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Technology spillover and TFP growth: A spatial Durbin model

A. Tientao*, D. Legros[1], M.C. Pichery[2]

Universite de Bourgogne, Laboratoire d'Economie de Dijon, UMR 6307 – CNRS, 2 boulevard Gabriel, BP 26611, 21066 DIJON CEDEX, France

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ABSTRACT

Beginning with a model in which technological progress is reflected by product variety, we provide a structural approach to estimate technology spillovers allowing for spatial interdependencies. To this end, we first present a theoretical model of TFP growth by decomposing TFP into quality and variety components. We address the quality component by introducing a country's distance to the technological frontier. Quality is assumed to be a negative function of the technological gap of country *i* with respect to its own technological frontier. This technological threshold is defined as the geometric means of knowledge levels in all countries. We deal with the variety component by using R&D expenditure combined with human capital stocks. In doing so, we show how a spatial Durbin model can be obtained from a theoretical model and thus better capture technology spillovers. Our TFP growth model is estimated from a sample of 107 countries for the period 2000–2011. The main focus is on the role played by technological spillovers. They impact productivity growth substantially, as do traditional factors such as R &D and human capital stock. Technological spillovers are captured by the spatial autocorrelation coefficient and the indirect impact of R &D.

* Corresponding author. Tel.: +33 3 8039 5430.
E-mail addresses: aligui.tientao@u-bourgogne.fr (A. Tientao), diego.legros@u-bourgogne.fr (D. Legros), marie-claude.pichery@u-bourgogne.fr (M.C. Pichery).
[1] Tel.: +33 3 8039 3520.
[2] Tel.: +33 3 8039 5434

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1. Introduction

Continued economic growth depends on our ability to maintain and increase current levels of innovation. Governments implement a wide range of policies to promote innovation including in R&D, intellectual property rights, education, labour markets, financial markets and product market regulations. Improving the business environment in order to encourage innovation is an especially important policy area and open trade is conducive to the free flow of technologies across borders, enhanced competitive pressure and the opening up of new markets. International trade provides a way for global firms to exploit innovations, and it is also a major source of innovation (Grossman and Helpman, 1991a,b).

There is a mass of theoretical research showing that international openness impacts growth and productivity positively in various ways (Aghion and Howitt, 2009, Chapter 15). Trade can boost productivity because producers gain access to new imported varieties of inputs. This can reduce the cost of innovation engendering more variety creation in the future. The effect of increased product variety on productivity is thought to depend upon the elasticity of substitution among different varieties of a good, and/or upon shifts in the apportionment of expenditure among new, remaining, and disappearing goods. Increasing the number of varieties does not appear to affect productivity much if new varieties are close substitutes for existing varieties or if the proportion of new varieties is small relative to existing ones (Broda et al., 2006).

Since the seminal paper of Coe and Helpman (1995), several empirical studies have documented that cross-country R&D spillovers, through the channel of trade flows, have been an important engine of the total factor productivity (TFP) growth in the industrialized countries (Coe et al., 1997, 2009; Bayoumi et al., 1999; Crespo et al., 2004). Coe and Helpman (1995) test the prediction of the trade and growth models of Grossman and Helpman (1991a,b) and Rivera-Batiz and Romer (1991) in which foreign R&D creates new intermediate inputs and perhaps spillovers that the home country can access through imports. Subsequent studies reveal that productivity spillovers arising from international openness are largely determined by the host country's capability to absorb and innovate. True, a large technology gap between local and foreign firms may signal considerable “catch-up” potential; however, it may also indicate the very poor absorptive capabilities of the local partners (Blomström and Sjholm, 1999). The availability of adequate human capital and basic infrastructure facilities is crucial for the adoption and development of advanced technologies (Borensztein et al., 1998). Empirical studies have reported that trade enhances competitive pressure. For instance, fierce competition arising from the entry of multinational corporations (MNCs) is found to be detrimental to the economy because it crowds out the least efficient domestic firms (Kokko, 1996).

Other channels of international technology diffusion have been examined. For example, Keller and Yeaple (2009) examine R&D spillover by substituting bilateral measures of Foreign Direct Investment (FDI) for imports. Lee (2006) uses bilateral technological proximity and patent citations between countries while Keller (2002) uses geographic location.

The studies that address the impact of trade on technology spillovers give little scope to spatial interdependencies because trade is by nature spatial. Ertur and Musolesi (2013) point this out and estimate an empirical model of R&D spillovers among countries by focusing on the issue of cross-sectional dependence. This paper proposes an alternative method for estimating technology spillovers taking into account spatial interdependencies. More precisely, we provide a structural approach to estimate technology spillovers by showing how a spatial Durbin model (SDM) can be obtained from a theoretical model. To the best of our knowledge, this issue has not been addressed in previous studies.

Based on a model in which technological progress shows up as an expansion of the number of varieties of products, we first present a theoretical model of TFP growth by decomposing TFP into quality and variety components. We address the quality component by determining a country's distance from the technological frontier. A country that is far from the technology frontier derives a certain advantage from this deficit, because it can grow rapidly simply by adopting technologies that have already been developed in more advanced countries. Technology transfer will stabilize the gap between rich and poor countries, allowing the poor countries to grow as fast as the rich. We assume that quality is a negative function of the technological gap of country i with respect to its own