

# **ESSAYS ON INNOVATION ECONOMICS**

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# ESSAYS ON INNOVATION ECONOMICS

*by*

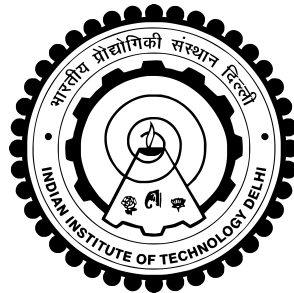
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*in fulfilment of the requirements of the Doctor of Philosophy*

*to the*



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## CERTIFICATE

This is to certify that the thesis titled **ESSAYS ON INNOVATION ECONOMICS**, submitted by **RITUPARNA KAUSHIK**, to the Indian Institute of Technology, Delhi, for the award of the degree of **Doctor of Philosophy**, is a bona fide record of the research work done by him under my supervision. The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

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## PREFACE

Chapter 2 of this thesis, "Strategic Interactions, Bargaining power and Stability of Joint Venture in an Emerging Nation", is published in Springer's Journal of Industry, Competition and Trade.

# ABSTRACT

The thesis has three empirical essays investigating innovation efforts in the context of India. Each chapter attempts to comprehend the crucial internal and external factors that channel, influence, and determine these efforts.

The first essay delves into Joint Venture (JV) as one of the critical drivers of innovation efforts in India and its implication for the JV's stability. The strategic interaction between a domestic and a foreign firm has been modelled, incorporating negotiations over equity shares and its implications for stability in the context of an emerging country. The foreign firm has superior technology, while the domestic firm has better local market knowledge. A rationale for the stability of the JV is found by modelling simultaneous innovation effort and bargaining power over equity share. Technological knowledge can empower the bargaining power under specific parameter configurations and assumptions, such that the firms will negotiate to agree over their equity shares and maintain the JV. The domestic firm's bargaining power and knowledge acquisition directly affect its R&D effort and threaten the JV's stability. Thus a probable situation where the firms may negotiate hard over equity shares but still maintain the JV is also deciphered.

In the second essay, role competition, which is a crucial external factor for innovation effort, is examined. It studies the persistence of Indian manufacturing firms' innovation efforts and how it gets affected by the extent of industry-wide competition and the import of technology. The study is based on a panel of listed firms observed continuously over ten years from 2006 to 2015. Using a dynamic panel structure with Heckman correction, evidence of the persistence of innovation effort among the firms is seen; however, the persistence diminishes as the industry level competition increases. The marginal effect of the competition is low, and it changes sign if external sources of R&D, such as technology and raw material import, are controlled. Hence, evidence indicates the 'path dependency' of R&D expenditures and persistence of innovation effort, but it is sensitive to the extent of competition in the firm's principal market and import. The findings also suggest that despite opening up the economy since the early 1990s, technology import is still complementing the domestic R&D in India and the persistence of innovation efforts.

The third essay investigates the role of STEM education of the board of directors of firms as a pivotal internal factor for determining innovation effort. It aims to understand the influence of a particular type of STEM education of corporate board members obtained at a specific set of STEM education institutes and its implications for firm com-

plexity. This question addressed in India's context is interesting because it unravels a mix of the board of directors' specific STEM educational backgrounds (IIT-JEE), India's fixation with that particular STEM education, and the broader implication for innovation effort. Based on the sample of Indian firms throughout 2006-2015, it has been found overall that having board members with IIT-JEE qualifications or more does enhance innovation effort to some extent. However, that positive effect mainly comes from directors who have IIT-JEE and a research degree (PhDs) rather than a sole IIT-JEE degree. Furthermore, R&D performing firms tend to be more complex and likely to hire board members with IIT-JEE degrees as their innovation effort increases. Hence, when it comes to the issue of the innovation effort, the dominant narrative of valuing solely particular STEM education (IIT-JEE) would not enhance the effort but focusing and prioritizing research education should play the more prominent role.

**KEYWORDS:** Strategic Interactions, Technology transfer, Innovation Effort, R&D, Persistence

JEL classification: L, O, F, C, G

## सार

इस शोध प्रबंध में भारत के संदर्भ में नवाचार प्रयासों की जांच करने वाले तीन अनुभवजन्य निबंध हैं। प्रत्येक अध्याय उन महत्वपूर्ण आंतरिक और बाहरी कारकों को समझने का प्रयास करता है जो इन प्रयासों को प्रभावित करते हैं और निर्धारित करते हैं।

पहला निबंध संयुक्त उद्यम (जेवी) में भारत में नवाचार प्रयासों के महत्वपूर्ण चालकों में से एक के रूप में और संयुक्त उद्यम की स्थिरता के लिए इसके निहितार्थ पर प्रकाश डालता है। एक घरेलू और एक विदेशी फर्म के बीच रणनीतिक बातचीत का मॉडल तैयार किया गया है, जिसमें इक्विटी शेयरों पर बातचीत और एक उभरते देश के संदर्भ में स्थिरता के लिए इसके निहितार्थ शामिल हैं। विदेशी फर्म के पास बेहतर तकनीक है, जबकि घरेलू फर्म के पास स्थानीय बाजार का बेहतर ज्ञान है। संयुक्त उद्यम की स्थिरता के लिए एक साथ नवाचार प्रयास और इक्विटी शेयर पर सौदेबाजी की शक्ति के मॉडलिंग द्वारा पाया जाता है। तकनीकी ज्ञान विशिष्ट पैरामीटर विन्यास और मान्यताओं के तहत सौदेबाजी की शक्ति को सशक्त बना सकता है, जैसे कि फर्म अपने इक्विटी शेयरों पर सहमत होने और संयुक्त उद्यम को बनाए रखने के लिए बातचीत करेंगे। घरेलू फर्म की सौदेबाजी की शक्ति और ज्ञान प्राप्ति सीधे उसके अनुसंधान एवं विकास प्रयासों को प्रभावित करती है और संयुक्त उद्यम की स्थिरता के लिए खतरा है। इस प्रकार एक संभावित स्थिति जहां फर्म इक्विटी शेयरों पर कठिन बातचीत कर सकते हैं लेकिन फिर भी जेवी को बनाए रखते हैं, को भी डिफ्रिक्ट किया जाता है।

दूसरे निबंध में, भूमिका प्रतियोगिता, जो नवाचार प्रयास के लिए एक महत्वपूर्ण बाहरी कारक है, की जांच की जाती है। यह भारतीय विनिर्माण फर्मों के नवाचार प्रयासों की दृढ़ता का अध्ययन करता है और यह उद्योग-व्यापी प्रतिस्पर्धा और प्रौद्योगिकी के आयात की सीमा से कैसे प्रभावित होता है। अध्ययन 2006 से 2015 तक दस वर्षों में लगातार देखी गई सूचीबद्ध फर्मों के एक पैनल पर आधारित है। हेकमैन सुधार के साथ एक गतिशील पैनल संरचना का उपयोग करते हुए, फर्मों के बीच नवाचार प्रयास की दृढ़ता का प्रमाण देखा जाता है; हालांकि, जैसे-जैसे उद्योग-स्तरीय प्रतिस्पर्धा बढ़ती है, दृढ़ता कम होती जाती है। प्रतिस्पर्धा का सीमांत प्रभाव कम है, और यदि अनुसंधान एवं विकास के बाहरी स्रोतों, जैसे कि प्रौद्योगिकी और कच्चे माल के आयात को नियंत्रित किया जाता है, तो यह संकेत बदल जाता है। इसलिए, साक्ष्य अनुसंधान एवं विकास व्यय की 'पथ निर्भरता' और नवाचार प्रयास की दृढ़ता को इंगित करता है, लेकिन यह फर्म के प्रमुख बाजार और आयात में प्रतिस्पर्धा की सीमा के प्रति संवेदनशील है। निष्कर्ष यह भी बताते हैं कि 1990 के दशक की शुरुआत से अर्थव्यवस्था को खोलने के बावजूद, प्रौद्योगिकी आयात अभी भी भारत में घरेलू अनुसंधान एवं विकास और नवाचार प्रयासों की दृढ़ता का पूरक है।

तीसरा निबंध नवाचार प्रयासों को निर्धारित करने के लिए एक महत्वपूर्ण आंतरिक कारक के रूप में फर्मों के निदेशक मंडल की एसटीईएम शिक्षा की भूमिका की जांच करता है। इसका उद्देश्य एसटीईएम शिक्षा

संस्थानों के एक विशिष्ट सेट पर प्राप्त कॉर्पोरेट बोर्ड के सदस्यों की एक विशेष प्रकार की एसटीईएम शिक्षा के प्रभाव और दृढ़ जटिलता के लिए इसके निहितार्थ को समझना है। भारत के संदर्भ में संबोधित यह प्रश्न दिलचस्प है क्योंकि यह निदेशक मंडल की विशिष्ट एसटीईएम शैक्षिक पृष्ठभूमि (आईआईटी-जेईई), उस विशेष एसटीईएम शिक्षा के साथ भारत के निर्धारण और नवाचार प्रयास के व्यापक निहितार्थ के मिश्रण को उजागर करता है। 2006-2015 के दौरान भारतीय फर्मों के नमूने के आधार पर, कुल मिलाकर यह पाया गया है कि आईआईटी-जेईई योग्यता या अधिक के साथ बोर्ड के सदस्य होने से कुछ हद तक नवाचार प्रयास में वृद्धि होती है। हालांकि, यह सकारात्मक प्रभाव मुख्य रूप से उन निदेशकों से आता है जिनके पास एकमात्र IIT-JEE डिग्री के बजाय IIT-JEE और एक शोध डिग्री (PhDs) है। इसके अलावा, आरएंडडी प्रदर्शन करने वाली फर्मों अधिक जटिल होती हैं और उनके नवाचार प्रयास बढ़ने पर IIT-JEE डिग्री वाले बोर्ड के सदस्यों को नियुक्त करने की संभावना होती है। इसलिए, जब नवाचार प्रयास के मुद्दे की बात आती है, तो केवल विशेष एसटीईएम शिक्षा (आईआईटी-जेईई) को महत्व देने की प्रमुख कथा प्रयास को नहीं बढ़ाएगी, लेकिन अनुसंधान शिक्षा पर ध्यान केंद्रित करने और प्राथमिकता देने से अधिक प्रमुख भूमिका निभानी चाहिए।

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