

# Imports, Productivity Growth, and Supply Chain Learning

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**Summary.** — We present evidence that importing is a source of international technology transfer. Using a detailed panel of Indonesian manufacturers, our analysis shows that firms in industries supplying increasingly import-intensive sectors have higher productivity growth than other firms. This finding suggests that linkages through vertical supply relationships are the channel through which import-driven technology transfer occurs. To our knowledge, these are the first firm-level results showing that downstream imports play a role in productivity gains. Together with the literature linking FDI and exporting to technology spillovers, the results provide a third component to the argument that trade and openness promote economic growth.

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## 1. INTRODUCTION

The international economics literature has had a lasting interest in the relationship between trade and technology transfer (Keller, 2000; Saggi, 2002; Werner, 2002). Early studies using aggregate country-level data suggest trade is an important driver of economic growth. These findings have prompted a stream of research on firm-level mechanisms that support these aggregate findings.

Existing research has mostly focused on two mechanisms: exports by local firms and foreign direct investment (FDI) by multinational firms. The majority of studies associate both mechanisms with increases in productivity, although the direction of the causality is still under scrutiny. But much less effort has been devoted to the export counterpart, imports, which are the focus of this paper. In particular, few studies have used firm-level data to examine imports as a mechanism for technology transfer (Amiti

& Konings, forthcoming; Fernandes, 2007; Keller & Yeaple, 2003; MacGarvie, 2006; Muendler, 2004), and the results so far have been mixed.

This paper asks whether imports can improve firm technological capabilities, as measured by productivity gains. Using a rich panel dataset on Indonesian manufacturers from 1988 to 1996, we examine factory productivity growth and its relation to imports in downstream industries. We control for the potential endogeneity between imports and productivity by

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conditioning on static industrial sector and firm-level attributes and by considering only import activity largely exogenous to the focal firm. We find strong evidence that firms selling to sectors that rely more on imports have greater productivity growth than other firms. This finding is consistent with the hypothesis that vertical supply relationships are an important mechanism through which import-driven technology transfer occurs. Identifying imports as a source of international technology transfer adds a critical third component, along with exports and FDI, to the argument that trade promotes economic growth.

The paper is organized as follows. The next section discusses the theoretical and empirical literature on the relationship between trade, technology, and productivity growth with particular attention to the role of imports and the importance of the supply chain structure. Section 3 provides some background on the liberalization of Indonesia's trade regime and Section 4 discusses the data. Section 5 highlights our econometric identification strategy, Section 6 presents the results, and Section 7 concludes.

## 2. TRADE, TECHNOLOGY TRANSFER, AND FIRM PRODUCTIVITY

### (a) *Trade and technology transfer: what do we know?*

Most north-south models of endogenous economic growth emphasize a product life cycle perspective of trade (see, e.g., Grossman & Helpman, 1995). They posit that innovative products are created in the North and, due to lower relative wages, Southern firms can undercut Northern producers' prices if they can obtain the relevant technology. Firms in catch-up economies thus have incentives to acquire advanced technologies created elsewhere and the literature often cites cross-border knowledge flows as a channel for this acquisition (see Keller, 2001; Saggi, 2002, for recent reviews of these issues). However, empirical evidence of international knowledge flows and their impact on technological capabilities in the less developed environment is limited.

The early and perhaps best known literature exploring international knowledge spillovers used country-level data to correlate economic growth with increased openness to trade. Despite many papers addressing this issue, no consensus exists. For example, Sachs and Warner

(1995) find empirical support for the view that open economies grow faster, while Rodriguez and Rodrik (1999) discuss the problems with existing empirical work and argue against a causal relationship between openness and growth. More targeted research has addressed the potential effect of international knowledge spillovers. Analyzing data for the OECD, Eaton and Kortum (1996) attribute more than 50% of the growth in some countries to innovation in the United States, Germany, and Japan. Also using country-level data, Coe and Helpman (1995) and Coe *et al.* (1997) likewise suggest that international technology spillovers are substantial and that trade plays an important role in these spillovers. Connolly (2003) specifically identifies imports in high technology sectors as a major source of productivity and economic growth. In contrast, Keller (1998) performs a similar analysis to Coe and Helpman (1995) and Coe *et al.* (1997), but finds no statistical support to relate trade and technology diffusion. Recent studies that use industry-level data (Feenstra, Markusen, & Zeile, 1992; Keller, 1997, 2000) or that separate general trade from capital-goods trade (Xu & Wang, 1999) again show imports to increase productivity growth. A limitation of these studies is that, by using country- or industry-level data, they have few observations and often cannot establish causality. In addition, it is difficult to isolate the channels that contribute to technology transfer and results differ with the particular definitions of the variables in the analysis.

The limitations of country- and industry-level data motivated efforts to use firm-level data to evaluate the role of trade in growth and international knowledge spillovers. An early example is Irwin and Klenow (1994), which studied the semiconductor industry and found technological externalities to be as large internationally as they were in the firm's home economy. In this new firm-level research, two aspects of trade have caught most of the researchers' attention: exports and foreign direct investment (FDI). Several studies have investigated whether entering a foreign market through exporting is a mechanism through which firms learn (e.g., Aw, Chung, & Roberts, 2000; Bernard & Jensen, 1999; Blalock & Gertler, 2004; Clerides, Lach, & Tybout, 1998; Delgado, Fariñas, & Ruano, 2002; Roberts & Tybout, 1997; Van Biesebroeck, 2003). Results are mixed and vary with market characteristics and the initial conditions of the firms that decide to export.

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