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Does environmental regulation indirectly induce upstream innovation? New evidence from India☆

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ABSTRACT

Exploiting a quasi-natural experiment, which involves the imposition of a ban by Germany in 1994 on an input ('Azo-dyes') used by the Indian leather and textile industries, we estimate the indirect impact of the environmental regulation on innovation activities of upstream (dye-producing) firms in India and examine how it varies by different firm characteristics: size and ownership. We find robust evidence of a significant increase (11–61%) in innovation expenditure for the dye-makers in response to the 'Azo-dyes' ban. Additionally, we find: (i) increase in technology transfer to the tune of 1.2–2.5 times more than that of internal R&D; (ii) increase in innovation expenditure with firm size; (iii) domestic firms investing more in technology transfer as compared to R&D, whereas foreign firms only undertaking the latter and (iv) decrease in investments towards innovation by downstream firms, thereby pointing towards a possible substitution effect in aggregate innovation by upstream firms. Our results are consistent with a variety of estimation methods and robustness checks.

1. Introduction

The relationship between environmental regulation and innovation has received considerable attention over the last two decades, especially after Michael Porter (Porter, 1991; Porter and Van der Linde, 1995) challenged the conventional wisdom about the impact of environmental regulation by arguing that well-defined regulation can actually increase competitiveness and innovation. Since then, there has been a plethora of studies investigating the role of regulation, especially environmental regulation, on business performance of firms and innovative activities (by looking either at innovation input or Research and Development (R&D) expenditure and/or innovation output or patents). However, till now there is no consensus on what is called the 'Porter's Hypothesis', as researchers continue to find conflicting evidence (Palmer et al., 1995; Jaffe and Palmer, 1997; Gray and Shadbegian, 1998; Berman and Bui, 2001; Greaker, 2006; Popp, 2006). New studies have also emerged in terms of examining the indirect impact of environmental regulation on technical change (Miller, 2015; Calel and Dechezleprêtre, 2016). We extend the literature by investigating whether environmental regulation affects upstream innovation. Using a quasi-natural experiment, in terms of imposition of a foreign regulation, targeted primarily towards the downstream sector, we estimate the innovation effects of the regulation on upstream firms. Our results show that the imposition of the foreign regulation led to a significant increase of innovation expenditure of upstream firms between 11 and 61%.

Global standards, especially non-tariff barriers have proliferated during the last two decades (as tariff barriers have started to

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decline). As this has happened, developing economies have contested that these shifts might potentially create trade barriers. UNCTAD (2005) quotes a 2002 study by International Trade Commission (ITC), documenting that 40% of exports from less developed countries are subject to non-tariff barriers, including standards. Chaturvedi and Nagpal (2002), also point out that the global proliferation of environmental and health related standards, along with a rise in trade in environmentally sensitive goods creates new challenges for firms in the developing world. This abundance of global standards started a debate on how and under what conditions can supplier firms in developing countries, especially firms in polluting industries such as leather and textile goods, dyes and chemicals (who are also large employers) comply with these stringent environmental regulations imposed by global buyers without necessarily compromising their competitiveness (Tewari and Pillai, 2005).

Our study exploits one such binding foreign regulation that originated because of a petition by some consumer advocacy groups due to health and environmental concerns. The regulation is popularly known as 'Azo-dyes' ban. It came from Germany in July 1994, and was primarily targeted on the goods produced by the leather and textile industries. The regulation banned the use of 'Azo-dyes', a colorant, in the production of leather and textile goods. During the early 1990s, Germany and USA were the two largest consumers of Indian-made textiles with two nations importing more than 70% of all Indian textiles (Iyer, 1992). In 1994, textiles alone made up 76% of all consumer good exports (IKB Deutsche Industriebank, 1994). On the other hand, the textile industry, specifically in India, accounts for some 70% of the consumption of dyestuffs produced by the chemical sector.[1] Therefore the 1994 German banning of 'Azo-dyes', one of the oldest and most widely used chemicals in the production of leather and textile goods, also became a *de-facto* indirect ban for the producers of this particular input in India, i.e., for the dye-maker firms of the Indian chemical industry.[2] Tewari and Pillai (2005) point out that the ban on the widely used chemical, effectively (though unintendedly) turned the input industry, in this case, the dye producers, into *de-facto* diffusers of environmental compliance. In 1997, the Ministry of Environment and Forests (MoEF), Govt. of India extended this foreign regulation for firms selling in the domestic market; an issue we will come to in our analysis below.

Facing a zero demand for one of their most important products, firms in the dye-making sector of the broader chemical industry opposed the ban to begin with. But, due to widespread demand for newer and safer dyes, especially, among the leather and textile firms in India, they started experimenting with development of new substitutes and offered technical assistance to downstream (leather and textile) firms to adapt and adopt them. The primary reason for these responses on innovation activity can be attributed to the fact that the leather and textile firms were the biggest buyers for the products of the Indian chemical industry in the domestic market. Using these primitives in our setting, we investigate whether this German 'Azo-dyes' regulation in 1994 induced upstream dye-producing chemical firms in India to invest more in innovative activities to produce a safer alternative. In addition, we explore if there is any role of firm heterogeneity.

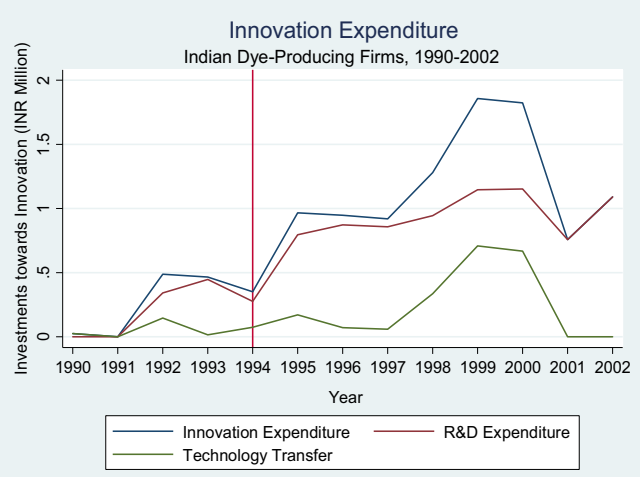

Fig. 1. Innovation Expenditure, Indian Dye-producing Chemical Firms, 1990–2002.
Notes: Lines represent the average expenditure of a "Dye-producing" firm in India towards innovation.
Source: CMIE Prowess

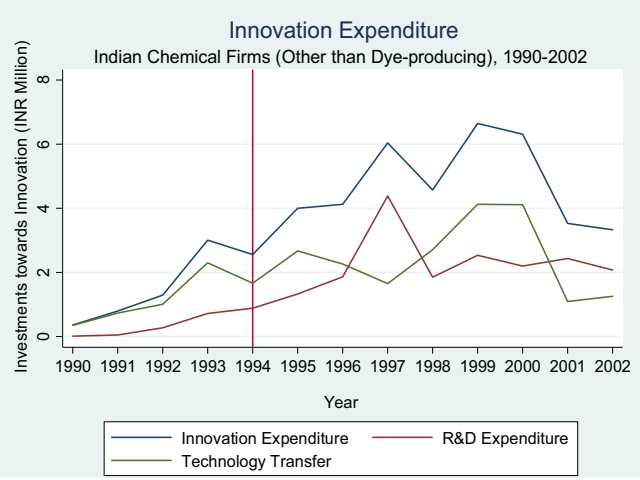

Fig. 2. Innovation Expenditure, Indian Chemical (other than Dye-producing) Firms, 1990–2002.
Notes: Lines represent the average expenditure of a "Chemical (other than Dye-producing)" firm in India towards innovation.
Source: CMIE Prowess

Fig. 1 plots the total innovation expenditure (sum of R&D expenditure and Technology Transfer) and its components (separately) of the Indian dye-producing chemical firms from 1990 to 2002. It shows a very sharp rise in the aggregate innovation expenditure of these firms right after 1994. The figure also point out that this rise in the investments towards innovation expenditure is primarily driven by the increase in R&D expenditure of these firms. In addition, Fig. 1 displays another significant increase in the innovation expenditure of the dye-makers in the post-1997 period. And, this jump in the aggregate innovation expenditure is a result of sudden increase in another component of the aggregate innovation expenditure, which is royalty payment for technical knowhow or technology transfer. Fig. 2 plots the same trends for other chemical firms (producing chemical compounds other than dyes) to understand whether such a trend (sharp rise after 1994 and 1997) is common to all sectors or is specific to the dye-makers. It does not

[1] (Source: https://www.dnb.co.in/Chemical/overview.asp)

[2] Overall, the Indian chemical industry is among one of the established traditional sectors of the country that play an integral role in the country's economic development. This sector forms a part of the basic goods industry and is a critical input for industrial and agricultural development. As on March 31, 2008, the size of the Indian chemical industry was estimated at around USD 35 Billion and 3% of India's GDP. The Indian chemical sector accounts for 13–14% of total exports and 8–9% of total imports of India. In terms of volume of production, it is the twelfth-largest in the world and the third-largest in Asia. The dyestuff sector is one of the important segments of the Indian chemical industry and has forward and backward linkages with a variety of sectors. (Source: https://www.dnb.co.in/Chemical/overview.asp)