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The fruit flies of innovations: A taxonomy of innovative small firms

Jeroen P.J. de Jong [a], Orietta Marsili [b],*

[a] *EIM Business & Policy Research P.O. Box 7001, 2701 AA Zoetermeer, The Netherlands*
[b] *Rotterdam School of Management, Erasmus University Rotterdam, Burg. Oudlaan 50, 3000 DR Rotterdam, The Netherlands*

Abstract

Taxonomies of patterns of innovation give a dominant role to large firms, and are often based on empirical studies that exclude micro firms. This paper proposes an empirical taxonomy of the innovative firms at the bottom of the size distribution, based on a new survey of 1234 small firms and micro firms in The Netherlands, in both manufacturing and services. These firms differ not only in their innovative activities, but also in their business practices and strategies, such as management attitude, planning and external orientation, that they use to achieve innovation. The taxonomy identifies four categories of small innovative firms: science-based, specialised suppliers, supplier-dominated and resource-intensive. It suggests a more diverse pattern of innovation of small firms than in Pavitt's [Pavitt, K., 1984. Sectoral patterns of technical change: towards a taxonomy and a theory. Research Policy 13 (6), 343–373] taxonomy, a pattern that is shared by both manufacturing and service firms. Finally, the research shows that taxonomies can be effectively used to map differences in the rates, sources and nature of innovation, with the differences in the business strategies of innovative firms.
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1. Introduction

Fruit flies are a favourite object of study in evolutionary biology because things happen fast in their world. Their evolution can be observed over short time periods (Maynard Smith, 1996).[1] By analogy, small firms operating at the margins of the business population may also be useful, in this case for the study of innovation. There

* Corresponding author. Tel.: +31 10 408 9508;
fax: +31 10 408 9015.
E-mail addresses: jjo@eim.nl (J.P.J. de Jong), omarsili@rsm.nl (O. Marsili).
[1] SPRU Conference on "Evolutionary Economics", University of Sussex, UK, March 11–12, 1996.

is lots of "room" for innovation at the bottom of the size distribution, because new small firms are continually entering the market with new ideas for new products and processes (Audretsch, 1995). To be sure, often these new small firms are short-lived, exiting the market within few years of their entry. There is a high turnover of such firms (Caves, 1998). However, the small firms that do innovate successfully increase their chances of survival (Cefis and Marsili, 2003) and growth (de Jong et al., 2004). The new small firms that survive contribute to a large proportion of growth at the economy-wide level, in fact (Foster et al., 1998).

The behaviour of small firms can vary substantially. Some small firms survive by competing in a market niche, while others pursue more radical innovations

and, eventually, themselves become market leaders. This diversity among new small firms cannot easily be reduced to a general model. Their variability demands a taxonomy, a classification system that can be used to identify the many variables that might be in play. Taxonomies are a regular part of evolutionary biology, and have contributed much to the study of fruit flies. The taxonomic approach is similarly beneficial to the study of small firms.

There has been little study done of the innovative behaviour of small and micro firms using taxonomies. The lack of an obvious taxonomy to apply in identifying the variables to be studied may be part of the problem. As well, it could be argued that there was so much variation among small firms that no clusters of common characteristics could be identified, although the validity of this assertion can easily be demonstrated by carrying out research.

The most commonly used taxonomy for identifying variables affecting innovation is Pavitt's, but Pavitt focused his study on sectors, although he examined firms. He found many commonalities amongst firms in the same sector, so much so that he spoke about industries: the chemical industry, for example. Pavitt's taxonomy focuses on large firms. Other studies that consider variables related to innovation in small firms do not pay much attention to sectors or industries.

This paper takes up the challenge of studying innovation patterns in small and micro firms. It develops a classification system for such firms, based on a study of small and micro firms in The Netherlands. The results of our research provide a useful snapshot of the innovative behaviour of small firms, but they also demonstrate that the classification system that we developed to analyse variables in the innovative behaviour of these firms is very similar to that developed by Pavitt, despite the different orientations of the research.

The paper begins with a theoretical discussion of several taxonomic schemes for studying innovation, which are summarized in a table at its conclusion. It then provides a discussion of other methodological issues that arose in developing a classification system for our study. Once these tasks have been done, the paper reports on the study. It concludes by discussing the relevance of Pavitt's taxonomy to the kind of study that we carried out, and it comments on the significance of the differences we found between his study and our own.

2. The problem of taxonomy

Taxonomy is the science of classification of organisms. Taxonomies have been widely applied to the study

of technological change, because they offer a way to organize and understand the diversity of innovative patterns in firms and sectors (Pavitt, 1984; Archibugi, 2001). In Pavitt's words:

> '. . .[T]ruths about the real innovating firm will never be elegant, simple or easy to replicate. Certainly, it is just as wrong to criticise formal models in evolutionary economics, because they don't help managers, as to criticise formal biological models, because they don't help us to survive in the forest. But in biology, there are also the empirical and often descriptive disciplines of botany and zoology, which offer insights that are mostly conditional and contingent, but quite useful in coping with the real world' (Pavitt, 1998).[2]

Taxonomies classify and label many different items into groups or clusters that share common traits. A useful taxonomy is one that reduces the complexity of empirical phenomena to few and easy to remember categories. Taxonomies of innovative firms, in particular, provide an empirically based framework that helps to build a theory of innovation as well as to guide S&T policies (Pavitt, 1984; Archibugi, 2001).

The use of taxonomies of innovation finds its theoretical precedent in the concept of "technological regime" (Nelson and Winter, 1977; Dosi, 1982). The assumption is that firm behaviour is shaped and constrained by the nature of technologies they use. The varieties of technologies can be categorised into a few broad categories, called "technological regimes". This type of classificatory exercise follows a bottom-up approach to theory building, what Nelson and Winter (1977) once called "appreciative theorising". Previous empirical research had shown that the sources, rates and directions of technological change do vary significantly across sectors as a result of firms' relationships to technologies (Pavitt, 1984; Klevorick et al., 1995; Evangelista, 2000).

In his pioneering article, Pavitt (1984) proposed a taxonomy of the structural characteristics and organization of innovative firms. Here, he suggested that there were four categories of firm (1) science-based, (2) specialised suppliers, (3) supplier-dominated and (4) scale intensive firms. These categories were designed to identify distinct sources, nature and directions of technological change, the ones that shape and differentiate the pattern of innovation of firms across sectors. Pavitt's taxonomy has become a heavy-cited framework for innovation researchers. It is often used to explore deviations across industries. Pavitt's taxonomy has also

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[2] The full quote is in the DRUID 1998 conference paper, pp. 21–22.