

**DIPARTIMENTO DI IMPRESA E MANAGEMENT**  
**CATTEDRA IN ADVANCED CORPORATE FINANCE**

**THE EFFECT OF CAPITAL STRUCTURE DECISIONS  
ON TECHNOLOGICAL INNOVATION**

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# ABSTRACT

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The goal of this work is to explore the interactions between capital structure decisions of technological firms and the effects that such decisions produce on their innovative output.

The elaboration is structured in 5 chapters, the first three focusing on the different topics required to dissect the fundamental elements of the discussed issue, the fourth exploring how such dynamics in general have developed in the Italian context, and the fifth one being an empirical attempt at replicating some specific research questions, based on the literature in chapter 3, on the Italian case.

The first chapter introduces the concepts related to technological innovation, in order to establish the ground base for further discussion. The first paragraphs present a definition of what economic literature depicts as technological innovation and then precedes into the analysis the various identifiable kinds of innovation and the different dimensions along which it can be studied, such as radical vs. incremental, continuous vs. discontinuous, closed vs. open innovation paradigms. Then, the discussion touches the sources of innovation, to give a picture of what the landscape originating innovative processes is. After elaborating on the sources, we then arrive at the core of the chapter, which is the discussion on how to measure a process like innovation. Indeed, the difficulties inherent to such measurement are brought to light, such as the latency between investment and results, the creation of intangible assets and the causal ambiguity of the development of new ideas. Following the relative literature, the different metrics useful to the measurement of innovative processes are

then identified in R&D statistics, Patent data, Innovation surveys and Product announcements. These metrics will be used in the remaining of the thesis as the units by which we can compare and measure innovative activity, keeping in mind the limitations of each one of them. The chapter concludes then with the presentation of why innovation is such an important topic in modern economic research on several levels, such as the importance of the valuation of intangible assets in stock markets and the repercussions that innovative activity has both on a macroeconomic and microeconomic level.

The second chapter is where the topics at the core of this dissertation start to be examined. The issues connected to the capital structure of innovative firms are presented, underlining the peculiarities that characterize them in conjunction with the financial markets. Indeed, we expose how the assumption of financial markets efficiency can't be held valid in this situation. This shapes a modified pecking order for technological firm, which emerges from credit rationing problems. Indeed R&D investments present several peculiarities that distinguish them from other industrial investments. The fact that the mid-term expected result of R&D investments is an intangible activity, represented by new knowledge, and that these investments are subordinated to higher uncertainty due to their long-term, high risk-high reward nature, makes them inherently less appealing to external investors with low risk tolerance. Furthermore, the appropriability of the new knowledge produced, the asymmetric information arising between investors and entrepreneurs, and finally moral hazard issues, all contribute in creating an investment not appealing to traditional financial intermediaries. As a consequence we see how innovative firms have to adopt a financing cycle approach to overcome financial constraints, where

specific financial resources are ideal at each respective life-stage of firms. The remaining part of the chapter analyzes the different financing methods used in conjunction with the aforementioned life stages and their characteristics: from informal investors such as Angel investors, to Venture Capital funds, IPOs and M&As as buyouts exits for investors and the importance of stock markets in such instances, and Crowdfunding.

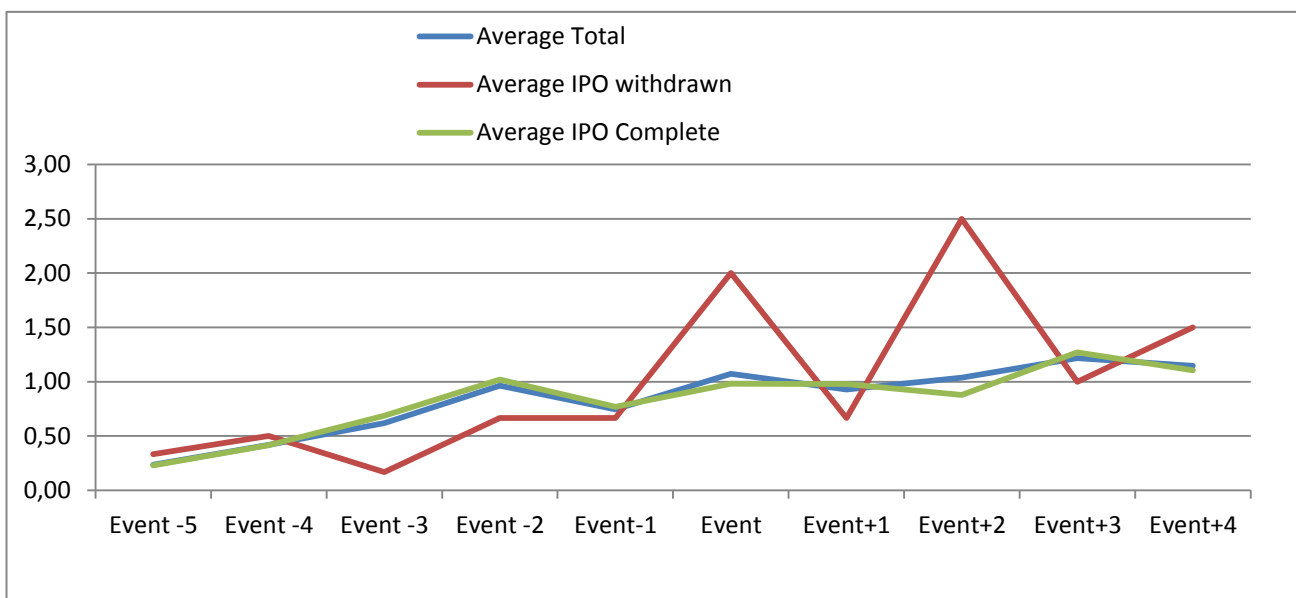
While in the second chapter we discuss how the innovative context influences the capital structure of technological firms, in the third chapter we arrive to the core of our literature review. In this instance indeed, we see this phenomenon from another perspective, or, how the capital structure and financing methods undertaken influence the innovative output of firms. The first evidence we find is that, overall, financing intermediaries do have a positive impact, on an industrial level, over the innovative output. We see indeed how informal investors do have a positive impact; on the other hand some critical points emerge with entrepreneur incentives to innovate. Indeed, we see how the capital structure influences entrepreneurs in their choice of undertaking innovative projects and ultimately may hinder the innovative output. We start to see in this instance how a public or a private ownership does have an impact on innovation. The following part of the chapter explores indeed how the decision to undertake a public ownership, through an IPO or an M&A, has an impact on the firms' produced innovation. We see how empirical evidence gathered by Bernstein (Bernstein, Does Going Public Affect Innovation?, 2012), highlights that the quality of innovative output sprouted from firms who completed an IPO is lower when compared to firms which filed for an IPO but ultimately withdrew it. This happens due to several reasons, such as the pressure from public investors on managers to undertake

safer investments due to the short-term mindset that characterizes shareholders, the departure of pre-IPO inventors after the IPO is completed, which ultimately leads to a turnover of human capital. M&As are also examined, and they present an intermediate result between private ownership and IPOs with regards to the degradation of innovation quality, but once again emerges firms acquired by private ownerships have better innovative outputs than those acquired by public ownerships. At the end of the chapter, we also analyze how the legal environment has a deep impact on the ability of firms to produce innovation. Indeed, the more labor laws are stringent concerning termination and allow employees to possess a long-term relationship with a firm, the more short term failures are undervalued and the stress is shifted on long-term results, which ultimately leads to more time for long-term, risky investments such as R&D ones.

After concluding with the third chapter the review of literature, the fourth chapter tries to take a picture of the Italian environment concerning the financing of innovation. We immediately identify what is called “the Italian gap” concerning the innovative output of our industrial and policy system compared to comparable European countries, and start analyzing the various factors that take part in its creation. The chapter then focuses on the problems more strictly tied to the financing of innovation, and it is immediately clear that both early stage financing and stock markets are not as developed as in peer countries. This takes us back to the credit rationing issues underlined in chapter 2: it is assumed that without the creation of a better environment for investors who wish to fund innovative firms, through the development of stock markets and better information sharing between banks and

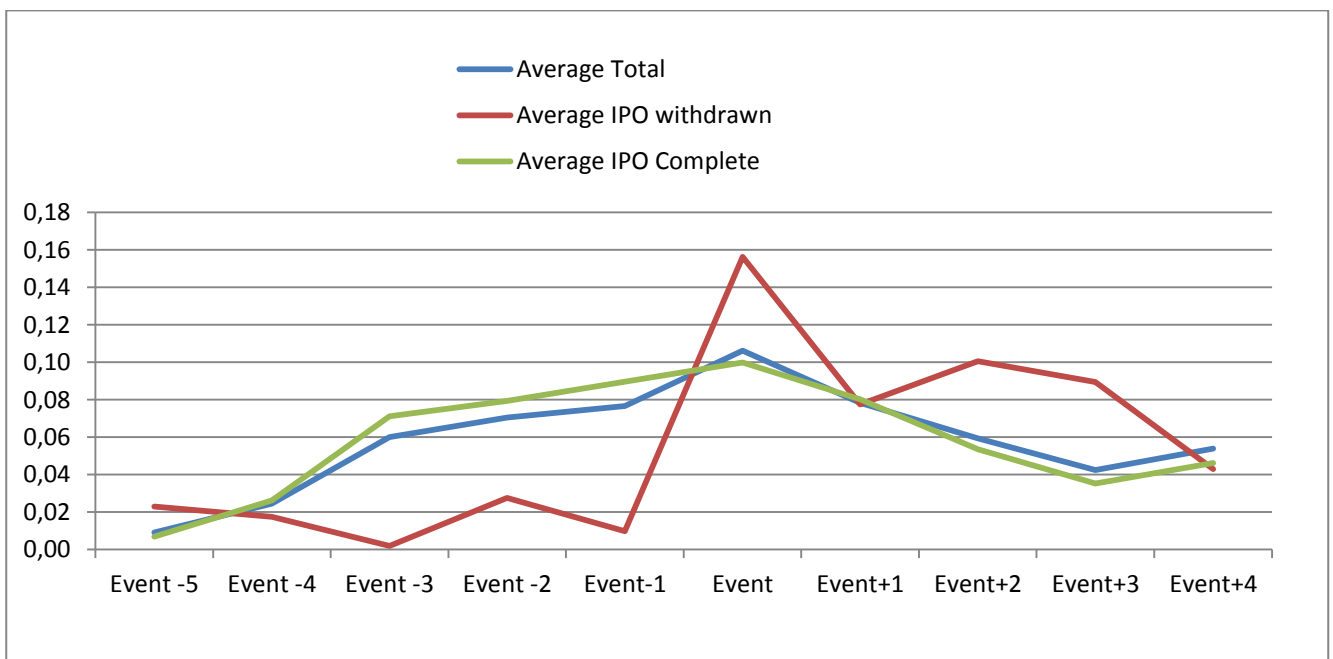
entrepreneurs, the gap between the innovative activities in Italy will be much harder to reduce.

In the final chapter, an empirical approach is undertaken to try to find some answers, with regards to the Italian context, to research questions emerged in chapter 3 concerning the relationship between going public through an IPO, and the innovative output of such firms. In the spirit of the research by Bernstein, we extracted from the Consob database the list of all prospects of companies who filed an IPO from 2002 to 2012 (CONSOB, 2015). Of these companies, we have therefore reported those who ultimately completed the IPO and those that withdrew it. For each firm that either completed or withdrew the IPO, we have then noted the patents filed in the years before the IPO filing and afterwards, using the online available database of the “Ufficio Italiano Brevetti e Marchi” (Ministero Italiano dello Sviluppo Economico, 2015). Keeping in mind that the sample is small compared to other countries, the findings have highlighted an overall increase of patent applications leading up to and in the years following the IPOs when considering patents in absolute numbers, with a slightly higher performance for those who withdrew the IPO compared to those who didn't.





The second part of the chapter though, takes a modification on the dataset to view, instead of the overall patent numbers, the relative share of patents produced by firms in the years around the IPO compared to their overall patenting activity from 1989 to 2015, in order to compensate for some firms having very high numbers of patents compared to the rest inflating the overall results. This approach created different results: we see that indeed that patenting activity does have an increase at the IPO event and then drastically reduced, even though at higher levels when compared to 5 years previous to the IPO.



This induces us to think that patenting activity may be used by Italian firms as a window-dressing tool prior to the IPO. The differences between the two datasets also highlights that there is a trend for bigger companies with higher R&D investments to have a better performance than small companies: this may be related to the credit rationing problems discussed in chapter 2 and 4 with regards to the Italian situation.

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