The finance of innovation in Latin America

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ABSTRACT

This study contributes to the extant literature on innovation by examining how private companies fund innovation activities and R&D in Latin America. Specifically, this study seeks to identify whether innovative companies exhibit financing patterns different from those of non-innovative ones. In addition, this study aims at gauging the association between innovation and firm features, such as age, bank financing, female participation in ownership, financial constraints, and foreign ownership, among others.

Based on information for Argentina, Colombia, Chile, Mexico, and Peru for 2010, firm size, firm age, financial constraints, and funding sources appear as the main drivers of innovation in Latin American countries. The figures also show that over 60% of the sampled firms displayed a very low or non-existent innovation level. A pending strategic task in Latin America is to increase both the R&D expenditure/GDP ratio and patent activities, and to attract highly-qualified researchers to industry.

1. Introduction

Economic theory has shown that firms operating in competitive markets tend to achieve suboptimal levels of research and development (R&D) investment (Arrow, 1962, chap. 23; Hall, 2002; Hall & Lerner, 2010, chap. 14). The main argument is that the knowledge of producing new products and processes, which is the primary output of R&D, is non-rival. Indeed, to the extent that knowledge cannot be kept secret, the benefits will not be fully appropriated by the firm carrying out the investment. This will lead to an R&D underinvestment, despite the fact that imitation is costly.

On the other hand, R&D differentiates from ordinary investment (Hall, 2002; Hall & Lerner, 2010, chap. 14). First, a very high percentage of R&D investment involves wages and salaries of highly-qualified human capital. Due to its intangible nature, human capital is very different from investment in physical assets, such as inventory goods or plant and equipment, in the sense that it may be partially lost as some highly-trained employees leave or are fired from the firm. Second, R&D investment is associated with a high degree of uncertainty regarding its final outcome and economic retribution. This state of uncertainty tends to be particularly severe at early stages of an investment project, so that traditional valuation methods render inappropriate to assess its profitability.

Alternatives ways to mitigate the underinvestment problem are an intellectual property system, government support of R&D, tax incentives, and encouragement of research partnerships. Such interventions are usually justified by the fact that the social return to R&D exceeds its private level. However, when the innovator and financier are different entities, there is an additional gap: the discrepancy between the private return and the cost of capital. Regarding this funding gap, Hall (2002) concludes that: (i) venture capital only partly mitigates the high cost of capital faced by small and new innovative firms; (ii) large firms tend to rely on internal funds for financing innovation; and, (iii) venture capital does not solve the funding gap completely, particularly in countries where public equity markets are not highly developed.

The purpose of this study is to contribute to the extant literature by examining how private companies fund innovation and R&D activities in Latin America. The information source is the World Bank’s World Enterprise Survey 2006 and 2010. Specifically, this study seeks to identify whether innovative companies exhibit financing patterns different from those of non-innovative ones. In addition, this study aims at gauging the association between innovation and firm features, such as age, size, female participation in ownership, financial constraints, and foreign ownership, among others.

Related research by Barona, Rivera, and Aguilera (2015)—based on the World Enterprise Survey 2010—showed that innovative firms in Colombia tend to rely heavily on retained earnings and bank debt to fund...
R&D activities, whereas non-innovative firms on trade credit (i.e., credit from customers and suppliers). In addition, Barona et al. found that innovation in Colombia is positively associated with firm size.

In another strand of the literature on innovation in Latin America, Hall and Maffioli (2008) analyzed the impact of government technology development funds (TDF) on innovation in Latin American countries. By focusing on Argentina, Brazil, Chile, and Panama, the authors concluded that TDF do not crowd out private investment, and that such funds have a positive impact on R&D intensity. However, the empirical analysis did not show a very statistically significant impact of TDF on patents, new products sales or increases in firm productivity. Hall and Maffioli speculate that these inconclusive findings may have been due to the short evaluation period.

Other examples of recent contributions to the innovation literature in Latin America are Benavente, Crespi, Garone, and Maffioli (2012), who analyzed the impact of national research funds in Chile (FONDECYT) on principal researchers’ quantity (number) and quality (citations) of their academic publications; Giuliani (2013), who focused on a wine cluster in Chile to measure network dynamics; Crespi, Giuliodori, Giuliodori, and Rodriguez (2016), who studied a tax-credit scheme for promoting innovation investment at the firm level in Argentina; and, Alvarez (2016), who found that information and communication technology (ICT) contributes positively to innovation and productivity in the services industry in Chile.

This article is in line with Barona et al.’s (2015), but it extends it in various ways by considering a more comprehensive sample of Latin American countries and alternative definitions of firm innovation. Its organization is as follows. In order to provide some background information, Section 2 presents figures on innovation in Latin America and the Caribbean and in Organization for Economic Co-operation and Development (OECD) countries. Section 3 presents the data and some descriptive statistics. Section 4 in turn focuses on the estimation process and discussion of the empirical results, while Section 5 summarizes the main findings and draws some policy implications of this research.

2. Some figures on invention in Latin America and the Caribbean

The Ibero-American and Inter-American Network on Science and Technology Indicators, www.ricyt.org, gathers information on science and technology indicators of countries belonging to the Americas and the Iberian Peninsula. For illustration purposes, Figs. 1 and 2, respectively, depict the dependency rate and the invention coefficient of Latin America and the Caribbean (LAC) and the United States (US) for the period of 1990–2013. The dependency rate is the number of patents requested by non-residents to that of residents, whereas the invention coefficient is the number of patents per 100,000 inhabitants.

As can be seen from Fig. 1, the US dependency rate fell into the (0, 1) range during the sample period, suggesting the preeminence of patents applied for by country residents. This pattern contrasts with that of the LAC economies where the dependency rate averaged 4.1 over 1990–2013. Fig. 2 in turn depicts the sizeable gap between the invention coefficients of the US and LAC: during 1990–2013 the number of patents per 100,000 inhabitants averaged 60.2 in the US as opposed to 1.7 in the LAC economies.

The above figures are a reflection of the much limited resources allocated to R&D in LAC economies as opposed to the US (Fig. 3). Table 1 provides figures of R&D expenditure to GDP during 2007–2013 for Argentina, Brazil, Chile, Colombia, Mexico, the United States, Ibero-America, Latin America & the Caribbean, and OECD. While, on average, the US allocated 2.7% of GDP to R&D during 2007–2013, Latin American and the Caribbean only averaged 0.70% of GDP over that period. OECD countries in turn averaged a slightly lower figure than the US during 2007–2013: 2.31% of GDP. Among Latin American countries, Brazil stood out as the one that invested the most on R&D: a maximum of 1.2% in 2013, with an average of 1.1% during 2007–2013. For the sake of illustration, longer time series of US and LAC R&D expenditure/GDP series are provided in Fig. 4 for the period of 1990–2013.

R&D usually requires of highly specialized human capital. As can been seen from Fig. 4, there was a sizeable difference between the number of Full-Time Equivalent (FTE) researchers per 1000 labor force in the US and LAC economies in the period of 1990–2012. Specifically, the number of FTE per thousand labor force in the US steadily increased from 5.7 in 1990 to 7.9 in 2012, averaging 6.9 in that time period. Meanwhile, in the LAC economies, such an indicator rose from only 0.5 in 1990 to 0.8 in 2012, averaging 0.6 in 1990–2012. Fig. 4 also shows that the number of FTE per 1000 labor force in OECD countries kept the pace with that of the US during 1990–2012, reaching an average of 6.0 in that time period.

Moreover, figures from the OECD Main Science and Technology Indicators suggest that the gross domestic expenditure on R&D (GERD) receives more government support in Latin America than in the US and the OECD countries. For instance, in 2014 the percentage of GERD financed by the government in Chile and Mexico was, respectively, 44% and 72% as opposed to 27% and 26% in the US and OECD countries.

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1 This is also documented in a review article by Kerr and Nanda (2014).

2 Argentina’s government contributed 76% of GERD in 2013.
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