Bucharest University of Economic Studies
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Direct and Spillover Effects of Foreign Direct Investment in CEE Countries

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Bucharest, 2014

TOPICS

1. The Goal of the Paper

2. Literature Review

2.1. Theoretical Background

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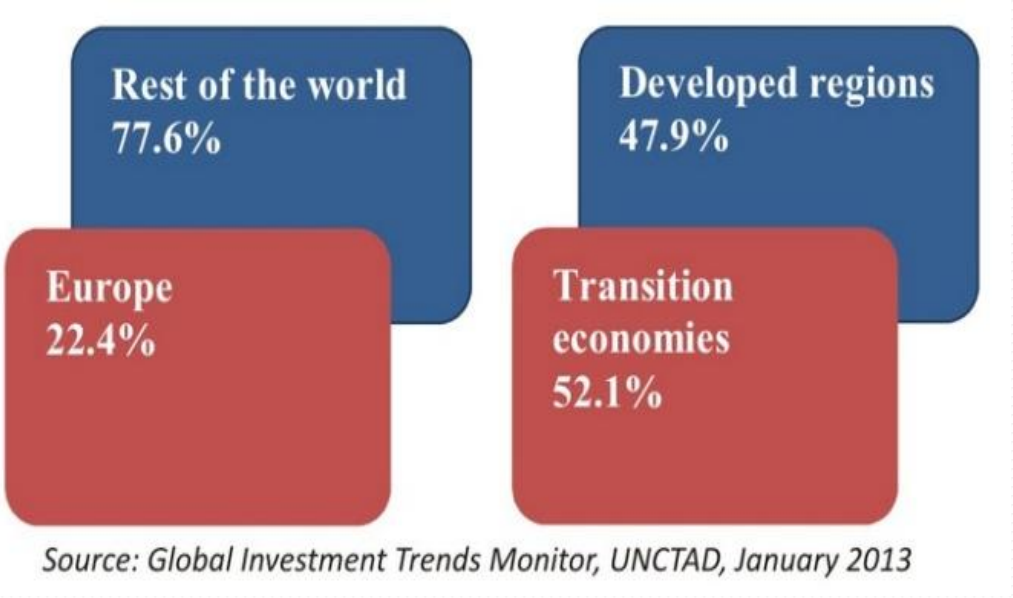
3. Economic Overview

Global repartition of FDI



Source: Global Investment Trends Monitor, UNCTAD, January 2013

4. Empirical Model

$$GDP_{j,t} = \alpha + \gamma_i InitialGDP_{j,t} + \beta_i FDI_{j,t} + \delta_i Z_{j,t} + \varepsilon_{j,t}$$

where:

- γ_i , β_i and δ_i are the parameters to be estimated and ε_{it} is the stochastic error term

- $Z_{j,t}$ is the set of other variables that affect economic growth, i.e. GCF, EXPO, HK, INFL, DC, GGC and TH_GAP

The analysis will focus on the economy of ten Central Eastern European countries, namely: **Hungary, Latvia, Lithuania, Montenegro, Macedonia, Poland, Romania, Serbia, Slovak Republic** and **Slovenia** for the period 1993-2012, considering, by applying the methodology of panel cointegration and causality, the presence of heterogeneity in the estimated parameters and dynamics across countries.

5. Data and methodology

5.1. Data

All data used in this paper were obtained from the World Development Indicators 2014, from the World Bank data base.

In order to standardize our data we have used variables in natural logarithm

- **InitialGDP** - empirically, the initial level of per capita GDP enters into the growth equation in the form $\log(y_{t-1})$ so that the coefficient on this variable represents the rate of convergence, that is, the responsiveness of the growth rate.
- **FDI** – net inflows as percentage of GDP
- **GCF** – formerly gross domestic investment, as percentage of GDP
- **EXPO** – exports of good and services, as percentage of GDP
- **HK** – gross enrolment ratio in tertiary education
- **INFL** – the annual growth rate of the GDP implicit deflator
- **DC** – domestic credit to private sector as a percentage of GDP
- **GGC** – government final consumption expenditure as percentage of GDP

- **TH_GAP** – $TH\_GAP = \frac{GDP_{EU,t} - GDP_{j,t}}{GDP_{j,t}}$, where $GDP_{EU,\ t}$ corresponds to EURO Area countries

5.2. Methodology

$$y_{j,t} = \alpha + \beta_i X_{j,t} + \varepsilon_{j,t}$$

$$j = 1,\ldots,N$$
$$t = 1,\ldots,T$$

$$y_{j,t} = \alpha + \beta_i X_{j,t} + \mu_{j,t}$$

$$\mu_{j,t} = \delta_i + \varepsilon_{j,t}$$

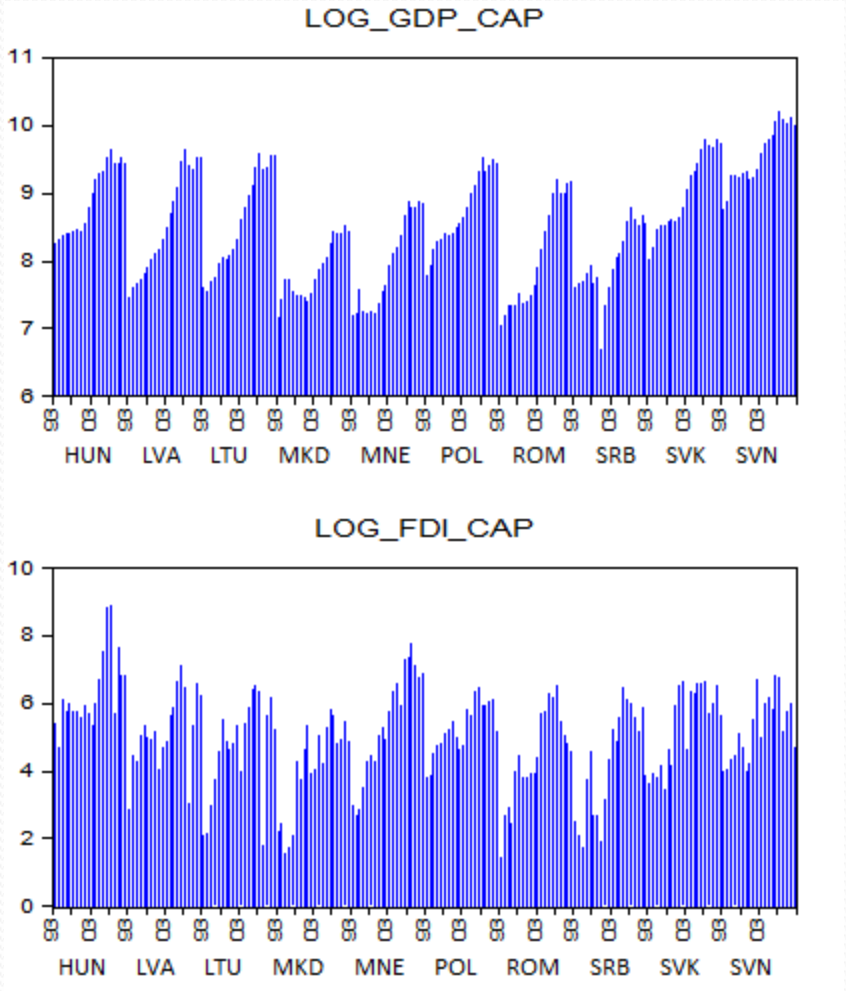
δ_i = cross-country fixed effects

$$y_{j,t} = \alpha + \eta_i + \beta_i X_{j,t} + \varepsilon_{j,t}$$

η_i measures the random deviation of each cross-section's intercept term from the intercept term α

6. Empirical Results

6.1. FDI and economic growth evolution in CEE countries



Source: E-views computes

6.2. OLS Estimation with no effects

Dependent variable: GDP growth - Annual percentage growth rate of GDP at constant 2005 U.S. dollars (1993-2012)

	Regression Number								
	1.1.	1.2.	1.3.	1.4.	1.5.	1.6.	1.7.	1.8.	1.9.
Independent variable	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)
Log (initial GDP)	-0.01013	-0.01501*	-0.00598	-0.00234	-0.00526	-0.00642	-0.00419	-0.02143***	-0.01865***
	(0.00791)	(0.00795)	(0.00815)	(0.00375)	(0.00788)	(0.00793)	(0.00812)	(0.00592)	(0.00623)
FDI	0.00893**	0.01191**	0.01145**	0.00999***	0.01166**	0.01197**	0.01289***	0.00158	0.00562**
	(0.00379)	(0.00543)	(0.00553)	(0.00289)	(0.00493)	(0.00561)	(0.00523)	(0.00277)	(0.00285)
GCF	0.05628***							0.05095***	0.04235***
	(0.0178)							(0.01300)	(0.01349)
HK		0.02230***						0.02281***	0.02043**
		(0.00808)						(0.00891)	(0.00953)
DC			0.05055***					0.04697***	0.04245***
			(0.01421)					(0.01398)	(0.01511)
TH_GAP				-0.10279***				-0.12410***	-0.08276***
				(0.02524)				(0.02456)	(0.02539)
EXPO					0.07718**			0.13854***	
					(0.03889)			(0.02347)	
INFL						-0.01526		0.00392	
						(0.01891)		(0.01372)	
GGC							-0.00372	0.01250	
							(0.00948)	(0.00897)	

Note: Regressions are estimated with White cross-section standard errors correction. The asterisks *, ** and *** denotes statistical significance at 10%, 5% and 1% level respectively.

6.3. OLS Estimation with fixed effects

Dependent variable: GDP growth - Annual percentage growth rate of GDP at constant 2005 U.S. dollars (1993-2012)

	Regression Number								
	2.1.	2.2.	2.3.	2.4.	2.5.	2.6.	2.7.	2.8.	2.9.
Independent variable	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)
Log (initial GDP)	-0.02252*	-0.03454**	-0.02102*	-0.01506	-0.02003*	-0.02129*	-0.02046	-0.03651***	-0.03555***
	(0.01214)	(0.01543)	(0.01292)	(0.01167)	(0.01189)	(0.01313)	(0.01498)	(0.01317)	(0.01317)
FDI	0.01624***	0.01878***	0.01969***	0.01819***	0.01995***	0.02021***	0.02093***	0.00831*	0.00821*
	-0.00553	(0.00733)	(0.00736)	(0.00627)	(0.00692)	(0.00756)	(0.00678)	(0.00489)	(0.00489)
GCF	0.05982***							0.04489***	0.04467***
	(0.01481)							(0.01516)	(0.01366)
HK		0.02967**						0.02254*	0.02294*
		(0.01408)						(0.01312)	(0.01271)
DC			0.05389***					0.0517***	0.05021***
			(0.01785)					(0.02047)	(0.01899)
TH_GAP				-0.07471				-0.10018**	-0.10145**
				(0.05079)				(0.04824)	(0.04866)
EXPO					0.08826**			0.13584***	0.13391***
					(0.03776)			(0.03349)	(0.03363)
INFL						-0.01963		0.00681	
						(0.02072)		(0.02148)	
GGC							-0.02612	-0.02336	
							(0.04221)	(0.02942)	

Note: Regressions are estimated with White cross-section standard errors correction. The asterisks *, ** and *** denotes statistical significance at 10%, 5% and 1% level respectively.

6.4. OLS Estimation with random effects

Dependent variable: GDP growth - Annual percentage growth rate of GDP at constant 2005 U.S. dollars (1993-2012)

	Regression Number								
	3.1.	3.2.	3.3.	3.4.	3.5.	3.6.	3.7.	3.8.	3.9.
Independent variable	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)	Coefficient (Std error)
Log (initial GDP)	-0.0123	-0.01585**	-0.00824	-0.00234	-0.00727	-0.0079	-0.00591	-0.02144***	-0.01946***
	(0.00872)	(0.00831)	(0.00910)	(0.00728)	(0.00863)	(0.00861)	(0.00890)	(0.00572)	(0.00800)
FDI	0.01037***	0.01235**	0.01299**	0.01**	0.01306***	0.01304**	0.01413***	0.00158	0.00607*
	(0.00407)	(0.00555)	(0.00584)	(0.0041)	(0.00522)	(0.00583)	(0.00548)	(0.01723)	(0.00395)
GCF	0.05811***							0.05095***	0.04271***
	(0.01756)							(0.01723)	(0.0165)
HK		0.02245***						0.02281***	0.02029**
		(0.00836)						(0.00727)	(0.00761)
DC			0.05099***					0.04697***	0.04227***
			(0.01421)					(0.01708)	(0.01799)
TH_GAP				-0.10279*				-0.12411**	-0.08122*
				(0.06352)				(0.06077)	(0.05684)
EXPO					0.07927**			0.13854***	
					(0.03863)			(0.03663)	
INFL						-0.01561		0.00393	
						(0.01928)		(0.02136)	
GGC							-0.00414	0.0125*	
							(0.01064)	(0.00721)	

Note: Regressions are estimated with White cross-section standard errors correction. The asterisks *, ** and *** denotes statistical significance at 10%, 5% and 1% level respectively.

6.5. Interaction of human capital with FDI

$$y_{j,t} = \alpha + \gamma_i InitialGDP_{j,t} + \beta_i FDI_{j,t} + \delta_i Z_{j,t} + \theta_i INTER_{j,t} + \varepsilon_{j,t}$$

Dependent variable: GDP growth - Annual percentage growth rate of GDP at constant 2005 U.S. dollars (1993-2012)		
Independent variable	Coefficient (Standard error)	
FDI	0.01989***	
	(0.00554)	
HK	0.07166***	
	(0.01955)	
FDI*HK	0.01508***	
	(0.00506)	
Periods included	19	
Cross-sections included	10	

Source: E-views computes

Results shows that even with the inclusion of the interaction term, the effects of aggregated FDI remain consistent. The significance of the interaction term may be the result of the omission of other relevant factors, in particular, the FDI variable by itself.

Thus, it is necessary to include FDI and tertiary school attainment (our measure of human capital) individually alongside their product. In this way, we can test jointly whether these variables affect growth by themselves or through the interaction term.

6.6. FDI – Led – Growth Hypothesis

In recent years the growth of FDI has served as a catalyst for investment in developing countries and for this reason is important to highlight also the potential long-run relationship between FDI and economic growth.

6.6.1. Series stationarity

First we have to check stationary properties of the panel data and for that several panel unit root test are available in econometric literature. The most known is IPS Unit Root Test (Im, Pesaran and Shin, 2003). The general equation of IPS Test is shown below:

$$\Delta X = \alpha_i + \beta_i X_{i,t-1} + \sum_{j=1}^{m_i} \beta_{i,j} \Delta X_{i,t-j} + \varepsilon_{i,t}$$

where:

- $X_{i,t}$ is a series for a country i over period t;
- m_i is the number of lags in the ADF regression;
- $\varepsilon_{i,t}$ represent the error terms that we assume to be serially correlated

<u>Hypothesis:</u>

Null hypothesis H_0: $\beta_i = 0$ for all i;

Alternative hypothesis H_A: $\beta_i < 0$ for $i = 1, 2, \ldots, N_1$;

$\beta_i = 0$ for $i = N_1+1, N_1+2, \ldots, N$.

	LEVEL			1st Difference		
	Include in test equation	Statistic	Prob.	Include in test equation	Statistic	Prob.
log_GDP/cap	Intercept	2.04931	0.97978	Intercept	-5.02995	0.00000
	Trend & Intercept	0.50441	0.69301	Trend & Ir	-5.55953	0.00000
log_FDI/cap	Intercept	-1.4277	0.17669	Intercept	-6.86232	0.00000
	Trend & Intercept	0.5044	0.69301	Trend & Ir	-5.55953	0.00000

Source: E-views computes

6.6.2. Testing for cointegration

Pedroni suggested two approaches for the test:

- based on within-dimension approach which includes four statistics (panel v-statistic, panel ρ-statistic, panel PP-statistic, panel ADF-statistic)
- based on between-dimensional approaches includes three statistics (group ρ-statistic, group PP-statistic, group ADF-statistic)

The estimated time series panel regression is shown below:

$$X_{it} = \alpha_i + \sum_{j=1}^{p_i} \beta_{ji} Z_{jit} + \varepsilon_{it}$$

$$\varepsilon_{it} = \rho_i \varepsilon_{i(t-1)} + w_{it}$$

Hypothesis of cointegration of the pooled (within-dimension) estimation are:

Null hypothesis	H_o:	$\rho_i = 1$	for all i;
Alternative hypothesis	H_A:	$\rho_i = \rho < 1$	

Hypothesis of cointegration of the pooled (between-dimension) estimation are:

Null hypothesis	H_o:	$\rho_i = 1$	for all i;
Alternative hypothesis	H_A:	$\rho_i < 1$	

Alternative hypothesis: common AR coefs. (within-dimension)						
				Weighted		
		Statistic	Prob.	Statistic	Prob.	
Panel v-Statistic		-3.67476	0.999881	0.739969	0.22966	
Panel rho-Statistic		-1.88125	0.029969	-1.77266	0.038143	
Panel PP-Statistic		-2.30691	0.01053	-1.93047	**0.026774**	
Panel ADF-Statistic		-2.01435	0.021986	-1.82066	**0.034329**	
Alternative hypothesis: individual AR coefs. (between-dimension)						
		Statistic	Prob.			
Group rho-Statistic		-0.70187	0.241379			
Group PP-Statistic		-1.82732	**0.033826**			

Source: E-views computes

6.6.3. Testing for panel causality

Previous results confirming that foreign direct investment and economic growth are sharing a long-run equilibrium relationship in Central and Eastern Europe could indicate that there is a possibility of causality existance between FDI and GDP.

The relations to be tested are:

$$l\_GDP_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_{ij} l\_GDP_{i,t-j} + \sum_{k=0}^{n} \beta_{ik} l\_FDI_{i,t-k} + \varepsilon_{i,t}$$

$$l\_FDI_{i,t} = \alpha_0 + \sum_{j=1}^{n} \alpha_{ij} l\_FDI_{i,t-j} + \sum_{k=0}^{n} \beta_{ik} l\_GDP_{i,t-k} + \mu_{i,t}$$

where j and k are 1,2 or 3, that is the number of lags to be tested for Granger causality.

The null hypothesis can be specified as below:

$$\beta_{i1} = \beta_{i2} = \beta_{i3} = 0$$

	Null Hypothesis:	Obs	F-Statistic	Prob.
	GDP does not Granger Cause FDI	190	3.23005	**0.07391**
LAG 1	FDI does not Granger Cause GDP		4.12576	**0.04365**
	GDP does not Granger Cause FDI	180	1.06078	0.34840
LAG 2	FDI does not Granger Cause GDP		2.19006	0.11497
	GDP does not Granger Cause FDI	170	0.10052	0.95961
LAG 3	FDI does not Granger Cause GDP		2.57361	**0.05587**

Source: E-views computes

7. Conclusions

There is a **direct and positive impact of foreign direct investment on economic growth** (after controlling also for the rest of important variables with direct and strong impact on the economic performance of the host country), i.e. FDI plays a key role in the process of creating a better economic environment which finally leads to economic growth.

FDI and GDP variables are cointegrated, witnessing for a **long-run relationship**.

Panel causality hypothesis shows the existence of a **bi-directional causality (at first lag)** between FDI and economic growth in the selected panel. At 5% level of significance FDI Granger causes GDP and the existence of **unidirectional causality running from FDI to economic growth** was confirmed **at the third lag**.

Interaction of FDI with human capital shows that all countries with a minimum level of tertiary school attainment will benefit positively from FDI.

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