

# Financial Reforms, Patent Protection, and Knowledge Accumulation in India

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**Summary.** — The main objective of this paper is to explore the impact of financial sector reforms, financial deepening, and intellectual property protection on the accumulation of knowledge for one of the world's largest developing countries. The findings indicate that increased intellectual property rights protection is associated with higher knowledge accumulation. While financial deepening facilitates the accumulation of ideas, the implementation of a series of financial liberalization policies is found to have a non-linear effect. The results show that financial liberalization will exert a beneficial impact on technological deepening only if the financial system is sufficiently liberalized.

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## 1. INTRODUCTION

Recent literature on endogenous growth theory suggests that there is a strong positive correlation between R&D activity and economic growth (Aghion & Howitt, 1998; Aghion, Howitt, & Mayer-Foulkes, 2005; Grossman & Helpman, 1991; Jones, 1995a, 2002; Laincz & Peretto, 2006; Segerstrom, 1998).<sup>1</sup> However, although the relevant literature has emphasized the role of R&D in stimulating productivity growth, studies so far have not explored how financial liberalization and financial deepening affect innovative activity. Little attention has also been paid to understanding how patent protection influences knowledge creation. Better access to finance facilitates the adoption of modern technology to boost the development of the knowledge and technology-intensive industries through reducing moral hazard problems and providing efficient credit facilities. On the other hand, the fundamental objective of having a better patent protection framework is to promote the creation and diffusion of technology by providing the inventors with some monopolistic power.

This study is related to two strands of literature. One has explored the effects of intellectual property protection on economic growth (e.g., Falvey, Foster, & Greenaway, 2006; Gould & Gruben, 1996; Park & Ginarte, 1997). The other strand has tried to assess the impact of financial reforms or financial deepening on economic growth (e.g., Ang, 2008; Arestis & Demetriades, 1997; Beck & Levine, 2004; Bekaert, Harvey, & Lundblad, 2005; Demetriades & Hussein, 1996; Edison, Levine, Ricci, & Sløk, 2002; Mavrotas & Son, 2006; Rioja & Valev, 2004; Rousseau & Vuthipadadorn, 2005). However, none of these studies has attempted to examine the roles of finance or intellectual property rights protection in determining growth rates via the channel of knowledge production.<sup>2</sup>

Moreover, although the literature has identified both finance and patent protection as important determinants for innovative activity, these two factors have often been analyzed in isolation and so far no attempt has been made to assess them in an integrated framework. In line with this, Liodakis (2008) argues that both intellectual property protection and finance have emerged to be the two pillars of the development of technological innovations in the recent years, highlighting the importance of considering them under a single framework.

This consideration is important given that banks may not want to finance risky innovative activities unless the protection framework of intellectual property rights is sufficiently strong. Thus, the provision of finance for innovative activities may be constrained by the appropriability conditions. On the other hand, the law makers may not want to strengthen the protection framework unless a proper institutional framework is in place in the financial system. Similarly, Kanwar and Evenson (2009) show that a country is able to provide a higher level of patent protection if the government has better access to financial resources. Thus, finance and patent protection may be strongly associated, and the consideration of these factors in an integrated framework is necessary to provide a more complete analysis.

We aim to enrich the existing literature by providing further evidence on how finance and protection of intellectual property affect ideas production, drawing on the experience of one of the largest developing economies in the world. We focus our analysis on the Indian experience due to several reasons. Research on the relationship between R&D and growth has focused exclusively on the United States and OECD countries due to the lack of R&D data for developing countries. Despite the fact that they suffer more from a knowledge gap, so far there has been little evidence documented for developing countries. India is an ideal candidate in this context given that it is one of the world's fastest growing developing countries. Its large population, representing about 17% of the world total, together with a substantial pool of workers engaged in R&D, provides an adequate basis for the use of an R&D-induced endogenous growth framework to test the underlying hypotheses.

We focus on documenting case studies evidence since this approach is more useful in disentangling the complexity of the financial and legal environments and economic histories of an individual country, and is therefore helpful in identifying

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reasons for growth variations within the country (Ang, 2007). By analyzing case studies, the econometric findings of this project can be related to the prevailing institutional structure, and therefore inform academic as well as policy debate. Moreover, the availability of long time series data on R&D going back as far as 1950 provides an added incentive for this research given that R&D data are particularly scant. In this connection, it is worth noting that a majority of the OECD countries have data starting only from 1970 (see, e.g., Coe & Helpman, 1995). The availability of a set of sufficiently long time series data allows for a meaningful time series investigation. This is important given that economic growth is a long-run phenomenon, which necessitates analyzing the evolution of the variables of interest over time in order to relate the findings to policy designs (Solow, 2001).

More importantly, India's recent financial sector and patent system reforms provide an ideal testing ground for further analyzing the relationship between finance, patent protection, and knowledge production. There was little intervention in the financial system of India during the 1950s and 1960s. However, the government gradually imposed more controls by raising statutory liquidity and cash reserve requirements over the 1970s and 1980s. Furthermore, several interest rate controls were implemented in the late 1980s. A series of comprehensive financial sector reform policies were undertaken in 1991 as part of broader economic reform. These were aimed at changing the entire orientation of India's financial development strategy from one of repression toward encouraging a more open, market-type system. Since then, interest rates were gradually liberalized and statutory liquidity requirements significantly reduced so that markets could play a greater role in price determination and resource allocation.

The industrial licensing requirements that restricted entry and expansion of both domestic and foreign firms were relaxed in the same year. The equity market was formally liberalized in 1992, although the first country fund was set up earlier in 1986, allowing foreign investors to access the domestic equity market directly. Capital account restrictions were also reduced. The regulatory framework was strengthened significantly in 1992. In addition, entry restrictions were deregulated in 1993, resulting in the establishment of more private and foreign banks. Consequently, regulations on portfolio and direct investment were eased. The exchange rate was also unified in 1993–94 and most restrictions on current account transactions were eliminated in 1994 (see also Ang, in press-a, 2009b).

India has a long history of patent system policy, which can be traced back to Act VI of 1856 on Protection of Inventions. However, under this Act, the Indian patent system has failed to stimulate the development of domestic inventions. A majority of the patents were filed by foreigners, who enjoyed significant monopolistic power in the market. In view of these limitations, the Patents Act of 1970 was enacted with the objective of promoting more domestic inventions and reducing the monopoly power of foreign firms. This led to some restrictions on patentable items and duration of protection. Although this policy change was strongly supported by domestic firms, there was no significant variation in the number of patents filed by domestic residents over the next two decades. In 1989, under significant external trade threats from developed countries, India reversed its position and agreed to include intellectual property rights in the negotiations of the General Agreement on Tariffs and Trade (GATT).

Furthermore, following the economic liberalization launched in the early 1990s, India has attached greater importance to developing an intellectual property rights protection

system. This was mainly motivated by the objective of attracting more foreign research which would potentially benefit the domestic research sector. This pro-patent reform position has subsequently led to the establishment of the 1999 Patents (Amendment) Act. More recently, India has revised its patent policy to conform to the Trade Related Aspects of Intellectual Property Rights (TRIPS) requirements. The Patent Act was further revised in 2005 to include more patentable items such as pharmaceutical and agricultural chemical products. The significant increase in patent applications in the recent years reflects the filing of inventions which were not patentable under the 1970 Act.

It is probable that one of the key indicators of the impact of these reforms has appeared in the form of a significant variation in innovative activities. As such, these policy changes provide an appropriate historical setting to analyze the subject at hand. The rest of the paper is organized as follows. Section 2 sets out the R&D-induced endogenous growth models. The effects of finance and patent protection on innovative activity are tested based on a semi-endogenous growth model with appropriate modifications. Specifically, we incorporate two institutional factors—liberalization or deepening of the financial system and the patent protection framework—into our analysis of the determinants of ideas accumulation. Section 3 discusses the construction of variables and data sources. Section 4 describes the estimation techniques. Section 5 performs the empirical analysis and presents the results. Section 6 checks the robustness of the results. The last section concludes.

## 2. A SIMPLE KNOWLEDGE CREATION FUNCTION AND ITS EXTENSIONS

### (a) *The ideas production function*

The R&D-based endogenous growth models of Jones (1995a), Kortum (1997) and Segerstrom (1998) can be summarized as follows:

$$Y_t = K_t^\alpha (AL_t)^{1-\alpha}, \quad 0 < \alpha < 1, \quad (1)$$

and

$$g_A = \frac{\dot{A}_t}{A_t} = \lambda X_t^\delta A_t^{\phi-1}, \quad 0 < \delta \leq 1, \quad \phi < 1, \quad (2)$$

where  $Y_t$  is total output,  $K_t$  is physical capital,  $A_t$  is total factor productivity (TFP) or the stock of knowledge in the economy,  $L_t$  is labor force,  $X_t$  is R&D input such as R&D personnel or R&D expenditure,  $\lambda$  is a research productivity parameter,  $\delta$  is the research duplication parameter (0 if all innovations are duplications and 1 if there are no duplicating innovations), and  $\phi$  measures the extent of externalities in the process of R&D. An increase in the level of R&D input should increase the growth rate of ideas production, but the relationship is not monotonic since the rate of discovery will decrease with the level of knowledge given that it is increasingly difficult to find the next new ideas so that  $\phi < 1$  (Jones, 1995b). Eqn. (2) sets out the analytical framework underlying our empirical modeling strategy. We will augment this analytical expression to consider the potential effects of finance and patent protection on inventive activity, as discussed below.

### (b) *Finance and innovative activity*

In their seminal work, McKinnon (1973) and Shaw (1973) noted that financial repression policies were largely accountable

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