Economics Letters 120 (2013) 450–453

Contents lists available at SciVerse ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Growth spillover through trade: A spatial dynamic panel data approach☆

Chun-Yu Ho [a], Wei Wang [a], Jihai Yu [b,*]

[a] Department of Economics, Antai College of Economics and Management, Shanghai Jiao Tong University, China
[b] Guanghua School of Management, Peking University, China

HIGHLIGHTS

- We investigate the growth convergence of 26 OECD countries over the period 1971–2005.
- We extend the Solow growth model by considering the spillover effect due to bilateral trade.
- The spillover effect is significant, but does not have strong persistence.
- The rate of growth convergence is higher after considering the spillover effect.

ARTICLE INFO

Article history:
Received 28 December 2012
Received in revised form
24 April 2013
Accepted 30 May 2013
Available online 6 June 2013

JEL classification:
O33
O47
O51

Keywords:
Convergence
Dynamic panels
Spatial effect
Spillover

ABSTRACT

This paper empirically examines the international spillover of economic growth through bilateral trade. We extend the Solow growth model with a spatial autoregressive term and a spatial time lag term, and estimate such a model with a sample of 26 OECD countries over the period 1971–2005. We find that there is a positive spillover effect of growth from one country to its trade partners. The implied rate of convergence is higher after including the spatial terms.

1. Introduction

Since the seminal work by Mankiw et al. (1992), there has been a vast empirical literature on economic growth across countries. This paper empirically examines the international spillover effect of growth from one country to its trade partners with the Solow growth model.

Recently, the spatial issue has been widely explored in regional and growth economics. In neoclassical growth theory, economies are assumed to be independent, and they do not interact with each other. However, technological advances in one economy might be transmitted to other economies. Also, international trade connects economies, thus creating output comovement among countries with large trade volume. Consequently, the closed economy assumption might not be valid, and we need to take into account possible spatial correlation. From the econometric point of view, spatial dependence leads to unreliable statistical inference if the spatial effect is present but omitted. Hence, to study growth convergence in an open economy, we adopt a spatial panel data model approach.

There is a growing literature suggesting that technological spillover is important to explain economic growth across countries and regions. Ertur and Koch (2007) and Yu and Lee (2012) study the convergence across countries and US states, respectively, by taking into account the spatial effect. Both studies find a significant

☆ Yu acknowledges funding from National Science Foundation of China (Grant No. 71171005).

* Correspondence to: Room 360, Guanghua School of Management, Building #2, Peking University, Beijing, 100871, China. Tel.: +86 10 62760702; fax: +86 10 62753624.

E-mail addresses: jihai.yu@gmail.com, jihai.yu@gsm.pku.edu.cn (J. Yu).

0165-1765/$ – see front matter © 2013 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.econlet.2013.05.027

spatial effect, and the rate of convergence is higher after taking into account the spatial correlation. However, both studies use a time-invariant spatial weight matrix constructed from the physical distance between economies, which implicitly assumes that the relative dependences among different economies are constant over time.

The present paper employs a spatial dynamic panel data (SDPD) model with time-varying spatial weight matrices to estimate the Solow growth model. Our approach incorporates the situation where the spillover effects can be influenced by the trade volumes that are time varying. Our results show that there is a positive spillover effect of growth from one country to its trade partners through bilateral trade. We also show that the implied rate of convergence is higher after the inclusion of spatial terms in the growth model.

Our work differs from previous studies using spatial econometric model to examine economic growth in two aspects. First, in contrast to Ertur and Koch (2007), we employ an SDPD model to estimate the growth model, so that we can avoid the omitted variable bias in the cross-sectional regression by including the country and time fixed effects. Second, in contrast to Yu and Lee (2012), we allow a couple of time-varying explanatory variables (X_t) in the model to capture the labor and capital in Solow growth model.[1] And we also allow the weight matrices to be time varying instead of time invariant in order to estimate the time-varying spillover effect through bilateral trade on economic growth.

The rest of the paper is organized as follows. Section 2 introduces the model and estimation equation. Section 3 presents the data, and Section 4 reports the empirical results. Section 5 concludes.

2. Model

Consider the Cobb–Douglas production function $Y_t = K_t^{\alpha}(A_t L_t)^{1-\alpha}$, where $0 < \alpha < 1$.[2] The labor-augmenting technological progress A grows at rate g exogenously, i.e. $A_t = A_0 \exp(gt)$, and the labor L grows at rate n exogenously, i.e. $L_t = L_0 \exp(nt)$. Approximating around the steady state, Mankiw et al. (1992) derive the following empirical growth model for output per unit of labor as follows:

$$\Delta \ln Y_{it} = -(1-e^{-ct}) \ln Y_{i0} - \frac{\alpha(1-e^{-ct})}{1-\alpha} \ln(N_i + g + \delta) + \frac{\alpha(1-e^{-ct})}{1-\alpha} \ln(S_i) + (1-e^{-ct}) \ln A_{i0} + gt.$$

The parameter c is the common rate of convergence across countries. The explanatory variables include labor growth rate (N), exogenous technical progress rate (g), capital depreciation rate (δ), and saving rate (S). We assume an exogenous technical progress rate, and we assume the capital depreciation rate to be constant across countries, i.e. $g + \delta = 0.05$, as in Mankiw et al. (1992), Islam (1995), and Ertur and Koch (2007).

To incorporate the economic growth spillover effects relating to bilateral trade, we augment the empirical growth model with a spatial autoregressive term and specify a panel data model as follows:

$$\ln Y_{it} = \lambda \sum_{j=1}^{n} w_{ij,t} \ln Y_{jt} + \gamma \ln Y_{i,t-1} + \beta_1 \ln(N_{it} + 0.05) + \beta_2 \ln S_{it} + \delta_i + \mu_t + u_{it}. \quad (1)$$

The dependent variable is Y_{it}, which is the real GDP per unit of labor in current year. $Y_{i,t-1}$ is the real GDP per unit of labor five years before. N_{it} is the average annual working-age population growth over the last five years, where $N_{it} + 0.05$ proxies the sum of the working-age population growth rate, exogenous technical progress rate, and capital depreciation rate in the model. S_{it} is the average investment share in GDP over the last one to five years, which can proxy the saving rate in the model. Finally, the common convergence rate per year estimated from a five-year interval sample is given by $c = \frac{-\ln \gamma}{5}$.

We include a spatial autoregressive term $\sum_{j=1}^{n} w_{ij,t} \ln Y_{jt}$ to estimate the spillover effect of growth for a country from the growth of its trade partners. There are two influential bodies of literatures suggesting that international trade is an important channel for transmitting growth across countries. First, empirical studies consistently show international trade is important in transmitting output movement across countries at different frequencies (such as, Frankel and Rose, 1998; Baxter and Kouparitsas, 2005; Cerqueira and Martins, 2009; Fidrmuc et al., 2012). Second, countries can acquire foreign knowledge through importing goods that embody technological know-how. In a seminal article, Coe and Helpman (1995) show that domestic productivity depends on the import share weighted sum of R&D expenditure in other countries, which indicates that trade promotes knowledge flows and technology transfer between trading partners. Recently, Ertur and Koch (2011) adopted this approach to use bilateral trade flow (average over the period 1990–2000) as a spatial weight matrix in their empirical growth study with a cross-sectional group of countries. Therefore, we exploit the panel structure, extending this idea to use bilateral trade flow (the sum of export and import flows) in last period to construct the time-varying spatial weights, $W_t = [w_{ij,t}]_{i,j=1}^{n}$. The (i, j)th entry of the weight matrix W_t is the bilateral trade flow (nominal US dollar value) of country i and j at time $(t-1)$.[3] The diagonal elements of W_t are all 0, and each W_t is row normalized.[4]

The equation also includes a full set of country dummies, δ_i. These country dummies capture any time-invariant country characteristics that affect its rate of technological progress. Additionally, a full set of time dummies μ_t is included to capture common shocks to the growth across countries. The error term u_{it} captures all other omitted country factors, with $E(u_{it}) = 0$ for all i and t.

In a recent work, Tao and Yu (2012) performed Monte Carlo experiments, showing that there are significant biases in regression estimates if a relevant spatial time lag is omitted, while there is no obvious efficiency loss if an irrelevant spatial time lag is included. Therefore, we estimate the following SDPD model with a spatial time lag term as a robustness check:

$$\ln Y_{it} = \lambda \sum_{j=1}^{n} w_{ij,t} \ln Y_{jt} + \rho \sum_{j=1}^{n} w_{ij,t-1} \ln Y_{j,t-1} + \gamma \ln Y_{it-1} + \beta_1 \ln(N_{it} + 0.05) + \beta_2 \ln S_{it} + \delta_i + \mu_t + u_{it}. \quad (2)$$

[1] In the model specification of Yu and Lee (2012), all the explanatory variables are collected into the individual fixed effects, which implicitly implies that the explanatory variables are time constant. Therefore, their model does not have labor and capital in the regression.

[2] As a robustness check, we estimate an augmented Solow growth model with human capital, but the coefficient of human capital is statistically insignificant in most specifications. The empirical results of the augmented Solow growth model are available upon request.

[3] In the spatial literature, the weight matrix is assumed to be exogenous to the dependent variable. Here, because Y_{it} may affect the trade flow in time t, we lag the trade flow one period to form the weight matrices in order to avoid the possible endogeneity problem.

[4] Since the weight matrices are all row normalized, it does not matter whether nominal or real terms of the trade volume are used.