



# Import and innovation: Evidence from Chinese firms<sup>☆</sup>



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## ABSTRACT

This paper investigates the relationship between imports and innovation by importing firms. We first construct a theoretical model in which imports stimulate innovation through cost-reducing knowledge spillovers. We then employ a combined micro dataset of Chinese manufacturing firms to estimate the effects of imported intermediates on the firm's R&D investment. The dataset allows us to construct firm-year level instruments for importing and exporting that are uncorrelated with the innovation decision of the firm. Our estimations find that: (1) importing intermediates tends to increase importing firms' R&D intensity; and that (2) exporting also increases importing firms' R&D intensity. Examining the channels through which importing affects innovation, we find that importing from high-income sources has a greater impact on innovation. High-tech firms tend to experience greater increases in innovation intensity, as do private firms. Our results are supported by a series of robustness checks.

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## 1. Introduction

China's continuous economic rise has attracted worldwide attention. Along with its economic upsurge, the Chinese economy has exhibited a noteworthy feature: the concurrent expansion of import value and steady growth in R&D intensity. China's import value, which has grown from 0.13 trillion USD to 1.95 trillion USD over the last 3 decades, has been the second largest in the world for over 6 years. Meanwhile, the R&D intensity<sup>1</sup> has risen from 0.23% in 1995 to 1.15% in 2012, making China one of the few developing countries with an R&D intensity above 1%.

Observing the simultaneous rise of import value and R&D intensity, one may speculate that imports may enhance R&D intensity. In this paper, we formalize this prediction by showing that importing materials from technologically advanced economies can stimulate indigenous firms' innovative activities through cost-reducing knowledge spillovers. Although a large

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<sup>1</sup> R&D intensity is measured by the ratio of R&D expenditure to GDP, which is calculated by using the R&D expenditure of all industrial firms recorded by China's National Bureau of Statistics (NBS).

body of research has shown that imported intermediate goods enhance firms' productivity,<sup>2</sup> the relationship between imports and innovative activities has been studied much less. One exception is the work of [Bøler et al. \(2015\)](#), which shows that R&D and international outsourcing are complementary activities. With less expensive R&D, firms tend to increase R&D investment as well as imports, which ultimately contributes to the reduction of production costs both at the micro and the macro levels. Instead of investigating the complementary relationship between imports and R&D investment, we focus on one direction, that is, on the mechanism through which importing stimulates innovative activities. Specifically, we concentrate on the effect of knowledge spillovers on R&D cost reductions. Using a dataset of Chinese manufacturing firms, we find that imports have a positive impact on innovation.

China's innovation activity has benefited greatly from the open policy that was established in the late 1980s. Foreign direct investment (FDI) has been well documented as a contributor to China's regional innovation capacity and patent surge ([Fu, 2008](#); [Hu and Jefferson, 2009](#)). Moreover, importing has spurred Chinese firms' incremental innovation by creating competitive pressure<sup>3</sup> ([Lu and Ng, 2012](#)). Yet the corresponding papers, which focus on the influence of competitive pressure on innovation, have neglected to consider that firms can innovate at a lower cost by learning from the technology embodied in imported materials from advanced economies.

This study aims to fill a gap in the existing literature by directly linking firms' import behavior with their innovation activity. We first construct a theoretical model to illustrate that imports can stimulate innovation through cost-reducing knowledge spillovers. Our model has three defining characteristics: first, it includes firm heterogeneity as in the Melitz model ([Melitz, 2003](#)); second, it incorporates firms' innovative behavior as in [Atkeson and Burstein \(2010\)](#); and third, it considers the decision to import, which enables us to analyze the impact of imports on firms' investment in innovation.

Our model is different from the "trapped factor" model of [Bloom et al., \(2013\)](#). In their model, labor and capital are "trapped" factors in that workers have some firm-specific human capital and capital has firm-specific adjustment costs. When import competition from low-wage countries removes the market for a firm's current products, these trapped factors become useless within the firm. This decreases the shadow value of these factors as inputs into innovation or the production of new goods, which ultimately lowers the opportunity cost of innovation. This leads firms to invest more in research to create new goods. In contrast, we focus on knowledge spillovers incurred by importing materials from foreign countries. In our model, knowledge diffusion increases importing firms' knowledge accumulation and reduces their innovation costs, which in turn enhances their returns on innovation.

To examine the relationship between imports and innovation, we combine the Chinese Manufacturing Firms Database and the China Customs Trade Database from 2000 to 2006. This matched dataset has two features. First, it contains firm-level R&D expenditures,<sup>4</sup> which allows us to use R&D intensity as a measure of innovation.<sup>5</sup> R&D has been suggested to be a more representative indicator of innovation than patents because it measures firms' independent innovation investment. In China, innovative firms are reluctant to apply for patents because the protection of intellectual property rights has been weak ([Hu and Jefferson, 2009](#)). This makes patent applications a particularly unsuitable indicator of innovation by Chinese firms. In addition, R&D intensity is consistent with our model's prediction that imports influence innovation intensity rather than innovation volume or outcomes, such as patents. Second, the dataset includes detailed information on firms' importing status, such as the category of each imported product and its source. This information allows us to open the "black box" of an import bundle to analyze the effect of imported intermediates on innovation. Moreover, we can use records of import sources to conduct an in-depth investigation of the underlying mechanism.

To address potential endogeneity problems, we construct instruments for importing and exporting at the firm-year level. Following [Hummels et al. \(2014\)](#), we employ the exchange rate and world export supply as instruments for intermediates imports, and the exchange rate and world import demand as instruments for exports. Because China has experienced a significant tariff reduction after joining the World Trade Organization (WTO) ([Lu and Yu, 2015](#)), we also use the import tariff as an instrument for the importing of intermediate inputs.

Our main findings are that (1) importing of intermediates increases the importing firms' R&D intensity and that (2) exporting also tends to increase their R&D intensity. Examining the channels through which importing can affect innovation, we find that importing from high-income sources has a greater positive impact on innovation and that high-tech firms and private firms experience a greater gain in innovation intensity.

This study makes the following contributions to the existing literature. First, it contributes to the literature on trade and technology. A large body of literature has documented the critical role of trade in stimulating technological change, although the mechanism varies from market size and knowledge diffusion, to competition in the product market. However, most

<sup>2</sup> Most of these studies focus on developing countries: [López and Yadav \(2010\)](#) on Chilean plants, [Goldberg et al. \(2008\)](#) on India, and [Halpern et al. \(2015\)](#) on Hungarian manufacturing firms.

<sup>3</sup> This phenomenon is also found in other countries. [Teshima \(2008\)](#) has found evidence that a reduction of import tariff has increased Mexican firms' R&D investment; [Gorodnichenko et al. \(2010\)](#) have found a positive correlation between trade liberalization and innovation using data from 27 emerging economies.

<sup>4</sup> R&D expenditures refer to the real expenditure of surveyed units on their R&D activities, including the direct expenditure on R&D activities, the indirect expenditure of management and services on R&D activities, the expenditure on capital construction and material processing by others, excluding the expenditure on production activities, and fees transferred to cooperating and entrusted agencies on R&D activities.

<sup>5</sup> Of course, employing this measurement raises some concerns. [Gorodnichenko et al. \(2010\)](#) have noted that R&D is an input rather than an output of innovation. They argue that R&D may fail to capture the feature of innovation in emerging economies where most firms are engaged in imitation and adaptation.

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