Available online at www.sciencedirect.com
ScienceDirect
Technovation 28 (2008) 408–423
technovation
www.elsevier.com/locate/technovation

Identifying high technology small firms: A sectoral analysis

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Abstract

This study explores the use of existing categorizations in classifying high and low technology firms such as the standard industrial classification (SIC). Such classifications tend to be applied to firms in a blanket fashion rather than on a systematic basis. This study uses both input and output approaches to identify high technology firms. The results indicate that electronics and IT/software firms meet the criteria for classification as high technology firms using both input and output criteria. The findings also indicate that distribution firms can also be categorized as high technology firms using the output approach only. Based on the analysis, we derived objective criteria for the classification of high technology firms.

Keywords: High technology; Standard industrial classification

1. Introduction

There are many definitions of technology. For example, Burgelman et al. (2004, p. 2) see technology as having both implicit and tacit attributes to derive the 'the theoretical and practical knowledge, skills, and artifacts that can be used to develop products and services, as well as their production and delivery systems'. Christensen and Raynor (2003, p. 39) define technology as 'the process that any company uses to convert inputs of labor, materials, capital, energy, and information into outputs of greater value'. Both of these definitions broaden the earlier description of technology propounded by Krajewski and Ritzman (2000, p. 17) as 'the know-how, physical things, and procedures used to produce products and services'. Over the past two decades, the development of high technology-based firms has been actively encouraged by Governments and development agencies Westhead and Storey (1994)—as a source of competitive advantage as well as employment creation. In many cases, small high technology-based firms have effectively exploited market opportunities and play a pivotal role in the economy (Shane and Venkatraman, 2000; Makri et al., 2006). This important role has been helped by the emergence of generic technologies, most notably information technology that is knowledge intensive rather than capital and labor intensive (Rothwell, 1994, p. 12). Such technologies have been effectively used to open up new market niches for small and medium sized firms. Accordingly, high technology firms have become well established as sources of both competitiveness and employment creation (Oakey, 1991).

From an academic perspective, the trend in the establishment of high technology firms has been paralleled by the number of empirical studies investigating their success in aspects such as innovation potential (Monck et al., 1988), and growth potential (Phillips et al., 1991). Interestingly, a study by Westhead and Cowling (1995) suggested that not all high technology firms possess similar capabilities and accordingly achieve varying degrees of success. However, to date there is no commonly accepted definition of a high technology firm—see Goss and Vozikis (1994). Instead, all firms are classified at the industry level, which tends to be all inclusive rather than firm specific. In other words, the overall industrial classification of an industrial sector, such as heavy engineering, might be perceived as low technology orientated whereas some firms within this sector may have leading edge high technology products and/or processes.

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doi:10.1016/j.technovation.2008.02.010

However, the demarcation line between high and low technology firms is often blurred, which arguably impacts on decision-making and investment decisions. For example, the product life cycles of high technology firms are far shorter than those of low technology firms (Balkin and Gomez-Mejia, 1987). This has implications for research and innovation-related activities. In addition, the blurring of demarcation lines between high technology and others firms is exacerbated by decisions by high technology companies such as Boeing to outsource product development and production, where Boeing itself is responsible for only 10% by value, and the remainder is provided by 40 partners worldwide. Arguably, the work of managers, investors and researchers in strategy formulation and the prediction of specific outcomes will be enhanced by clearer descriptions of high technology firms that include a number of well-developed variables.

Accordingly, this study examines the appropriateness of existing industrial classification methodologies and seeks to develop a 'high technology footprint' underpinned by a number of input and output criteria in order to identify high technology firms. The paper is structured as follows: first, we consider current methods of firm classification with reference to high technology firms. Second, we examine high technology firms from an input perspective by using the resource-based view (RBV) of strategy. Third, we examine high technology firms from an output perspective by focussing on company growth and financial performance. Fourth, we develop both input and output technology footprints. Finally, we test the proposed technology footprints and present the results derived. We also outline limitations and directions for further research.

2. High technology firms

High technology firms play an enormous role in the economic growth of many countries. This leads to the question—what is a high technology firm? In seeking to define a high technology firm, we face the dilemma that any attempt to develop a universally accepted industrial classification is unlikely to totally address the issue in the medium to longer term as industrial boundaries are rapidly changing. Nevertheless, we need a workable classification, but how can such a classification be derived? Is it on the basis of input criteria such as innovation, staffing, processes or on output criteria such as products and organizational performance? And what level of each criterion ensures that the firm is classified as high technology?

The standard industrial classification (SIC) provides an industrial classification code for all firms, both service and manufacturing. Arguably, the selection of high technology-based firms using the SIC can be fraught with difficulties as the boundaries between classifications tends to be arbitrary, and few attempts have been made to update the classification to bring it into line with modern day business. For example, a perusal of the SIC categories suggests that categories such as 'electro medical equipment' are high technology in orientation, whereas categories such as 'office machinery and supplies' do not readily indicate the degree of high technology inherent in the companies under this heading. From an empirical perspective, Walsh and Linton (2002) examined the use of SIC codes as a proxy for the identification of competencies and found little or no value in including the SIC code as a measure of technical competence, particularly where radical or disruptive innovation is the norm.

The more commonly accepted approach is to define high technology based on the degree of expenditure on R&D as a percentage of sales greater than 5% (Balkin et al., 2000). This has gained currency as the accepted approach to identifying high technology companies. Nevertheless, further refinements were suggested to broaden this approach to include significant R&D investment, effective innovation and significant levels of creativity.

While this 'enhanced' classification method takes into account the creativity and skills of the workforce, it focuses on the levels of R&D expenditure rather than the results of that spending. In doing so, it again places an unduly high emphasis on the use of R&D as the main driver of high technology and innovation—a point strongly rebutted by the literature (see Mowery and Rosenberg, 1989). Arguably, the complexities involved in deploying the enhanced classification suffer from methodological weaknesses—see Audretsch (1995)—as well as relevance to small and medium sized firms that often lack a structured R&D approach see Filson and Lewis (2000). Obstacles to a structured approach in SMEs include financial resource deficiencies, management and/or staff lacking requisite skills, and difficulties establishing cooperation with other firms (Freel, 2000; Rothwell, 1994). In addition, SMEs are a highly heterogeneous grouping, where the high growth ventures tend to be more high technology orientated—see reference to 'gazelles' in Birch (1989). The degree of heterogeneity in SMEs with regard to innovation is underpinned by the extant literature—see Acs and Yeung (1999) and Hadjimanolis and Dickson (2000).

Drawbacks in deploying the industrial classification in practice were evident in the work of Butchart (1987) who listed the SIC categories according to both innovation and R&D intensity. However, he classified firms according to product innovation and omitted to take into account process innovation. This is a significant drawback as shown by Geroski et al. (1993), who found that the process of innovation is as important as the product of innovation in overall corporate performance and success. Nevertheless, Butchart's classification has been adopted by others (Garnsey et al., 1994).

Other contributions to the literature contend that high technology firms tend to have employees that are highly educated, have a large proportion of their assets tied up in intellectual human capital and do not have as much capital intensive investment as traditional type firms (Milkovich et al., 1991). Accordingly, the literature on the classification