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Does productivity growth fall after the adoption of new technology?☆

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Abstract

A number of theoretical models of technology adoption have been proposed that imply that measured productivity growth may initially fall and then later rise after the adoption of a new technology. This paper investigates whether or not this implication is a feature of plant-level data from the Colombian manufacturing sector. We focus on technology adoption embodied in new equipment. We find evidence that the effect of a large equipment purchase is initially to reduce plant-level total factor productivity growth. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

A number of theoretical models of technology adoption have been proposed with the following feature. After a production unit adopts a new

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technology, not all the expertise in the old technology transfers to the new technology and there is a period of technology-specific learning. One implication of these theories is that measured productivity growth may at first fall and then later rise after adopting a superior technology.[1]

In this paper we provide micro-evidence on the question of whether productivity growth first falls and later rises after the adoption of new technology embodied in new equipment. We are motivated to address this question as micro-evidence on productivity growth is key for issues related to aggregate productivity growth dynamics. Consider an example. Greenwood (1996), Hornstein and Krusell (1996) and Greenwood and Yorukoglu (1997) hypothesize that an increase in the pace of embodied technological change is the cause of the aggregate productivity growth slowdown experienced by the majority of the advanced economies since the 1970s. A microeconomic mechanism behind this hypothesis is that existing production units experience a temporary fall in productivity growth after adopting new technology embodied in new equipment.[2] At the aggregate level, productivity growth could temporarily slow down when an increased fraction of production units make such investments. To evaluate such a hypothesis at a quantitative level, one would need micro-evidence on productivity growth dynamics after a production unit adopts new technology.

To address the question posed above, we identify the adoption of a new technology at a particular production unit with the purchase of equipment. In particular, we will say that those plants making equipment purchases that increase their real equipment stocks by more than a critical fraction are adopting new technology embodied in new equipment. A number of remarks are in order in regards to this assumption. First, an equipment purchase is precisely the mechanism of technology adoption emphasized in the literature. Second, the evidence in the papers by DeLong and Summers (1991, 1993) and Greenwood et al. (1997) suggests that equipment investment may be a quantitatively important source of technology adoption.[3] Third, in plant-level data it is the case that investment displays a lumpy pattern at the plant level with the bulk of plants making little or no purchases of equipment in a given

[1] Zeckhauser (1968), Parente (1994, 1998), Klenow (1998) and Yorukoglu (1998) provide theoretical models with these features.

[2] We emphasize existing production units since in the data set that we explore the vast majority of equipment investment occurs at existing plants rather than at brand-new plants. Gort and Boddy (1967, p. 398) report a similar finding for the US manufacturing sector.

[3] DeLong and Summers (1991, 1993) show that the growth rate of labor productivity across countries is highly positively correlated with the fraction of equipment investment in GDP. Greenwood et al. (1997) argue that the bulk of postwar US growth in labor productivity can be attributed to technological change embodied in new equipment.