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Initial public offering and financing of biotechnology start-ups: Evidence from Japan☆

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ABSTRACT

This study explores the initial public offering (IPO) and financing of biotechnology start-ups in Japan. Using a unique data set, we find that biotechnology start-ups initially backed by venture capital (VC) firms and those originating from universities are more likely to go public within a shorter period. Moreover, we find that neither staged financing nor syndication by VC firms is associated with higher IPO value relative to investment. Furthermore, we provide evidence that the timing of IPOs does not depend on equity market conditions in the biotechnology industry, whereas IPO value tends to depend on equity market conditions. We discuss the factors that explain these findings, which contradict findings in previous studies of VC investments.

1. Introduction

Many believe that the emergence of new technologies spurs future economic growth. Among the new technologies, biotechnology has created a paradigm shift in the pharmaceutical and agricultural fields. For instance, the primary drug discovery approach seems to have shifted from chemical-based to biotechnology-based ones following the recent developments in biotechnology.[1] This paradigm shift may have a considerable impact on industrial organization in the pharmaceutical industry. While large pharmaceutical companies were central to drug discoveries in the past, the division of labor among biotechnology start-ups, universities, and pharmaceutical companies has recently become more important. This is because the drug discovery process is highly uncertain and includes multiple stages. Small, young firms and universities often undertake new discovery projects and are likely to play an important role in providing new drug candidates and drug discovery technologies. Large pharmaceutical companies may prefer alliances with universities and biotechnology start-ups for drug discovery. At the same time, the division of labor enables large pharmaceutical companies to reduce the high risk in the early stages of drug development and to increase the supply of new drug candidates by aligning with biotechnology start-ups, although the risk is ultimately borne by private equity markets.

As biotechnology start-ups often require large research and development (R & D) investment, they need external finance. However, biotechnology start-ups typically cannot rely on bank loans because of the uncertainty in R & D and information asymmetries between entrepreneurs and creditors. To secure external financing for R & D, biotechnology start-ups rely on equity financing. Many biotechnology start-ups, although not all do this, expand their access to equity financing by going public; that is, they issue an initial public offering (IPO). In particular, biotechnology start-ups that require significant funding for R & D such as clinical research are compelled to go public just to continue their R & D activities. In this case, we have the saying “public or perish.”

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[1] Among the best-selling drugs of 2013, for example, seven drugs derived from biotechnology were ranked in the top ten for worldwide sales. For more details, see the Free Daily Pharma Industry Newsletter website. http://www.fiercepharma.com/special-reports/top-10-pharma-companies-2013-revenue [accessed on February 17, 2015].

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This study explores the IPO and financing of biotechnology start-ups, focusing on the role of venture capital (VC) firms. Recent R & D activities in Japan have largely focused on life sciences, information science and technology, and energy and environment.[2] Undoubtedly, biotechnology is a core field of life sciences, and many expect it to play an important role in other fields, such as energy and environment. Japanese organizations are important contributors to global R & D in biotechnology. For instance, the US accounted for 41.5% of biotechnology patent applications, based on the Patent Co-operation Treaty, and Japan followed with a share of 12% in 2006 (OECD, 2009). Nevertheless, biotechnology start-ups appear to be relatively inactive in the Japanese economy, especially compared to those in the US. One potential source for this gap is the underdevelopment of private equity markets in Japan. Private equity financing, including VC firms, plays a critical role in providing funds to high-tech start-ups—especially those with large R & D investment—to grow until they exit from private equity markets, either through an IPO or merger and acquisition (M & A). However, private equity financing is very thin in Japan. In particular, the scale of VC investments is relatively small, and many VC firms are subsidiaries of banks and securities companies. These features may adversely affect the contribution of VC firms to the development of the biotechnology industry. Investigating the contribution of VC firms to the IPO and market values of biotechnology start-ups in Japan can greatly clarify the mechanism of how private equity financing contributes to the development of the biotechnology industry. In this study, we construct a unique data set of 213 Japanese biotechnology start-ups founded in the most recent 20-year period, 1995–2014.

This study examines the time to IPO and the market value of equity (market capitalization) at IPO (hereafter, "IPO value") by focusing on VC financing of biotechnology start-ups. Using a survival analysis approach, we find that biotechnology start-ups initially backed by VC firms and those originating from universities are more likely to go public within a shorter period.[3] The results also reveal that two investment practices, often considered value enhancing—staged financing and syndication, which are very common in VC investments—are not associated with higher IPO value relative to investment. Furthermore, we provide evidence that the timing of IPOs does not depend on equity market conditions in the biotechnology industry, whereas IPO value tends to depend on equity market conditions.

The remainder of this paper is organized as follows. The following section introduces the research background, including a review of the relevant literature on the financing of high-tech start-ups and investment practices of VC firms. Section 3 explains the method used in this study, with the data described in Section 4. Section 5 presents the estimation results for the time to IPO and IPO value. Finally, we discuss the factors that explain these findings, which contradict findings in previous studies of VC investments, in light of prevailing theory and evidence on staged financing and syndication.

2. Research background

2.1. Financing of high-tech start-ups

It is widely recognized that R & D and innovative activities are difficult to finance in the market (e.g., Himmelberg and Petersen, 1994; Hall, 2002; Hall and Lerner, 2010). This is due to the features of R & D, which make it different from ordinary investments. First, the returns to R & D investment are highly uncertain; therefore, external suppliers of capital, especially banks, are reluctant to provide capital for such investment. As Kamien and Schwartz (1978) argued, external financing is difficult to obtain without substantial tangible collateral, and failed R & D projects generally leave behind few tangible assets of value. Specifically, as Hall (2002) and Hall and Lerner (2010) emphasize, most R & D spending is the wages and salaries of highly educated scientists and engineers. Second, it is hard for external suppliers of capital to evaluate the actual quality of R & D activities. That is, information asymmetries between firms and external suppliers of capital result in adverse selection and moral hazard that constrain external suppliers' decision to provide capital.

In addition, some scholars have argued that younger firms are more likely to have trouble financing R & D in the market (e.g., Müller and Zimmermann, 2009; Honjo et al., 2014a). This is because such firms have limited operating histories and lack complementary assets, including the know-how and relationships that take many years to develop, although banks often use relationship lending to alleviate problems associated with information asymmetries. As Müller and Zimmermann argued, younger firms have less collateral available to pledge to banks, and the higher default risk of these firms is a further age-specific impediment to bank loans.

2.2. Role of VCs and IPO performance

Because of the inherent constraints of debt financing, private equity is an important source of finance for high-tech start-ups. As Gompers (1995) emphasizes, venture capitalists (VCs) concentrate investments in younger firms and high-tech industries where uncertainty and information asymmetries are significant and monitoring is valuable. At the same time, VCs seek exit strategies for their investments, and an IPO is undoubtedly one of the most typical exit strategies.

Many studies have emphasized the role of VCs in the IPO process. Megginson and Weiss (1991), for example, found that VC-backed firms are significantly younger, have greater median book values of assets, and have a larger percentage of equity in the capital structure than their non-VC-backed counterparts. Helwege and Packer (2009) argued that firms controlled by VCs and private equity specialists are less likely to stay private and that these firms value the IPO as an important exit strategy for outside equity. Regarding the IPOs of biotechnology firms, Lerner (1994b) examined the timing of IPOs and private financings by VCs, using a sample of 350 privately held VC-backed biotechnology firms in the US between 1978 and 1992. The results showed that these firms go public when equity values are high, and that they employ private financings when equity values are lower. The findings indicated that the likelihood of an IPO for biotechnology start-ups increases with favorable market conditions.

In addition, many studies have examined IPO performance. For instance, Pagano et al. (1998) estimated the effects of an IPO on firm performance based on accounting measures, such as the return on assets and capital expenditures, using data on Italian firms. In particular, some studies have focused on IPO value, which means the market value of equity at IPO, as well as the determinants of IPO value. For instance, Deeds et al. (1997) addressed the amount of capital raised from an IPO. If access to capital is the major goal of going public, then the success of an IPO is measured by the amount of capital raised by the firm. Deeds et al. defined IPO value as the total value of capital raised from the IPO minus the underwriter's fees, and estimated the effects of location, the number of products, and citations on IPO value, using data on 92 publicly-held firms in the US biotechnology industry.

While these studies provide interesting results, it is important to note that there is no guarantee that a firm's value will generate sufficient returns for investors, even if this value is high at IPO. From the investors' viewpoint, the return on investment matters.[4] Several studies

[2] According to the Center for Research and Development Strategy (CRDS) of Japan Science and Technology Agency, R & D expenditures are the highest in life sciences and clinical research, at more than three trillion yen in fiscal year (FY) 2014. http://www.jst.go.jp/crds/report/report02/CRDS-FY2015-FR-07.html [accessed on May 23, 2016].

[3] In this study, the term "start-ups initially backed by VC firms" or "initially VC-backed start-ups" refers to start-ups that raised equity from VC firms at the foundation of the start-ups, and the term "initial VC financing" refers to the investment of VC firms.

[4] Some scholars used the cumulative average market-adjusted return and average buy-and-hold return post-IPO (e.g., Yung et al., 2008). However, we highlight performance at IPO, rather than after IPO, and do not employ these measures.