

Chapter 4

International Evidence on Financing of R&D

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ABSTRACT

This chapter examines the financing patterns of R&D expenditures using data from 38 countries for the period 1980-2006. The major hypothesis is that higher equity financing and higher past stock market valuation are associated with higher R&D expenditures. The evidence supports this hypothesis for firms, especially in market-based countries. The sensitivities of equity financing and internal funds are different between financially constrained and unconstrained firms. The results are robust when the effect of patent rights protection, which has also a nonlinear effect on R&D, is controlled.

INTRODUCTION

The survey by Levine (2005) indicates that there is a strong relationship between financial development and economic growth. Recently, some studies have investigated the relationship between finance, innovation, and growth to explain specific channels for how financing creates growth. These papers show that fluctuations in R&D expenditures of companies are associated with fluctuations in the availability of internal and external financial sources (Brown, et al., 2009; Martinsson, 2010). The evidence shown in these papers suggests that

financing of innovation activities (mainly R&D expenditures) may be an important mediating variable explaining the finance-growth relationship. While Brown *et al.* (2009) test this relationship using a dataset consisting of 1,347 US companies, Martinsson (2010) uses data from 700 companies located in ten different European countries.¹ Understanding the finance-growth relationship better at a broader perspective therefore urges for more research on the relationship between finance and innovation.

In this chapter, we elaborate on previous research by looking into the financing of R&D expenditures from an international perspective. In particular, we analyze the relationship between

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corporate R&D expenditures and the availability of financial resources using a large dataset consisting of almost 49,000 firm/year observations in 38 countries for the period 1980-2006. We investigate patterns of finance from three different angles.

First, we examine the role of different sources of finance in covering R&D expenditures. We focus on internal capital (cash flows) and equity finance. With respect to internal capital, we take into account the possibility that the relationship between this type of capital and R&D expenditures may be non-linear, an issue that has been raised recently in the literature on explaining financing of investment decisions in general. According to this relationship, firms decrease their R&D at low level of cash flows and increase them at high level of cash flows. For a high level of R&D intensity, internal funds are not sufficient to cover all expenditures. The requirement of raising external financing opens the discussion of capital structure choice. There are several theories, such as pecking order and trade off theory dealing with market frictionless depending on information asymmetry, agency cost, or sources of capital to explain the proper debt-equity choice for financing of R&D investments. Since R&D expenditures indicate high growth opportunities with low liquidation value in the event of bankruptcy, equity finance can be considered as the optimal source for financing of R&D expenditures. With respect to equity capital, we investigate the role of using equity as such, as well as the extent to which firms issue new shares after periods when their shares are valued higher relative to their industry peers. Companies use this overvaluation for timing the market to issue new equity and, thus, temporarily reducing costs of capital. Both the issue of the non-linear relationship between internal capital and investment expenditures, as well as the market timing argument, have not been studied before in the context of financing R&D expenditures.

Second, when investigating financing patterns of R&D expenditures, we take into account firm-specific characteristics that may influence these

patterns. In particular, we focus on whether or not firms are financially constrained (i.e. they have insufficient internal capital to finance their investment expenditures), because this may influence firms' behavior regarding the issuing of new shares in periods during which shares are considered as being overvalued. Previous studies have shown that this matters for explaining financing patterns of investment expenditures (Campello & Graham, 2007).

Third, we investigate whether and how the context of financial market development influences financing patterns of R&D expenditures. Our main premise to investigate this comes from the observation that R&D expenditures are constrained by access to finance and that these expenditures in most cases are financed either by internally available funds (i.e. cash flows) or by external equity. Yet, access to external finance may be conditional on contextual features such as the nature of national financial markets. As we will argue, access to external equity finance may be relatively easier in market-based financial systems, since equity markets are generally more developed. We are not aware of any study that looks into these issues using a large cross-country sample of firms.

This chapter provides evidence supporting a U-shaped relationship between cash flows and R&D expenditures. Increases in cash flows elicit greater expenditures at higher level of cash flows. For high level of R&D, increasing in R&D is only possible with an increase in internal funds because raising additional debt financing creates additional risk. However, when cash flows are negative or perhaps small, firms decrease R&D expenditures to be able to cover their financing costs.

The results of this chapter also show that firms with high level of R&D expenditures use more equity financing. The argument for this finding is that for these firms, increases in R&D expenditures will be viewed at some point as risky and firms will respond by using more equity. The evidence for market timing is clear; there is a positive

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