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## Innovation and financial liberalization



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## ABSTRACT

This paper attempts to shed some light on the role of financial sector policies in generating new knowledge, drawing on the experience of one of the fastest growing and largest developing countries. Using time series data for India over the period 1963–2005, the results indicate that interest rate restraints help generate ideas. Other financial repressionist policies, in the form of high reserve and liquidity requirements, as well as significant directed credit controls, appear to have a dampening effect on ideas production. These results lend some support to the argument that some form of financial sector reforms may help stimulate economic growth via increasing technological innovation.

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## 1. Introduction

The importance of finance in the process of technological innovation can be traced to the early work of Schumpeter (1911), who argues that adequate credit is required to facilitate the widespread adoption of new technologies. Hence, the availability of financial instruments, services and institutions is closely related to the course of technological change. Recent developments in the theoretical growth literature have continued to emphasize the importance of finance in explaining innovative growth. In the models developed by Blackburn and Hung (1998), Aghion et al. (2005) and Aghion and Howitt (2009), the relationship between finance and growth is analyzed in the context of innovation-based growth models. These models predict that financial restrictions lead to higher monitoring costs or lower costs of hiding successful inventions. Financial reforms remove these restrictions and therefore tend to stimulate innovative production.

However, despite the important role of finance in facilitating the diffusion of new technologies and in the generation of new ideas, as illustrated by the theoretical contributions of the studies cited above, the issue of what kind of financial policies contribute to ideas production has not yet received much attention. The objective of this paper is to fill this gap in the literature by

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providing an empirical assessment of the influence of various financial sector policies on the generation of new ideas with a case study of a large developing country. While the literature tends to focus on the overall financial liberalization (see, e.g., Levine, 2001; Hermes and Lensink, 2008; Ang, 2010d, 2011a, 2011b; Demetriades et al., 2013), a more satisfactory approach to assessing the effect of financial reforms would explicitly account for each component of the reform program. This would provide a more complete analysis of the costs and benefits associated with financial repression and liberalization.

This study is more closely related to Ang (2010b) who examines the long-run impact of financial reforms, financial deepening and intellectual property protection on the accumulation of knowledge (or the stock of ideas) in India. His findings suggest that better patent protection is associated with higher knowledge accumulation. Moreover, 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, implying that financial liberalization will exert a beneficial impact on technological deepening only if the financial system is adequately liberalized. The above study, however, does not consider how each component of the reform or repressionist program affects knowledge. Given that the overall effectiveness of the entire reform program would depend on each policy type, analysis performed at the disaggregated level is more satisfactory as it helps identify an appropriate mix of financial liberalization and repressionist policies that is effective at stimulating ideas production.

Using annual time series data for more than four decades, the present study attempts to address the question of how government intervention in the financial system (including interest rate controls, directed credit programs and reserve and liquidity requirements) affects the evolution of knowledge production in India. We focus our analysis on India for several reasons. First, empirical research on endogenous growth models has focused mainly on the U.S. and other OECD countries due to the lack of adequate and reliable R&D data for developing countries (see, e.g., Ha and Howitt, 2007; Ulku, 2007; Venturini, 2012a,b). With some exceptions such as Ang (2010c) and Madsen et al. (2010b), so far there has been little case study evidence documented for developing countries.

Second, India provides an ideal ground for further analysis given that it has recently emerged as one of the fastest growing developing nations, and has also undergone significant financial sector reforms. Finally, the availability of long time series data on R&D going as far back as the 1950s provides an added incentive for this research, given that R&D data for developing countries are particularly scant. In this connection, it is worth noting that a majority of OECD countries have data starting only from 1965. 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 relevant variables over time in order to relate the findings to policy designs.

The remainder of this paper is organized as follows. The next section describes the experience of technological development and financial liberalization in India. Section 3 sets out the innovation-driven endogenous growth framework. It is augmented to take into consideration the influence of financial sector policies in producing knowledge. Data and construction of variables are discussed in Section 4. Section 5 describes the econometric techniques employed in this study. The results are presented and analysed in Section 6. Some robustness checks are provided in Section 7, and the last section concludes.

## 2. Innovative production and financial reforms in India

After achieving independence in 1947, India's technology policy was focused on acquiring better technology from abroad, paving the way for rapid industrial growth over the following few decades. Motivated by the profitability of independent technological work, there was a shift in preference from foreign to indigenous technology in the 1960s and 1970s. As a result, inflows of technology were arranged through licensing that was subject to strict controls. MNCs were allowed to participate only in sectors in which local technology was unavailable. Emphasis has been placed on the effective absorption and adaptation of imported technology through the encouragement of more investment in engineering and in-house R&D activities. This is reflected by the granting of generous fiscal incentives and the establishment of R&D centers, which increased substantially, from 106 in 1973 to 930 in 1986 (Sahu, 1998). Science and technology personnel increased markedly from about 0.2 million in 1950 to more than 3.8 million in 1990. R&D expenditure as a percentage of GDP increased considerably from just 0.05% in 1950 to 0.8% in 1990. While these figures may seem small compared to some of the OECD countries, they are nonetheless very impressive for a developing nation. Some liberalization efforts in industrial licensing and capital goods imports were initiated in the late 1980s to facilitate inflows of foreign technology. Between 1950 and 1990 over 140,000 foreign collaboration proposals were approved by the government. India's growing technological capability has subsequently enabled it to become a key player in the generation of industrial technology exports among the NICs.

Alongside the technological development, there has also been significant growth in the financial sector. The provision of finance for investments in local R&D has significantly enhanced the levels of absorptive and adaptive capacities in the technological sector, allowing the effective assimilation of foreign technology. The number of scheduled commercial banks rose sharply, thus providing significant financial resources to fuel industrial growth. Rapid expansion in bank branches has also facilitated the mobilization of savings, contributing to a tremendous increase in intermediary activity. In terms of financial policy, the Reserve Bank of India gradually imposed more controls over the financial system by introducing interest rate controls in the 1960s. The statutory liquidity ratio was raised from 25% in 1966 to 38% in 1989, and the cash reserve ratio increased considerably from 3% to 15% during the same period. These requirements enabled the Reserve Bank to purchase government securities at low cost. The extent of directed credit programs has also increased markedly since the nationalization of the 14 largest private banks in 1969. A number of priority lending rates were set at levels well below those that would prevail in the free market. This process culminated in the late 1980s when directed lending was more than 40% of the total.

The major phase of financial liberalization was undertaken in 1991 as part of the broader economic reform in response to the balance of payments crisis of 1990–91. The objective was to redirect the entire orientation of India's financial development strategy towards a more open system in order to provide a greater role for markets in price determination and resource allocation. Consequently, interest rates were gradually liberalized and reserve and liquidity ratios were significantly reduced. 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, allowing foreign investors to access the domestic equity market directly. The formerly restrictive capital account regime has also become more open. The regulatory framework was also significantly strengthened. In addition, entry restrictions were reduced in 1993, resulting in the establishment of more private and foreign banks. Regulations on portfolio and direct investment have since been eased. The exchange rate was unified in 1993 and most restrictions on current account transactions were eliminated in 1994.

These liberalization measures have significantly reduced restrictions in the financial system. Increased access to credit has encouraged more investment in education, providing a large pool of scientific and technical personnel to the technological sector. Since liberalization, R&D personnel have grown by more than two-fold over the period 1991–2005. The transfer of technology has been greatly facilitated in recent years following India's accession to the WTO, where minimum standards of patent protection are mandated by the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) that came into force in 1995.

## 3. Analytical framework

### 3.1. The R&D-based endogenous growth models

In this section, we present the analytical framework underlying our modeling strategy. Assuming a standard neoclassical production function with constant returns, we can write the aggregate output at time  $t$ ,  $Y_t$ , as:

$$Y_t = A_t f(K_t, L_t) \quad (1)$$

where  $A_t$  is the stock of knowledge or ideas,  $K_t$  is the capital stock and  $L_t$  is the number of workers. The R&D-based endogenous growth literature (see, e.g., Romer, 1990) suggests that the rate of

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