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## Abstract

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The present thesis sheds light on the potential synergistic effects of innovation strategies and policies in developing countries. The findings have contributed to the complementarity literature by expanding our understanding of complementarity assets that potentially exist in innovation. The main concerns are placed on investigating the interdependent relationships between technological sourcing strategies, and also the potential interactions between innovation obstacles.

Furthermore, this thesis also discusses the methodology in testing complementarity in the case of more than two activities. By comparing two commonly used one-sided multivariate hypotheses; it provides a detailed examination of their potential problems and statistical powers, and also gives implications on which hypothesis should be adopted across different model specifications. The Investment Climate Survey from the World Bank has been used as the main data source for the empirical analyses.

The first chapter introduces the topic of inquiry in this thesis and describes the data used in the empirical analysis. It follows by giving a concise outline of the remaining chapters.

The second chapter is a step towards understanding the concept of complementarity and reviews previous innovation studies in the literature that adopts the complementarity approach. It presents an insightful interpretation of complementarity between pairwise economic activities by using a hierarchical classification. Complementarity is broadly classified into two types based on whether or not it is embedded in a specific objective function: objective complementarity and behavioral complementarity. Further classifications in the lower level of hierarchy are also defined. Apart from elaborating different types of complementarity, chapter 2 also introduces the approaches adopted in empirical studies to test complementarity/substitutability. Three approaches are distinguished: CORR (Correlation approach), MP (Miravete and Pernías approach) and PROD (Production approach). Moreover, reviewing the previous studies that try to investigate complementarity in the innovation process, it shows the problems and limitations that exist in literature. The chapter on literature review provides a detailed discussion on these problems and limitations. It also explains how they will be addressed in this thesis.

Chapter three investigates the existence of complementarity between in-house R&D and external technology acquisition by using a panel data of Chinese manufacturing firms. It tries to explore

the impact of internal and external technology sourcing on firms' innovation and productivity performance in Chinese small- and medium-sized manufacturing firms. In particular, it estimates the returns of R&D and external technology purchasing (TP) and their possible complementarity or substitutability. It does so by distinguishing two performance measures: innovation in products or processes and labor productivity. Since size may matter in this regard, we estimate separately the relationships for firms with fewer than 100, between 100 and 300, and more than 300 employees. The findings show that in-house R&D seems to accelerate the assimilation of external know-how whereas external technology sourcing enhances the efficiency of in-house innovation activities. The results also exhibit some evidence of complementarity between in-house R&D and TP in raising the sales of new products per employee in small-sized Chinese manufacturing firms with 100 to 300 employees while R&D and TP are substitutes when it comes to raising labor productivity.

The fourth chapter is another empirical study to test potential synergistic effects between technological strategies by using firm cross-sectional data from 24 developing and least developed countries. In this chapter, we try to identify factors that determine the choice of a specific technological sourcing, as well as factors that foster the potential complementarity between them. It examines the roles of internal R&D efforts and external technology sourcing in fostering productivity in manufacturing firms. Three testing approaches are compared and adopted in the empirical analysis, namely CORR, PROD and MP (Miravete and Pernías approach, see chapter 4). The analysis emphasizes that in a cross-sectional analysis, the MP approach stands out compared with the other two approaches by providing a structural framework, which effectively corrects the bias caused by the correlation between unobservables. The empirical finding highlights the critical role of external technology acquisition in manufacturing industries across developing countries and exhibits signs of complementarity only in middle-income countries. The results also show that different approaches give different results.

Chapter five discusses different types of multivariate one-sided hypothesis defined to test pairwise complementarity among three or four activities. This chapter uses simulated datasets to compare the validity and efficiency of two types of hypotheses with different model specifications and sample sizes. The simulation results verify the potential bias which might exist in the non-exhaustive hypothesis formulation. Conclusions based on such hypotheses tend to be biased if the nature of the inequalities is not taken into account. Findings from this chapter also suggest that combining two tests of hypothesis always guarantees a more accurate conclusion in testing complementarity. In some situations, especially when the sample size is large and the R-square value is high for linear models, only one hypothesis testing can also provide adequate information to draw correct conclusions.

In order to gain a deeper understanding of the barriers to innovation, chapter six applies the complementarity approach to firm level data from the Investment Climate Survey 2009 Eastern European

and Central Asian countries (EECA) to investigate if there exists complementarity or substitution among four types of obstacles to innovation across different sectors, income levels and size groups. The approach of testing pairwise complementarity when more than two activities occur, is borrowed from chapter 5. Findings from this chapter provide a clear explanation of complementarity between obstacles to innovation: the presence of one obstacle eases the hampering effect of the second obstacle to innovation. The finding suggests that a policy package that attempts to tackle both obstacles is preferred. Policies that only eliminate one obstacle would amplify the deterring effects from the other. A substitutive relationship between obstacles, on the other hand, suggests removing one obstacle is enough because its presence would worsen the negative effects induced by the other.

The final chapter concludes the dissertation, providing a number of policy implications and it recommends avenues for future studies.