



## 1. Motivation

Our endogenous growth model is inspired mainly by Lucas (1988), Greiner (2008) and Liu (2008). We contribute to endogenous growth theory by analyzing the relationship between foreign direct investment (FDI) and economic growth with a special emphasis on human capital formation through spillover effects. We analyze the effect of increasing share of foreign capital on economic growth, the reactions of human capital and productive public capital, the stability and dynamics of the growth model. Then the model is empirically tested. The previous empirical findings on FDI and economic growth may be considered skeptical. Because they do not fully control simultaneity bias, the use of lagged dependent variables and country specific factors (Carkovic. M and Levine. R, 2002). Hence, the estimates can be biased. To overcome these problems, we will apply dynamic panel data analysis using Arellano and Bover/Blundell and Bond system estimator and new data for 29 transition countries, which have not been analyzed considerably.<sup>1</sup>

## 2. Model Framework

An open economy: A final good sector that produces consumption goods and physical capital, a household sector that receive labor income and income from its saving, and the government.

### The Household

The physical capital is decomposed into domestic and foreign-invested capitals:  $K = K_d + K_f$  or  $K = (1 - \theta)K + \theta K$ . An infinite lived household maximizes CRRA utility function, resulting from consumption, subject to his budget constraint

$$\dot{Q} = (1 - \tau_w)w u_h L + (1 - \tau_a)rQ - C + T_p + \varrho \Pi$$

where  $Q = (1 - \theta)K$ ,  $C$ ,  $\Pi$  and  $T_p$  are the amounts of domestic assets, consumption, profits and transfers, respectively. Further,  $u_h$  is the fraction of human capital or the amount of time used for production and  $1 - u_h$  is the amount of time used for human capital accumulation.

$T_p > 0$  and  $T_p < 0 \Rightarrow$  lump-sum transfers and lump-sum tax, respectively.

### The Productive Sector

Utilizing Lucas (1988), Greiner (2008) and Liu (2008), we assume that output is produced with a constant returns to scale technology and takes the Cobb-Douglas form:

$$Y = ADK^{1-\alpha-\gamma}(u_g G)^\alpha (u_h h L)^\gamma$$

where  $A$  represents exogenous, common technological factors.  $D$  is the productivity parameter relating to the superior technology brought through FDI.  $G$  is productive public capital.  $u_g$  is the fraction of government spending affecting the production of output.  $1 - u_g$  is used for education for the purpose of the human capital accumulation.  $1 - \alpha - \gamma$ ,  $\alpha$ , and  $\gamma$  represents the elasticities of output with respect to physical capital, government education expenditure and human capital, respectively.

The firm maximizes instantaneous profit

$$\max_{K,L} ADK^{1-\alpha-\gamma}(u_g G)^\alpha (u_h h L)^\gamma - w u_h L - r K$$

### Human Capital Formation

The growth of human capital is given by

$$\dot{h} = BP(K_f)^{1-\epsilon-\nu} ((1 - u_h)hL)^\epsilon ((1 - u_g)G)^\nu$$

where  $B$  is a technology parameter or an efficiency parameter of the production.  $P(K_f)$  denotes public information on technology and management methods associated with foreign invested firms. Such that  $P(K_f) = \Psi K_f = \Psi \theta K$ . Where  $\Psi$  indicates the reaction of public information to changes in FDI.  $0 < \epsilon + \nu < 1$  represents the intensity of spillovers. If there are no spillovers, then  $\epsilon + \nu = 1$ .

### The Government

The government receives tax income from labor income taxation and taxing the returns on domestic and foreign assets and uses it for public investment and for transfer payments. Thus the government's budget constraint is given by

$$\dot{G} = (1 - \varphi)(\tau_w w u_h + \tau_a r(1 - \theta)K) + \tau_a r \theta K$$

where  $\varphi$  represents the fraction of tax revenues (excluding the tax income from the return on foreign assets) used for transfers. In turn,  $\varphi > 0$  and  $\varphi < 0$  represents the fractions for lump-sum transfers and lump-sum tax, respectively.

### Equilibrium and Balanced Growth Path

**Definition 1** An equilibrium is a sequence of prices  $\{w(t), r(t)\}_{t=0}^\infty$ , a sequence of household consumption, domestic and foreign assets  $\{C(t), K_d(t), K_f(t)\}_{t=0}^\infty$ , a sequence of government policy  $\{G(t), \tau(t), T_p(t)\}_{t=0}^\infty$  such that the following conditions are satisfied:

1. Given prices, the household decisions  $\{C(t), K_d(t)\}_{t=0}^\infty$  solve the household problem.
2. The firm maximizes profit.
3. The government's budget constraint is satisfied.

We solve the model according to Definition 1 and then to analyze our economy around a balanced growth path (BGP), we get three dimensional system of first order differential equations of the form:

$$\begin{aligned} \dot{c} &= c(g, \tilde{h}, c, \theta, \dots) \\ \dot{\tilde{h}} &= \tilde{h}(g, \tilde{h}, c, \theta, \dots) \\ \dot{g} &= g(g, \tilde{h}, c, \theta, \dots) \end{aligned}$$

where  $\tilde{h} \equiv \frac{h}{K}$ ,  $c \equiv \frac{C}{K}$ , and  $g \equiv \frac{G}{K}$ .

## 3. Dynamic Analysis of The Model

Solving the system, we find the steady state values and analyze the dynamics of the growth rates according to changes in foreign investment share  $\theta$ . However, the solution is too complex. Hence, we pursue numerical analysis using benchmark parameters and find the impact of the share of foreign assets and the stability of the BGP.

|                  | B = 0.2 |               |       |             |        |  |
|------------------|---------|---------------|-------|-------------|--------|--|
| FDI share        | $c^*$   | $\tilde{h}^*$ | $g^*$ | $\dot{Y}/Y$ | Stable |  |
| $\theta = 0.001$ | 0.22    | 0.02          | 1.21  | 2.73        | No     |  |
| $\theta = 0.143$ | 0.31    | 0.07          | 0.75  | 6.69        | Yes    |  |
| $\theta = 0.477$ | 0.32    | 0.08          | 0.69  | 8.16        | Yes    |  |

The values of  $\theta$  are included according to the observation of data on  $K_f/K$  of 29 transition countries for the period 1990 - 2006 and represents minimum, mean and maximum values, respectively. Stability occurs for high efficiency parameter  $B$  with the determinant of the Jacobian matrix being positive (characterized by one positive and two eigenvalues) implying that we have saddle point stability.

## 4. Econometric Methodology

Econometric methodology is based on dynamic panel data analysis introduced by Arellano and Bover (1995), and Blundell and Bond (1998). The Generalized Method of Moments (GMM) estimator designed by the authors allows us to find the consistent and efficient estimates of the impacts of FDI and human capital on economic growth. Arellano and Bover/Blundell and Bond system estimator uses the moment conditions (where the lags of the dependent variable and first differences of the exogenous variables are instruments) for the differenced equation and the moment conditions (where the lagged first differences of the dependent variables are instruments) for level equation.

## 5. Conclusion

We find that there is a unique balanced growth path and the model is saddle point stable. Furthermore, the results suggest that as the share of foreign capital increases, human capital also increases and, in turn, both have positive impact on economic growth. We also found that FDI is a substitute for productive public capital. As to the empirical support, the estimations suggest that foreign direct investment has positive and significant impact on economic growth when we control for the inflation rate, which reflects the efficiency of the financial sector. Further, the secondary school enrollment rate used as a proxy for human capital has positive and significant effect on economic growth. However, the tertiary enrollment rate is significant (but negative) only when we control for democracy. It can be explained such that there might still exist low democracy and high corruption in the education sector of the most countries in our sample. However, as expected, the synergy between FDI and secondary school and tertiary enrollment rates have positive and significant impact on economic growth.

## References

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<sup>1</sup>The data included in the estimation: FDI, human capital (proxied by secondary school and tertiary enrollment rates), initial income per capita, labor force, private credit (ratio of total bank credit to private sector), government expenditure (proxy for productive public capital), inflation, openness to trade (ratio of exports and imports to GDP), democracy (polity score - degree of democracy dummy variable with score range from -10 (hereditary monarchy) to 10+ (consolidated democracy)), and reform indicators. Sources of data: International Monetary Fund (IMF), European Bank for Reconstruction and Development (EBRD) and The Political Instability Task Force (PITF).