

## Chapter 5

# Is Collaboration Important at All Stages of the Biotechnology Product Development Process?

Catherine Beaudry  
*Polytechnique Montreal, Canada*

### ABSTRACT

*Using the four Biotechnology Uses and Development surveys of Statistics Canada, the chapter examines the importance of collaborating with firms and public institutions at various stages of product development, from research and development to clinical trials and then on to production and commercialization. The models examine the propensity to have products at a particular stage of development using instrumental variables probit regressions. This chapter finds that while small firms do not benefit from collaborating with firms at the research and development stage, during the clinical trials and in the production phases, collaborating with firms has a strong positive effect. The factors that affect the R&D phase are R&D expenditures, an important IP strategy, revenues from contracts and to some extent contracting out some innovation activities. In later stages of the development process, the number of patents and the diversity of the biotechnology employment team play a more crucial role.*

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## **INTRODUCTION**

Extensive literature exists on the impact of collaboration on innovation, generally measured by the number of patents or the number of products (Baum *et al.*, 2000; Deeds & Hill, 1996; Faems *et al.* 2005; Rogers, 2004; Shan *et al.*, 1994; Stuart, 2000). Innovation is treated as a relatively broad concept in the literature, from research and development (Esteve-Perez, *et al.* 2004; Hall, 1987) to new products and processes (Audretsch, 1991, Schoonhoven, *et al.* 1990) and patents (Banbury & Mitchell, 1995; Christensen, 1998).

In the case of biotechnology the product development process is considerably long and costly; the time elapsed between R&D, patents and products on the market can be as long as ten to fifteen years. Biotechnology is characterised by very risky R&D (Senker, 1998) that spreads over a long period of time where a large number of steps are necessary to bring a product to the market (Kellog & Charnes, 2000). The literature is however relatively scarce on the biotechnology product development process let alone on the factors that affects the various stages.

Firms may develop new innovations entirely within the boundaries of the firm, but this is less and less the case as products and processes increase in complexity. Collaboration then acts as a complement to the internal innovation capabilities of the firm, hence contributing to adding to its capacity (Deeds & Rothaermel, 2003; Hagedoorn, 2002). Collaboration is thus essential to its innovative process and eventually to its survival (Deeds & Hill, 1996; Oliver, 2004; Powell *et al.*, 1996).

Kortum and Lerner (2000) as well as Engel and Keilbach (2007) for instance, highlighted the importance of venture capital in the early stage of the product development process. Other studies are all in agreement concerning the incapacity of traditional debt financing to provide funding for the very risky early R&D phases (Czarnitzki & Kraft, 2009; Gompers & Lerner, 2001; Hall, 2002). Baum and Silverman (2004) found no impact of venture capital on a firm's propensity to patent, but noticed the importance of government funding in this regard.

Building on both the literature on innovation and on collaboration and alliances, this chapter aims to determine whether collaboration is required at each stage of the development process or whether other characteristics take over at some point along the innovation chain. The author is fortunate to have had access to Statistics Canada's four Biotechnology Uses and Development Surveys spanning the period 1999-2005. The data collected provides the classic innovation survey indicators in addition to specific strategy measures, and detailed data on the various product development phases.

Using instrumental variable probit regressions, the chapter investigates the influence of collaboration and other innovation factors on the biotechnology product development process in Canada. The results show that firms that collaborate with

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