«ΣΠΟΥΔΑΙ», Τόμος 55, Τεύχος 1ο, (2005) / «SPOUDAI», Vol. 55, No 1, (2005), University of Piraeus, pp. 9-30

FDI AND GROWTH: EVIDENCE FROM A PANEL OF EUROPEAN TRANSITION COUNTRIES

by

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Abstract

This paper studies the effects of Foreign Direct Investment (FDI) on economic growth, measured by the increase in per capita growth of GDP for ten European countries in transition, utilising an unbalanced panel data set of annual observations from 1990 to 2003. The net inflows of foreign investments, and the net portfolio investments, both as a percentage of GDP, are used as FDI proxies. The results show that planned foreign investments have a positive and significant effect on the economic growth of these economies. On the other hand, portfolio investments are found to have a negative and insignificant effect. These results could be explained by the fact that stock markets are not fully developed in transition countries, while their relatively cheaper labour makes them quite attractive to planned FDI (JEL: D92, E22).

1. Introduction

There are many studies examining the effects of **FDI** in economic growth. The aim of this paper is to shed some light on the controversial issues discussed by those who have written in this area. The work here innovates in the following ways: It uses (a) a set of transition (i.e. not fully developed), countries of Europe, where FDI is a very important factor in enhancing their economic position, (b) a panel data set which allows the use of alternative methods of estimation, instead of the cross-sectional analyses employed widely so far in the literature and (c) two alternative measures for **FDI,** namely net FDI

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and Foreign Portfolio Investments (FPI), both as a percent of GDP, in order to check which of the two alternative measures affects growth.

In order to put our work into context, we present a brief review of some work in this area. In general the relation between FDI and growth is examined in the literature through regressions based on cross-country data. Levine and Renelt (1992) were the first to question the reliability of the results obtained by such an econometric analysis. Taking a sample of 119 countries (excluding the major oil exporters), for the period from 1960 to 1989 they tested whether the relationship between economic growth and its explanatory variables, such as indicators of fiscal, monetary and political policies as well as of international trade, is strong enough to come to any conclusions. For more accurate results two sets of data source were used: first, the IMF/WB data and second, data obtained from an empirical study of Summers and Heston (1988). Both sets proved that many indicators are highly correlated with economic growth or have insignificant influence and should be excluded from the equation. They came to the conclusion that the cross-country statistical relationship between long-run average growth rates and almost every particular macroeconomic indicator is fragile.

One of the first seminal works was that by Barrel and Pain (1997) using panel data for 15 EU countries. This was the first time that the effects of FDI, for both the home (i.e. the advanced) and the host (i.e. the transition) countries were so closely examined. The focus of the analysis is on rhe developed countries, especially members of OECD, as these appear to attract and at the same time distribute most of the world's investment flows.

Special attention was given to changes in the patterns of FDI after the abrogation of non-tariff barriers and the entry of some countries into a common market, for example NAFTA and EU. Yet the factors of production (relative costs), level of technology, market size and consumer preferences along with national differences are also taken into account, for the type of investment the host country attracts depends largely on these characteristics. To measure the impact of FDI on economic growth a production function (implied by the long-run solution to labour demand equation) was used and the results shown to be positive. Their results come to the conclusion that FDI has a highly positive impact on both the home and the host countries.

Borensztein, Gregorio and Lee (1995) tested the effect of FDI on economic growth using data for 69 developing countries from 1970 to 1989. The cross-country regression analysis proved that foreign investment tends to have a greater positive effect on economic growth than domestic investment as it enhances transfer of technology, knowledge and skills, on condition that the host country has a certain level of human capital available. The authors argue that a minimum threshold stock of human capital is necessary in order to absorb foreign technologies efficiently, and that the higher the level of education the more beneficial is the effect that FDI has on economic growth in the host country. Their results also show that FDI is an important vehicle of technology transfer.

Choe (2003) using panel data examines a mutual relationship between FDI and economic prosperity of the host country and discovers that though there is a strongly positive relationship between the two variables, high inflows of FDI should not be always associated with rapid economic growth. He argues that rapid economic growth enhances more FDI inflows rather than the other way.

Alternative studies within a cross sectional context were carried out by Durham (2003, 2004). They include as a measure of FDI the level of foreign portfolio investments and examine its relationship with growth. These studies concluded that there is a rather negative relationship between these two variables that is moderated by financial and/or institutional developments in the host country. However, these results are questionable due to possible simultaneity bias.

We have chosen to consider the relation between FDI and economic growth for a set of European countries in transition between state controlled and free market economies. Such transition economies are becoming increasingly significant on the world scene. The choice to work with panel data was made because of the variety of methods of estimation it allows, i.e. common constant, fixed and random effects. Finally it was decided to consider separately the impact of FDI inflows and that of FPI, in order to have a more exact picture of how foreign investment is directed in transition economies. With respect to the last point, as it was intuitively expected foreign investors tend to bypass the less developed stock exchanges and prefer to directly invest in industrial units, taking advantage of lower labour costs.

The rest of the paper is organised as follows. Section 2 presents a discrete time model of FDI and growth. Section 3 makes certain methodological points and presents the empirical results of our panel data regressions and Section 4 concludes the discussion with remarks based on the analysis.

2. A Model of FDI and Growth

Our theoretical model is in effect a discrete time version of the formulation by Borensztein, De Gregorio and Lee (BDL, 1995). Obviously, in purely theoretical discussions continuous time models have in general a distinct advantage over corresponding discrete time versions. On the one hand continuous models result in closed form solutions, i.e. an explicit formula as a function of time is obtained, and on the other hand the outcome of allowing, in a discrete version, the time interval to tend to zero could depend on how the limits are taken. We adopt here the discrete time approach because we find that this is more convenient in econometric applications since data sets appear at discrete intervals. As in BDL, here as well, the model is not a closed economy because of the presence of foreign firms.

We are working with labour force rather than, as BDL do, with human capital. Labour force is the quantity of working hours of people in the economy. Human capital is calculated by weighting the working hours with the investment in education, training and health. We have taken the labour force data as a more direct and simple variable available. We show a possible derivation of certain results and connection with those on BDL, through approximations as the time interval between decisions decreases.

An economy is considered in which technical progress takes place through "capital deepening". So, technological progress simply leads to the increase of the number of vintages of capital goods in the economy (see Romer (1990) and Grossman and Helpman (1991)).

There are three (sets of) agents in the economy. The producer(s) of the consumption good, the consumer(s), and the producers of the capital good.

The economy produces a single consumption good with the following production function

$$Y_t = AL_t^{\alpha} K_t^{1-\alpha} \tag{1}$$

where L_t is the exogenously given labour at time *t*, K_t is capital and Y_t the single good produced at time *t*.

At each point of time we have the following composition of capital

$$K_t = \left(\sum_{i=1}^{N} x_{it}^{1-\alpha} d_i\right)^{\frac{1}{1-\alpha}} \tag{2}$$

where the x_{it}'s denote the various types of capital and the d_i's denote their weights. Therefore the overall production function takes the form:

$$Y_t = AL_t^{\alpha}(x_{1t}^{1-\alpha}d_1 + x_{2t}^{1-\alpha}d_2 + \ldots + x_{Nt}^{1-\alpha}d_N) \tag{3}$$

where the d_i's are aggregation factors: the machine of more modern vintage get higher *d*.[1]

There are N varieties of capital goods in the economy:

$$N_t = n_t + n_t^*$$

where n_t denotes the varieties produced by domestic firms, and n_t* is the varieties produced by foreign firms. At least initially the distribution of these varieties is arbitrary. We are interested in capital deepening in the form of an increase in the number of vintages of capital goods available.

The firms which produce capital rent it out at

$$m_{it} = A(1-\alpha)L_t^{\alpha}d_i x_{it}^{-\alpha} \tag{4}$$

where m_{it} is the real rental rate and $A(1\text{-a})L^a{}_t d_i x_{it}{}^{-a}$ is the marginal productivity of x_{it}.

This assumes competitive conditions. The firm producing the consumption good maximizes per capital vintage

$$\pi_{it} = AL_t^{\alpha}d_i x_{it}^{1-\alpha} - m_{it}x_{it}.$$

This follows from the separability of the consumer's profit function in capital goods. Note that there is only one good and we have taken the price to be $p_{it}=1$.

A fixed setup cost F_t is required before the production of a new type of capital can take place. This is given by

$$F = F\left(n_t^*, \frac{N_t}{N_t^*}\right) \quad ; \text{ where } \quad \frac{\partial F_t}{\partial n_t^*} < 0 \quad \text{and} \quad \frac{\partial F_t}{\partial\left(\frac{N_t}{N_t^*}\right)} < 0. \tag{5}$$

Here N_t* is the number of varieties of capital goods produced in general in more advanced countries.

Intuitively, the setup costs of new types of capital are decreasing in the number of varieties already produced by foreign firms in the host country. In other words, capital deepening decreases such costs. Setup costs are also decreasing with respect to the ratio of the varieties of capital goods produced in the host country divided by the number of varieties produced in advanced countries as the technological gap between transition countries and advanced countries narrows down. In general, increased know-how decreases the setup costs.

The profits for the producer of x_{it} are

$$\Pi_{it} = \sum_{s=t}^{\infty}(m_{is}x_{is} - x_{is})\frac{1}{(1+r)^{(s-t)}} - F\left(n_t^*, \frac{N_t}{N_t^*}\right) \tag{6}$$

An interpretation is as follows. There is a setup cost $F\left(n_t^*, \frac{N_t}{N_t^*}\right)$ which is paid once at time t.

The capital good produced at time t will live forever and is denoted by x_{is} at time s. It will be rented out at a constant rental rate $m_{is}=m_{it}$. It will bring in an income of m_{is} x_{is} and will cost x_{is} to maintain. Finally the discount market rate r is taken to be constant. Hence we obtain the profit function of the producer of the capital good of a particular vintage.

We now consider the problem

$$Max\,\Pi_{it} = \sum_{s=t}^{\infty}(m_{is}x_{is} - x_{is})\frac{1}{(1+r)^{(s-t)}} - F\left(n_t^*, \frac{N_t}{N_t^*}\right)$$

$$s.t. \quad m_{it} = A(1-\alpha)L_t^{\alpha}d_i x_{it}^{-\alpha}.$$

By substitution we obtain inside the first bracket

$$\sum_{s=t}^{\infty}(A(1-\alpha)L_s^{\alpha}d_i x_{is}^{1-\alpha} - x_{is})$$

a typical term of which is

$$A(1-\alpha)L_s^{\alpha}d_i x_{is}^{1-\alpha} - x_{is}$$

which on maximization with respect to x_{it} gives

$$A(1-\alpha)^2 L_s^{\alpha}d_i x_{is}^{-\alpha} - 1 = 0$$

or,

$$A(1-\alpha)^2 d_i\, L_s^{\alpha} = x_{is}^{\alpha}$$

Hence,

$$x_{is} = A^{\frac{1}{\alpha}}(1-\alpha)^{\frac{2}{\alpha}} d_i^{\frac{1}{\alpha}} L_s, \tag{7}$$

which is the relation (7) in BDL, except for the aggregation factor d_i and after we replace s by t. This is the supply of the good at t. Now in order to make demand equal to supply we substitute (7) into (4) to get

$$m_{it} = A(1-\alpha)L_t^{\alpha}d_i A^{-1}(1-\alpha)^{-2}d_i^{-1}L_t^{-\alpha}.$$

Thus,

$$m_{it} = \frac{1}{1-\alpha} \tag{8}$$

So we have reached relation (8) in BDL which says that $m_{it} > 1$, i.e. the rental rate is higher than the maintenance costs. This makes the maximum profit Π_{is}* positive for sufficiently low r. Now because of free entry r will be driven to a level where profits are equal to zero. This is an assumption of perfect competition.

Now we want to calculate r which makes IV=0. For this, we proceed as follows.

We know that $x_{it} = x_{is} = L_t A^{\frac{1}{a}} (1-a)^{\frac{2}{a}} d_i^{\frac{1}{a}}$ and $m_{it} = \frac{1}{1-a}$. Therefore the expression for maximum profit is

$$\Pi_{it}^* = \frac{\alpha}{1-\alpha} L_t A^{\frac{1}{\alpha}} (1-\alpha)^{\frac{2}{\alpha}} d_i^{\frac{1}{\alpha}} \sum_{s=t}^{\infty} \frac{1}{(1+r)^{(s-t)}} - F \tag{9}$$

and because we require $\Pi_{it}^* = 0$ we have, after calculating the sum of the geometric progression, that

$$0 = -F + \frac{\alpha}{1-\alpha} L_t A^{\frac{1}{\alpha}} (1-\alpha)^{\frac{2}{\alpha}} d_i^{\frac{1}{\alpha}} \frac{1+r}{r}.$$

Therefore r can be obtained from

$$\frac{r}{1+r} = F^{-1} A^{\frac{1}{\alpha}} \alpha (1-\alpha)^{\frac{2-\alpha}{\alpha}} d_i^{\frac{1}{\alpha}} L_t = F^{-1} \psi L_t \tag{10}$$

and of course $\psi = A^{\frac{1}{\alpha}} d_i^{\frac{1}{\alpha}} \alpha (1-\alpha)^{\frac{2-\alpha}{\alpha}}$.

Relation (10) here is the discrete time analogue of (9) in BDL. An intuitive, non rigorous, way of how an approximation can take place is as follows. For a time interval of *dt* relation (10) might be thought of as becoming

$$\frac{rdt}{1+rdt} = F^{-1} A^{\frac{1}{\alpha}} \alpha (1-\alpha)^{\frac{2-\alpha}{\alpha}} d_i^{\frac{1}{\alpha}} L_t dt_t.$$

Taylor expanding the left hand side at $dt = 0$ we obtain $0 + rdt$. Cancelling *dt* on both sides we obtain what is basically (9) in BDL.

It is easy to check using relation (10) that the derivative of *r* with respect to *di* is positive. This means that the more modern capital is (i.e. the higher *di* is), the less restrictive is the upper ceiling on r for the profit to be positive.

Now we turn to the individuals' utility maximization, where c is the consumption. In discrete time we have at time t

$$U_t = \sum_{s=t}^{\infty} \frac{c_s^{1-\sigma}}{(1-\sigma)} \frac{1}{(1+\rho)^{\rho(s-t)}}. \tag{11}$$

We assume $0<\sigma<1$, in order to secure positive first derivative of the strictly concave felicity function, $\frac{c_s^{1-\sigma}}{1-\sigma}$ and the denominator 1-σ can be eliminated through a monotonic transformation. Further, ϱ is the psychological rate of discount. Its comparison with the market rate is always relevant. The market rate r determines the budget constraint.

Example: we consider the two period model and maximize

$$U = \left[c_0^{1-\sigma} + \frac{1}{1+\rho} c_1^{1-\sigma} \right] (1-\sigma)^{-1}$$

Subject to

$$c_0 + \frac{c_1}{1+r} = w_0 + w_0 \frac{1}{1+r}.$$

U gives the sum of the discounted instantaneous utilities at the psychological rate of discount p. The constraint says that the individual receives *wo* income in both periods.

We now from the Lagrangean function

$$V = \left[c_0^{1-\sigma} + \frac{1}{1+\rho} c_1^{1-\sigma} \right] (1-\sigma)^{-1} + \lambda \left(w_0 + w_0 \frac{1}{1+r} - c_0 - \frac{c_1}{1+r} \right).$$

If we take the F.O.C.'s we have

$$c_0^{\sigma} - \lambda = 0$$

$$\frac{1}{1+\rho} c_1^{\sigma} - \lambda \frac{1}{1+r} = 0$$

$$w_0 + w_0 \frac{1}{1+r} = c_o + \frac{c_1}{1+r}$$

It is easy to show that the S.O.C.s are satisfied.

From the first two of our F.O.C. we have

$$\left(\frac{c_1}{c_0}\right)^{\sigma} = \frac{1+r}{1+\rho} \tag{12}$$

$$\frac{c_1}{c_0} = \left(\frac{1+r}{1+\rho}\right)^{\frac{1}{\sigma}}$$

and the rate of increase is

$$\frac{c_1 - c_0}{c_0} = \left(\frac{1+r}{1+\rho}\right)^{\frac{1}{\sigma}} - 1. \tag{13}$$

Now we show how we can approximate relation (11) in BDL through our approach. Suppose that instead of period 1 (discrete model) we have period *dt* tending to 0. Relation (11) now becomes

$$\left(\frac{c_{t+dt}}{c_t}\right)^{\sigma} = \frac{1+rdt}{1+\rho dt}.$$

Taylor expanding at $d_t = 0$ we have left-hand side being equal to

$$\left(\frac{c_t}{c_t}\right)^{\sigma} + \sigma\left(\frac{c_t}{c_t}\right)^{\sigma-1} \frac{1}{c_t}\frac{dc_t}{dt}dt$$

and the right-hand side equal to $l + (r\text{-}p)$ and relation (11) in BDL follows:

$$\frac{1}{c_t}\frac{dc_t}{dt}=\frac{1}{\sigma}(r-\rho). \tag{14}$$

We emphasize that going from discrete to continuous models is not always obvious or straightforward. Relation (14) is a usual equation of calculus of variations involving the elasticity of marginal felicity.

We rewrite our (13) as

$$\frac{c_{t+1}-c_t}{c_t}=\left(\frac{1+r}{1+\rho}\right)^{\frac{1}{\sigma}}-1. \tag{15}$$

Adopting the idea of steady state growth, we postulate

$$g=\frac{Y_{t+1}-Y_t}{Y_t}=\frac{c_{t+1}-c_t}{c_t}$$

and if we substitute (10) into (15) we obtain

$$(1+g)^{\sigma}=\frac{1}{1+\rho}\left[\frac{1}{(1-F^{-1}L_t\psi)}\right]. \tag{16}$$

Taking logarithms of (16) we obtain

$$\log(1+g)=\frac{1}{\sigma}\left[\log(\frac{1}{1-F^{-1}L_t\psi})-\log(1+\rho)\right] \tag{17}$$

where $F^{1}L_t\psi$ is a proxy for new foreign investment. Thus, equation (17) gives us an expression of the growth rate of the economy, g, which contains, at least implicitly, L_t, *FDI,* and *Y.* In particular *FDI* is contained in *F.* The prediction is that as n* goes up, *F* goes down and therefore *g* goes up. A similar prediction is obtained with respect to *N**.

The predictions of our theoretical discussion, which determine the sign the relevant derivatives, are that the rate of growth of output is directly related to ψ and L_t and inversely related to *F.* They are the outcome of assumed rational behaviour on the part of the agent. In order to test the predictions of a theoretical formulation one resorts to an econometric application. We return to this in Section 3.

3. Methodology, Data, and Empirical Results

3.1 Methodology

In putting forward an econometric model to test the predictions of a theory we are usually faced with a number of problems, such as the availability of data, the fact that proxy variables have to be used etc. Furthermore it is not always possible to cast the application exactly in the same format as the theory. This might be due to the fact that efficient, applied techniques are not always available.

Theoretical constructions attempt to be part of the cumulative development of a discipline and the setting up of approximating econometric models tests their possible validity. The suggestion that we could make the same applied formulation on intuitive grounds is not always very helpful. On the one hand there are usually alternative intuitive formulations and furthermore a fundamental issue is to put to proper use the available methodological, theoretical arguments and discover their possibilities and limitations.[2]

The empirical model we propose here in order to test the theory developed in Section 2 can be thought of as an approximation of equation (17), in the spirit of (13) approximating (12) in BDL. Although we put forward a linear form, in spite of the fact that (17) is not linear, we can, as a first step, test the derivates' predictions with respect to *F*, ψ and L_t. Note that as a proxy for F we use the ratios of FDI to GDP and FPI to GDP.

Explicitly, our econometric model based on a linearization of (17) is given by

$$g_{it} = c_{i0} + c_1 F_{it} + c_2 L_{it} + c_3 Y_{it} + c_4 X_{it} \tag{18}$$

where g denotes growth of per capita *GDP*, *F* stands for foreign investments and is proxied either by FDI to GDP ratio or by FPI to GDP ratio, *L* is the labour force, *Y* is real GDP per capita and finally *X* can be a set of additional explanatory variables for which we use, given its big significance in transition economies, the rate of inflation.

We shall estimate versions of equation (18) using panel data techniques which allow us to include the data for all ten transition economies (the ten cross-sections) for 14 years at once, hence increasing the explanatory power of our regressions. More importantly, three different methods of estimation are going to be used: common constant, fixed effects and random effects.

According to the common constant method of estimation, also known as pooled OLS method, no differences exist among the data for all ten countries and therefore a common constant can be used. In order to be able to apply this method we must work only with homogenous data, i.e. we should have a set of countries that share common characteristics. As all our countries are from the Central and Eastern Europe this method might be an appropriate one.

The fixed effects method, or the Least Squares Dummy Variables (LSDV) estimator, provides different constants for each section - in other words for each country - therefore forcing us to include a dummy variable for each group. Unfortunately, this method has some disadvantages, as for example the fact that it does not allow us to include further dummy variables in the model or explanatory variables which change slowly in time, for they would appear to be highly collinear with the effect.

Finally, the main hypothesis under the random effects method is that each of the ten countries has its own error term. As a result a constant is used for each section as a random parameter. To be able to use this method one should make sure that the unobserved effect from all ten countries would not be correlated with the explanatory variables, for otherwise the results would be inconsistent and biased. All three alternative methods will be estimated and a Hausman test will help us decide which method is the appropriate one.

3.2 The Data Set

The panel data set consists of annual observation for 1990 till 2003 for ten Eastern European countries. These are: Bulgaria, Check Republic, Estonia, Lithuania, Latvia, Poland, Russian Federation, Slovakia, Slovenia and Romania. In our analysis we focuse mainly on seven variables: the dependent variable g which denotes the growth rate of real GDP per capita, the inflow of net foreign direct investments as a percentage of the GDP (FDIN), the inflow of foreign portfolio investments as a percentage of the GDP (FDIP), the labour force (L), real GDP per capita (Y) and inflation (DCPI), measured as the logarithmic change of the consumer price index (LCPI) as an additional explanatory variable. There are several sources for data that have been used in this study. A key source is the IMF publication "International Financial Statistics" (IFS) (2004). Other important information was derived from the annual publications of the main financial institutions of the countries we are studying.[3] Of course, the use of panel data implies that all evidence is used collectively[4].

3.3 Empirical Results

Tables 1 to 3 present summarised results of specification of equation (18) when Y is included in the regression specification. Table 1 presents results for common constant across the panel, while Tables 2 and 3 present the results for random and fixed effects respectively. In all cases we first estimate the model including only Y (regression 1) and then we add in the specification FDIN, to see the importance of FDIN. Then, we add also the other determinants to see whether the inclusion of the other variables that affect growth will change the significance of our results (regressions 2 to 5). Then, we do the same for the alternative measure of FDI, FDIP (see regressions 6 to 9).

For the common constant case (Table 1) we see that in all cases Y is positive (suggesting in a sense non convergence according to the Barro and Sala-i-Martin type of beta convergence hypothesis). Adding FDIN in the regressions we see that in all cases the coefficient is positive (suggesting positive effects of FDIN on growth) and in most of the cases statistically significant as well. On the other hand, FDIP is negative and statistically insignificant in all cases. At the same time the results reveal that there is a negative effect on the level of economic growth from FDIP. This can be partly explained by the level of development of the countries in our sample, while it is consistent with the results obtained by Alfaro *et al* (2002).

Interestingly enough the coefficients of DCPI and L are negative and positive respectively which is a well established case in the literature regarding transition economies. When we estimate the same sets of regression with fixed effects the results show that neither FDIN nor FDIP are significant, but the coefficients are again positive in the first case and negative in the second case as before. Finally estimating the same regression by using the method of random effects the results are again similar but this time the significance of FDIN is quite high.

Hausman tests suggested that random effects against the fixed effects, is the appropriate method of estimation, which implies that FDIN affects growth positively while FDIP has detrimental effects. In particular, for the regressions in Table 3 the test result ranged for a minimum value of around 9 for regression 3 to a maximum value of almost 19 for regression 5, while for the regressions in table 6 the statistic ranged from a minimum value of around 11 for regression 3 to a maximum value of almost 17 for regression 4. The critical value of the statistic using the chi-square tables is around 6 or 7 maximum, leading to the acceptance of the random effects model against the fixed effects in all cases.

For robustness we estimate once more all the regressions using again all three alternative methods of estimation, this time excluding Y from the specification. The results are quite similar to the case described above, suggesting that the estimations are robust. So, finally in all cases the full model of FDIN (i.e. the one that contains not only FDIN, but all the other possible determinants of growth as well[5]) proved to be the most significant in terms of explanatory power.

4. Conclusions

The aim of this paper has been to examine the relationship among economic growth and **FDI** for ten transition economies. For this reason annual data for a set of variables were selected for the time period 1990 to 2003, and an empirical analysis of growth regressions using panel data was employed. Also, in order to test the effects of foreign investments two different proxies were used. These were the ratios of net **FDI** inflows to **GDP** and of **FPI** to GDP.

The results obtained support the hypothesis that **FDI** affects growth under all three alternative specifications, namely common constant, fixed effects and random effects. The random effects, which proved to be the most appropriate method of estimation, showed clearly that the effect was a positive and significant one. On the other hand the FPI appeared to be insignificant on all the three specifications and entered with a negative coefficient. This could be explained by the fact that stock markets are not fully developed in transition countries, while transition economies with their relatively cheaper labour are seen to be quite attractive for planned FDI. The robustness of the results obtained from alternative specifications make the basic conclusions of our empirical analysis quite strong.

References

Alfaro, L., Chanda, A., Kaiemli-Ozcan, S. and Sayek, S.: "FDI and Economic Growth: The Role of Local Financial Markets", *Harvard Business School Working Paper* No. 01-083, (2002).

Barrel, R. and Nigel Pain, N.: "Foreign Direct Investment, Technological Change, and Economic Growth within Europe", *Economic Journal* 107: 1770-1786, (1977).

Borensztein, E., De Gregorio, J., Lee, J-W.: "How does Foreign Direct Investment Affect Economic Growth?", *Journal of International Economics* 45: 115-13, (1995).

Choe, J. I.: "Do Foreign Direct Investment and Gross Domestic Investment Promote Economic Growth?", *Review of Development Economics* 7(1), 44-57, (2003).

Durham, J. B.: "Foreign Portfolio Investment, Foreign Bank Lending, and Economic Growth", provided by Board of Governors of the Federal Reserve System (U.S.) in its series *International Finance Discussion Papers* No: 757, (2003).

Durham, J. B.: "Absorptive Capacity and the Effects of Foreign Direct Investment and Equity Foreign Portfolio Investment on Economic Growth", *European Economic Review,* 48(2), 285-306, (2004).

Grossman, G., Helpman, E.: *Innovation and Growth in the Global Economy,* Cambridge, MA: MIT Press, (1991).

Levine, R., Renelt, D.: "Sensitivity Analysis of Cross-Country Growth Regressions", *American Economic Review* 82, 942-63, (1992).

Romer, P.: "Idea Gaps and Object Gaps in Economic Development", *Journal of Monetary Economics,* 32, 543-73, (1993).

Sarantides, S. A.: "Theory and Praxis in Economics Science"(in Greek), *SPOUDAI,* 54, 5-22, (2004).

Summers, R., Heston, A.: "A new set of international comparisons of real product and price levels estimates of 130 countries, 1950-1985", *Review of Income and Wealth,* 34, 1-25, (1998).

Notes

1. Note that the production function is homogeneous of degree 1 in $(L_t, x_{1t}, x_{2t}, ..., x_{Nt})$.

2. A recent scholarly discussion of methodological issues in economics is by S. Sarantides (2004). The construction of theoretical models and the investigation of the implications of their econometric analysis is what we understand by the use of the deductive and the inductive approaches in a complementary manner.

3. More analytical information on the data and the results is available from the authors on request.

4. It should be noted that the data set is unbalanced in the sense that some of the variables were not available for all years in all countries. As a result, there were missing observations that resulted in differences in the numbers of observations among different regressions.

5. This corresponds to regressions number 5 for the first set of regressions (see Tables 1-3) and regressions number 4 for the second set of regressions (see Tables 4-6).

TABLE 1

Basic Equation Estimation including the level of GDP as explanatory variable
Method of Estimation Common Constant

Varia-bles	Regr. 1	Regr. 2	Regr. 3	Regr. 4	Regr. 5	Regr. 6	Regr. 7	Regr. 8	Regr. 9
Constant	0.703076 (0.656139)	0.926317 (0.927783)	-2.740143 (-.673725)	1.840321 (2.188156)	-0.488277 (-0.347390)	2.322435 (2.613535)	2.664821 (3.594640)	0.377535 (0.241487)	1.477997 (1.134630)
Y	0.142201 (0.863468)	0.050230 (0.351826)	0.073347 (0.524517)	0.183198 (1.529014)	0.195031 (1.638618)	0.076431 (0.578369)	0.189593 (1.716306)	0.076461 (0.576268)	0.188732 (1.692048)
FDIN		0.352929 (2.347316)	0.308682 (2.091090)	0.183389 (1.451599)	0.159102 (1.265423)				
FDIP						-0.404161 (-1.629537)	-0.158546 (-0.763558)	-0.372188 (-1.495057)	-0.139924 (-0.668013)
DCPI				-0.017018 (-6.027722)	-0.016343 (-5.807925)		-0.015814 (-4.553038)		-0.015910 (-4.559983)
L			0.340466 (2.761906)		0.213684 (2.040659)			0.180045 (1.506789)	0.110495 (1.106384)
Obs	124	115	114	111	110	104	100	103	99
R-sq. adj.	0.002073	0.035075	0.090011	0.273136	0.294176	0.012003	0.213627	0.024157	0.190706

TABLE 2

Basic Equation Estimation including the level of GDP as explanatory variable
Method of Estimation Fixed Effects

Varia- bles	Regr. 1	Regr. 2	Regr. 3	Regr. 4	Regr. 5	Regr. 6	Regr. 7	Regr. 8	Regr. 9
Y	16.026 (4.034)	15.65736 (4.255462)	11.57879 (3.468910)	13.82675 (13.82675)	10.96493 (3.137176)	13.24775 (3.734601)	10.15280 (3.128844)	12.41843 (3.224159)	10.26019 (2.930333)
FDIN		0.361836 (0.745360)	0.076729 (0.513056)	0.043082 (0.237209)	0.012666 (0.080594)				
FDIP						-0.117624 (-0.439718)	0.073291 (0.316519)	-0.115294 (-0.425998)	0.064762 (0.275518)
DCPI			-0.014139 (-4.721294)		-0.013453 (-4.421912)		-0.012771 (-3.429258)		-0.012713 (-3.376148)
L				0.485017 (2.146041)	0.246203 (1.228977)			0.153055 (0.721097)	0.009704 (0.052844)
Obs	124	115	111	114	110	104	100	103	99
R-sq. adj.	0.098175	0.148121	0.307173	0.179208	0.312294	0.122058	0.226024	0.119579	0.218418

TABLE 3

Basic Equation Estimation including the level of GDP as explanatory variable
Method of Estimation Random Effects

Varia-bles	Regr. 1	Regr. 2	Regr. 3	Regr. 4	Regr. 5	Regr. 6	Regr. 7	Regr. 8	Regr. 9
Constant	0.722940 (0.727743)	0.973276 (1.058857)	1.974036 (3.339846)	-2.380387 (-1.611868)	0.216730 (0.286470)	2.305329 (2.346020)	2.709258 (5.420486)	0.052623 (0.029791)	1.693951 (1.984567)
Y	0.138569 (0.907564)	0.048248 (0.370599)	0.181436 (2.266397)	0.067010 (0.552638)	0.186934 (3.385514)	0.081050 (0.554585)	0.178082 (2.406075)	0.083706 (0.534393)	0.175367 (2.586598)
FDIN		0.342678 (2.332506)	0.155269 (1.411984)	0.311550 (2.200028)	0.152651 (1.713957)				
FDIP						-0.391333 (-1557014)	-0.238309 (-1.263807)	-0.348020 (-1.368484)	-0.241823 (-1.324486)
DCPI			-0.017463 (-6.501785)		-0.017811 (-7.394436)		-0.016892 (-5.180557)		-0.017753 (-5.527401)
L				0.309483 (2.781420)	0.161618 (2.945886)			0.207617 (1.570267)	0.096868 (1.421972)
Obs	124	115	111	114	110	104	100	103	99
R-sq. adj.	0.01049	0.025625	0.251436	0.076675	0.264685	0.025248	0.148482	0.046425	0.140472

TABLE 4

Basic Equation Estimation excluding the level of GDP - Method of Estimation Common Constant

Varia-bles	Regr. 1	Regr. 2	Regr. 3	Regr. 4	Regr. 5	Regr. 6	Regr. 7	Regr. 8
Constant	1.170861 (1.639959)	-2.347573 (-1.617570)	2.682149 (4.192779)	0.487167 (0.379603)	2.749443 (5.577943)	0.801153 (0.582593)	3.695994 (8.426494)	2.482074 (2.119753)
FDIN	0.362639 (2.463150)	0.322985 (2.233606)	0.224620 (1.808738)	0.202934 (1.638882)				
FDIP					-0.420748 (-1.713469)	-0.389415 (-1.580949)	-0.211440 (-1.019527)	-0.193837 (-0.927252)
DCPI (INFL)			-0.016767 (-5.912503)	-0.016111 (-5.687569)			-0.015625 (.4.456486)	-0.015740 (.4.469379)
L		0.337315 (2.748590)		0.206978 (1.962595)		0.180578 (1.516368)		0.113155 (1.122206)
Obs	115	114	111	110	104	103	100	99
R-sq. adj.	0.042557	0.095954	0.264132	0.282956	0.018449	0.030675	0.172787	0.174835

TABLE 5

Basic Equation Estimation excluding the level of GDP - Method of Estimation Fixed Effects

Varia-bles	Regr. 1	Regr. 2	Regr. 3	Regr. 4	Regr. 5	Regr. 6	Regr. 7	Regr. 8
FDIN	0.425696 (2.405413)	0.192754 (1.031127)	0.227902 (1.511039)	0.115800 (0.721332)				
FDIP					-0.330835 (-1.186067)	-0.258164 (-0.920584)	-0.078054 (-0.328670)	-0.048688 (-0.201312)
DCPI (INFL)			-0.016563 (-5.395216)	-0.015217 (-4.872110)			-0.014878 (-3.873389)	-0.014450 (-3.724986)
L		0.708374 (3.082598)		0.391849 (1.924925)		0.403856 (1.946966)		0.192745 (1.069911)
Obs	115	114	111	110	104	103	100	99
R-sq. adj.	0.007979	0.082561	0.229959	0.249608	-0.000167	0.028680	0.148718	0.149468

TABLE 6

Basic Equation Estimation excluding the level of GDP - Method of Estimation Random Effects

Varia-bles	Regr. 1	Regr. 2	Regr. 3	Regr. 4	Regr. 5	Regr. 6	Regr. 7	Regr. 8
C	1.249348 (1.991510)	-1.818202 (-1.460095)	2.689201 (4.657919)	0.693179 (0.640521)	2.747704 (5.650546)	0.710086 (0.497676)	3.662399 (10.29970)	2.570530 (2.740667)
FDIN	0.340267 (2.460685)	0.328270 (2.464186)	0.223780 (1.901214)	0.219216 (1.940073)				
FDIP					-0.423113 (-1.727145)	-0.379901 (-1.529540)	-0.28349 (4.443423)	-0.276684 (-1.416415)
DCPI (INFL)			-0.016847 (-6.024464)	-0.016377 (-5.948847)			-0.016175 (-4.749387)	-0.016611 (-4.871862)
L		0.286563 (2.801678)		0.183686 (2.128901)		0.189565 (1.536941)		0.102361 (1.256183)
Obs	115	114	111	110	104	103	100	99
R-sq. adj.	-0.020732	0.028367	0.229983	0.234771	0.013771	0.046486	0.068223	0.054408