.g. Ahuja and Katila, 2001; Cassiman et al., 2005).

<sup>2</sup> Approaches focusing on acquiring firms alone are frequent in the general literature on acquisition effects as are approaches using the combined effect approach (see e.g. Cosh et al., 2005; Mueller, 1980). The latter is more directly useful for policy discussions since it focuses on allocative efficiency issues which typically dominate industrial and competition policy discussion. In relation to innovation it typically restricts analysis to 20–50 acquisition events.

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