IMPACT OF FOREIGN DIRECT INVESTMENT ON ECONOMIC GROWTH: EVIDENCE FROM OECD COUNTRIES

Andrea Furková
Department of Operations Research and Econometrics
Faculty of Economic Informatics, University of Economics in Bratislava

Introduction

- Conflicting predictions concerning the economic growth – foreign direct investment (FDI) inflow relation. According to the theory and empirical literature economic growth may induce FDI inflow, and FDI may also stimulate economic growth.
- Many economists agree that FDI leads to an increased rate of economic growth (e.g. impact on capital stock, technology transfer, skill acquisition)
- Reverse relationship, economic growth may induce FDI inflow (e.g. FDI is seeking consumer markets)
- Many empirical studies attempt to identify causality between FDI and GDP. This increased interest issues from mixed empirical evidence.

The effects of FDI on the economic growth have been shown to be **positive** in numerous empirical studies:

•Borensztein et al. (1998) detected positive impact FDI on GDP, but the magnitude of this effect depends on the level of human capital.

• De Mello (1999) supposed positive effect FDI on GDP, but the contributions of FDI depends on primarily host country characteristics, mainly the quantum of skilled labor.

•Johnson (2006) demonstrated that FDI inflow increased economic growth in developing countries, but not in advanced nations.

Negative effect: e.g. Moran (1998), Wijeweera et. al. (2007)

Reverse link between economic growth and FDI:

Veugelers (1991), Taylor (1999), Trevino at al. (2002)

Goal of the paper:

- to make a contribution to the empirical literature on the relationships between economic growth and FDI inflows in host countries

- As most of the empirical studies in this field have employed the least squares method to examine the relationship between examined variables, our paper exploits a stochastic production function approach. The model contains input factor variables as well as several variables as inefficiency variables. This approach allows us to distinguish the effects of FDI on economic growth via technical efficiency and efficiency change and quantify the effects of FDI, along with other variables, on efficiency levels.

METHODOLOGY FOR ANALYZING FDI AND ECONOMIC GROWTH RELATIONSHIP

Stochastic Frontier Analysis – time invariant efficiency

- Based on econometric theory and pre-specified functional form is estimated and inefficiency is modeled as an additional stochastic term.

The Stochastic frontier production function model (Cobb-Douglas form for panel data):

$$\ln y_{it} = \beta_0 + \sum_n \beta_n \ln x_{nit} + v_{it} - u_i \qquad i = 1,\ldots,N \quad t = 1,\ldots,T$$

$$\varepsilon_{it} = v_{it} - u_i \qquad u_i \geq 0$$

y_{it} - observed output quantities of the *i*-th unit in year *t*,

x_{it} - observed inputs quantities of the *i*-th unit in year *t*,

u_i - non negative time-invariant random variables capturing time-invariant technical inefficiency,

v_{it} - random variables of *i*-th unit in year *t* reflecting effect of statistical noise

Maximum likelihood estimation (ML)

- Distribution assumptions:

  $u_i \sim \text{iidN}^+(0,\sigma_u^2)$ or $u_i \sim \text{iidN}^+(\mu,\sigma_u^2)$, $v_{it} \sim \text{iidN}(0,\sigma_v^2)$

- Maximization of the log likelihood function
- The individual estimates of the technical inefficiency:

  JLMS decomposition - the conditional distribution of u_i , conditional mean $E(u_i|\varepsilon_{it})$ or conditional modus $M(u_i|\varepsilon_{it})$ of this distribution can be used as a point estimator for u_i

- The individual estimates of the technical efficiency:

$$TE_i = \exp\left\{-E(u_i \mid \varepsilon_{it})\right\}$$

Analyzing Efficiency Behavior

Two questions:

- What is the behavior of efficiencies over time? Are they increasing, decreasing or constant?
- What explains the variations in inefficiencies among units and across time?

Time behavior of inefficiencies

Assumption:

$$u_{it} = u_i + \beta_t$$

Model:

$$\ln y_{it} = \beta_{0t} + \sum_n \beta_n \ln x_{nit} + v_{it} - u_{it} \quad i = 1,\ldots,N \quad t = 1,\ldots,T$$

- Cornwell, Schmidt and Sickles, Lee and Schmidt, Kumbhakar, Battese and Coelli

Technical Inefficiency Effects Model

Inefficiencies are assumed to be a function of a set of explanatory variables associated with inefficiency of units over time :

$$u_{it} = \mathbf{z}_{it}^{T} \delta + w_{it}$$

where

$\mathbf{z}_{it}$ - vector of variables which may influence the efficiency of units

δ - vector of unknown parameters to be estimated

$w_{it} \sim$ iid N $(0, \sigma_w^2)$ – random variables reflecting effect of statistical noise

$u_{it} \sim$ iid $N^{+}(\mathbf{z}_{it}^{T}\delta, \sigma_u^2)$ - non negative time-varying random variables capturing time-varying technical inefficiency

Model specification and Data

Data: unbalanced panel data set (266 observations) for 30 OECD countries observed over a period from 2002 to 2010

Production function specification (translog form)

Time varying technical efficiency (estimation method ML):

$$\ln Y_{it} = \beta_0 + \beta_1 \ln C_{it} + \beta_2 \ln L_{it} + (1/2)\left[\begin{array}{l}\beta_{11}(\ln C_{it})^2 + \beta_{22}(\ln L_{it})^2 \\ + \beta_{12}(\ln C_{it})(\ln L_{it})\end{array}\right] +$$

$$+ \beta_{13}(\ln C_{it})t + \beta_{23}(\ln L_{it})t + \beta_{33}t^2 + v_{it} - u_{it} \qquad i = 1,\ldots,N \quad t = 1,\ldots,T$$

where

$$u_{it} = \delta_1 \ln FDI_{it} + \delta_2 \ln Corruption_{it} + \delta_3 \ln Openness_{it} + w_{it}$$

Factor Inputs:

•Capital (*C*) expressed as Gross Capital Formation (in constant 2000 USD millions)

•Labor (*L*) labor defined as civilian labor force (in thousands)

•Interaction terms of explanatory variables

• Linear and non-linear time trends

Inefficiency variables:

• *FDI* (in USD millions)

• *CPI* - The Corruption Perceptions Index (*Corruption*) chosen to control for institutional inefficiency, index varies from 0 (highly corrupt) to 10 (highly clean)

• *Openness* - country's trade (sum of exports and imports in USD millions)

Output variable (Granger Causality Test confirmed a strong one-way causality from real GDP to FDI):

•Real GDP (*Y*) (in of millions of USD)

Results

Parameters of the Production Function and Inefficiency Effects

	Coefficient	Standard Error	t-Ratio
Frontier Model			
Constant	3,8120*	1,2470	3,0569
Capital	0,4848*	0,0954	5,0824
Labor	-0,2400*	0,1001	-2,3976
Capital^2	-0,0210*	0,0043	-4,8495
Labour^2	0,0977*	0,0101	9,6619
Capital x Labor	0,0089*	0,0051	1,7533
Capital x Trend	0,0017*	0,0010	1,8007
Labor x Trend	0,0001	0,0022	0,0290
Trend^2	-0,0019*	0,0009	-2,1424
Inefficiency Effects			
FDI Inflows	0,3709*	0,0251	14,7627
Corruption	-0,5291*	0,0634	-8,3440
Openness	-0,3755*	0,0311	-12,0893
Variance Parameters			
Sigma-squared	0,0397*	0,0066	5,9847
Gamma	0,9593*	0,0209	45,9208
Log-likelihood	174,5476		
LR-Test	384,7087		

* significant at $\alpha = 0,05$

Conclusions

- A majority of the parameters concerning production factors are statistically significant at conventional levels and have expected positive signs besides negative signs of the parameters of Labor and quadratic term for Capital.

- The gamma parameter value is 0,96 which suggests that 96 % of the variation in the composite error term is due to inefficiency component.

  (γ - parametrization of Log-likelihood function,

  $$\gamma = \sigma_u^2 / \sigma^2 \quad , \quad \sigma^2 = \sigma_u^2 + \sigma_v^2 \quad)$$

- Negative parameter´s signs of inefficiency effects variables mean an increase in an efficiency and a positive effect on economic growth. Our results do not confirm our expectations as for the impact of FDI inflows on economic growth.
- FDI parameter is statistically significant but has positive sign (i.e. negative impact on growth). This conclusion may not be so straightforward e.g. it would be interesting to observe interaction between FDI and high quality educated labor. Study of Wijeweera et.al. (2007) confirmed that FDI inflows exert a positive impact on economic growth only in presence of a highly skilled labor i.e. FDI by itself does not induce efficiency gains. This is an important finding, especially for developing countries with unskilled labor.

- Another inefficiency variable *Openness* has negative sign and thus has positive effect on economic growth. Various studies confirmed this result and show that countries that have chosen to open their economies over the last two decades have achieved considerably higher growth compared to countries that remained comparatively closed.

- The model also indicates that less corruption in the host economy would increase economic growth. The corruption can depress economic activity, decrease of FDI inflows or inhibit impact of FDI.

- The technical efficiency indexes reflect how far a country is from its best possible production frontier. TE statistics over a period 2002 – 2010 suggest that countries such United States, United Kingdom, Canada, Australia or France are closest to the production frontier (their TE scores are higher than 0,90).

- **average***

  Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom

- **average****

  Australia, Canada, Japan, Korea, New Zealand, United States

- **average*****

  Czech Republic, Hungary, Slovakia

- **average******

  Mexico, Turkey, Iceland