A causal relationship between foreign direct investment, economic growth and export for Central and Eastern Europe

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Abstract. Foreign direct investment is generally considered to be an instrument how to stimulate economic growth of any country. For this purpose governments of transition countries try to encourage the inflow of foreign direct investment by various measures. The aim of this paper is to analyse the relation between foreign direct investment, economic growth and export in eight countries of Central and Eastern Europe. Estimation of effects on economic growth and export was performed for each country of the region individually in the period from 1993 to 2010. The co-integration method and vector error correction model were applied on quarterly data. The results confirm the existence of long-term causal links between variables studied in five of the eight countries of the region. The impact of foreign direct investment within the region of Central and Eastern Europe, however, is not clear, since there were positive as well as negative effects proven on export.

Keywords: foreign direct investment, export, economic growth, Central and Eastern Europe, co-integration.

JEL Classification: F41, F43
AMS Classification: 62P20

1 Introduction

The paper is aimed to analyse long-term causal relations between export, economic growth and foreign direct investment (FDI). It is assumed that there might be a long-term link between these variables. Export is considered to be the determinant for economic growth. Export and growth of economy openness might lead to the growth of output level and increase of economy growth. As stated in theory, it is the foreign direct investment that contributes to the export performance increase of a country. Such effect happens when we speak about the export oriented FDI. In addition, positive impact on the economy growth of a country is attributed to the foreign direct investment according to the theory. These facts are pointed out by, for example Dritsaki et al. [2], Feridun and Sissoko [4], Pacheco-Lopéz [5].

The paper is divided into six chapters. First chapter is the introduction. The second chapter is aimed at the relevant bibliography overview. A model used and data are specified in the third chapter. The fourth chapter deals with the long-term links model between foreign direct investment, export and gross domestic product. The fifth chapter is about the vector error correction model. The last chapter includes causal relation model results between selected variables.

2 Bibliography overview

There is a series of empirical studies examining FDI effects on economic growth and export and relations between these variables. Such effects are examined by various approaches. The results of individual studies vary, which depends on the period selected, data processed, other variables included in the model or it depends on the econometrics. In respect to this, there is the examination of one way relationship or two way causal relationships. The result of such activity might be to find the one way, two-way or lack of causality. VAR autoregressive model, regression analysis, as well as panel data analysis are used in order to examine relationships among the given variables. The results of selected relevant studies are included in this sub-chapter.

VAR autoregressive model was used to examine the relationships between FDI, export and economic growth in the empirical study by Dritsaki et al. [2]. The research was performed for Greece by means of annual data during 1960 – 2002. The results of study point out the two-way relationship between export and economic growth. Moreover, the impact of foreign direct investment on export, as well as on economic growth in Greece was proven. Fabry [3] examines the relationship between foreign direct investment, export and economic growth by means of Johansen test for cointegration and Granger causality test. The research was performed on a sample of countries from Central and Eastern Europe. According to the research, the impact of foreign direct investment

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on economic growth was proved in Albania and Russia. On the contrary, the impact of economic growth on FDI inflow was proved in case of Hungary, Poland and Romania. The author states at the end of the research that export has stronger impact on the economic growth than it has on foreign direct investment in Central and Eastern Europe and, on the contrary, the impact of foreign direct investment on export has not been proved by the research in countries of Central and Eastern Europe. Pacheco-Lopéz [5] who tested annual data from 1970 – 2000 between foreign direct investment and export in Mexico took similar approach. Based on the VAR model she proved the two-way relationship between export and foreign direct investment. On the one hand, export stimulates the foreign direct investment; on the other hand the foreign direct investment contributes to the country's growth of export. Pelinescu and Radulescu [6] deal with impact of foreign direct investment on economic growth in Romania. They use data of gross domestic product, foreign direct investment and export, which are quarterly calculated by logarithm and they are season adjusted, for the period 2001 – 2009. In order to model causal relations they use the same approach as already mentioned in the above researches. In the study they conclude that FDI have slight, however positive influence on both the gross domestic product and export. Furthermore they state that in order to have stronger positive FDI impact on economic growth and export it is necessary to use longer time interval.

3 Model specification and data

Dritsaki et al. [2] use the above mentioned study from the methodology point of view of the causal relations model between exports, gross domestic product and foreign direct investment. Causal relation between the variables shall be examined by VAR autoregressive model in the following form:

$$EXP = f(FDI, GDP) \tag{1}$$

Individual variables in an equation are: EXP = export, FDI = foreign direct investment, GDP = gross domestic product.

Export represents the export of goods and services at regular prices. Foreign direct investment defines the FDI condition in a country. Gross domestic product is expressed in market prices. Each data is in million EUR. These are quarterly data for different time periods depending on the data availability in each country. Time period in Poland is for Q1. 2004 – Q4. 2010. Time period in the Czech Republic and Latvia is for Q1. 2000 – Q4. 2010. In Estonia it is for the time period of Q1.1996 – Q4. 2010. Time period selected for Lithuania, Slovakia and Slovenia is for Q1. 2001 – Q4. 2010. The research in Hungary was performed for a period of Q1. 1995 – Q4. 2010.

The data describing export and gross domestic product are obtained from Eurostat. The data on FDI condition are gained from the individual countries' central banks. Export and gross domestic product data are season clear. Season clear series is marked with "sa" at the end of the time series' title. Individual data were calculated by logarithm before the testing. Calculation by logarithm was performed for the purpose of the time series smaller dispersion and consequently to ensure stationarity of the time series. Individual time series calculated by logarithm are marked with capital letter "L" before the each time series' title.

3.1 Unit root test

In order to perform cointegration that shall be used to test the long-term causal relations between selected variables it is necessary for the logarithmized time series being stationary on the first difference I(1) and nonstationary on its own values. Stationarity test is performed by Augmented Dickey – Fuller test (ADF test). Lag length of the time series in the ADF test was based on the Schwarz criterion. According to the development of logarithm adjusted data, a test stationary equation included a coefficient in case of FDI and EXP and it included a trend coefficient in case of gross domestic product. This is demonstrated by the following equation:

$$\Delta X_t = \delta_0 + \delta_1 t + \delta_2 X_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta X_{t-i} + u_t \tag{2}$$

ADF test is used to determine a unit root X_t on the level of each variable calculated by logarithm in time *t*. Variable ΔX_{t-i} determines the first difference with lag length and u_t suggests the autocorrelation of the error. Coefficients δ_0, δ_1, δ_2 a α_i are suggested. Null and alternative hypothesis for the existence of a unit rook in variable X_t is: H_0: $\delta_2 = 0$, H_ε: $\delta_2 < 0$ (Dickey and Fuller [1]).

Results are shown in the Table 1. On the left side you can find the data determining time series which are not stationary in level value. On the right side there are data determining stationarity of time series with the first difference. On the level of importance, an index "a" means 1% importance, "b" means 5% importance and "c" means 10% importance. The assumption for further test and research of long term relationships between specified variables is met since the time series stationarity was proved in the first differences.

Country	Variable	In their levels		1st differences	
		Lagged	T-statistics ADF	Lagged	T-statistics ADF
CZE	LEXP_sa	9	(-1.194)	9	(-4.904)[a]
	FDI	9	(-2.095)	9	(-4.706)[a]
	LGDP_sa	9	(-1.192)	9	(-4.457)[a]
EST	LEXP_sa	10	(-1.670)	10	(-4.968)[a]
	LFDI	10	(-0.713)	10	(-7.121)[a]
	LGDP_sa	10	(-1.133)	10	(-2.884)[b]
HUN	LEXP_sa	10	(-1.854)	10	(-4.864)[a]
	LFDI	10	(-1.950)	10	(-8.674)[a]
	LGDP_sa	10	(-0.589)	10	(-6.398)[a]
LVA	LEXP_sa	9	(-0.497)	9	(-3.966)[a]
	LFDI	9	(-0.872)	9	(-4.055)[a]
	LGDP_sa	9	(-1.159)	9	(-3.086)[b]
LTU	LEXP_sa	9	(0.701)	9	(-4.788)[a]
	LFDI	9	(-1.257)	9	(-4.707)[a]
	LGDP_sa	9	(-1.430)	9	(-4.174)[a]
POL	LEXP_sa	6	(-1.045)	6	(-2.843)[b]
	LFDI	6	(-1.830)	6	(-4.120)[a]
	LGDP_sa	6	(-1.675)	6	(-3.715)[b]
SLO	LEXP_sa	9	(-1.299)	9	(-3.251)[b]
	LFDI	9	(-2.188)	9	(-5.781)[a]
	LGDP_sa	9	(-0.100)	9	(-4.795)[a]
SVK	LEXP_sa	9	(-0.985)	9	(-3.720)[a]
	LFDI	9	(-2.861)	9	(-6.748)[a]
	LGDP_sa	9	(-0.655)	9	(-4.046)[b]

Table 1 ADF – Unit Root Test

4 Long term relationship test between FDI, EXP and GDP

Johansen test for cointegration was used to test long term relationships between FDI, EXP and GDP. It is necessary to define appropriate time lag length within this test. Here, an Akaike criterion was used while determining the appropriate lag length, which was applied for the non-differentiated VAR model estimation. Two periods with an appropriate lag length were proved in Hungary, Latvia, Poland, Slovenia and Slovakia. Four periods with appropriate lag length were proved in Estonia. Three periods were proved in the Czech Republic and one period in Lithuania.

Long term relationships test between FDI, EXP and GDP in individual countries was performed on the basis of the following equation (3):

$$LEXP\_sa = \alpha + \beta_1 LFDI + \beta_2 LGDP\_sa + \mu \tag{3}$$

The dependent variable is export and the independent variables are FDI and GDP. Cointegration relationships were examined for each country individually. Long term relationships between variables in Johansen test are examined on the basis of two tests, and that is a Trace test and Max-eigenvalue test. The results are shown in

the Table 2. The Table 3 includes cointegration equations. There was no long term relationship between the variables proved according to the Johansen cointegration test in the Czech Republic, Lithuania and Latvia.

Country	Null Hypothesis	Trace Statistic	Critical Value 0.05	Max-Eigen Statistic	Critical Value 0.05
CZE	r=0	38.25707	35.19275	24.66499	22.29962
	r<=1	13.59208	20.26184	9.150793	15.8921
	r<=2	4.441288	9.164546	4.441288	9.164546
EST	r=0	35.33130	35.19275	14.40979	22.29962
	r<=1	20.92152	20.26184	12.87337	15.89210
	r<=2	8.048144	9.164546	8.048144	9.164546
HUN	r=0	63.44122	35.19275	38.12878	22.29962
	r<=1	25.31244	20.26184	19.68283	15.89210
	r<=2	5.629603	9.164546	5.629603	9.164546
LVA	r=0	38.37530	35.19275	23.25614	22.29962
	r<=1	15.11916	20.26184	11.76007	15.89210
	r<=2	3.359081	9.164546	3.359081	9.164546
LTU	r=0	43.42952	35.19275	32.48876	22.29962
	r<=1	10.94076	20.26184	8.710273	15.89210
	r<=2	2.230486	9.164546	2.230486	9.164546
POL	r=0	41.07743	35.19275	24.74526	22.29962
	r<=1	16.33217	20.26184	10.99543	15.89210
	r<=2	5.336741	9.164546	5.336741	9.164546
SLO	r=0	43.09568	35.19275	19.59360	22.29962
	r<=1	23.50207	20.26184	15.35180	15.89210
	r<=2	8.150273	9.164546	8.150273	9.164546
SVK	r=0	38.65633	35.19275	22.70358	22.29962
	r<=1	15.95274	20.26184	11.13284	15.89210
	r<=2	4.819906	9.164546	4.819906	9.164546

Table 2 Johansen cointegration test Variables LEXP, LFDI and LGDP

Country	Cointegration equation
CZE	No cointegration relationship
EST	*LEXP_SA=-0.490LFDI+2.576LGDP_sa-8.835* *(0.480) (0.958) (3.709)*
HUN	*LEXP_sa=3.208LFDI-3.309LGDP_sa+7.786* *(0.529) (0.929) (3.975)*
LVA	No cointegration relationship
LTU	No cointegration relationship
POL	*LEXP_sa=0.067LFDI+1.178LGDP_sa-3.751* *(0.117) (0.199) (0.932)*
SLO	*LEXP_sa=0.840LFDI-0.588LGDP_sa+6.211* *(0.318) (0.858) (4.887)*
SVK	*LEXP_sa=-0.102LFDI+1.367LGDP_sa-2.800* *(0.095) (0.138) (0.431)*

Table 3 Cointegration Equation

5 Vector error correction model

Long term relationships between variables were proved in five countries out of eight; however, cointegration does not take into account short term deviations. For this reason there is a Vector error correction model (VECM) used to detect such deviations within the cointegration.

Vector error correction model was used in such situations where the existence of cointegration relationships was proved. On the basis of the test, an appropriate lag length was defined for two periods (Hungary, Poland, Slovenia and Slovakia), four periods (Estonia). A suitable model setting was tested by selected autocorrelation, normality and heteroscedasticity test. The test proved that neither of the effect was present in the model, it means that the model is set correctly. The results of vector error correction are shown in the Table 4.

Variable	**HUN**	**POL**	**SLO**	**SVK**	**Variable**	**EST**
	D(L_EXP_sa)	**D(L_EXP_sa)**	**D(L_EXP_sa)**	**D(L_EXP_sa)**		**D(L_EXP_sa)**
CointEq1	-0.022	0.399	0.050	0.033	CointEq1	-0.347 [a]
	(-1.180)	(1.087)	(0.594)	(0.189)		(-2.481)
D(L_EXP_sa(-1))	0.476	0.643	0.772	0.431	D(L_EXP_sa(-1))	0.303
	(3.109)	(1.433)	(2.728)	(2.216)		(1.924)
D(L_EXP_sa(-2))	0.061	-0.284	0.101	0.292	D(L_EXP_sa(-2))	0.311
	(0.396)	(-0.642)	(0.383)	(1.469)		(2.117)
D(L_FDI-1))	-0.030	0.039	-0.109	-0.103	D(L_EXP_sa(-3))	0.156
	(-0.398)	(0.113)	(-0.964)	(-0.720)		(1.007)
D(L_FDI-2))	0.061	0.033	0.037	0.305	D(L_EXP_sa(-4))	-0.125
	(0.775)	(0.095)	(0.314)	(2.168)		(-0.813)
D(L_GDP_sa(-1))	0.080	0.017	-0.600	0.138	D(L_FDI-1))	0.157
	(0.448)	(0.027)	(-0.925)	(0.342)		(1.665)
D(L_GDP_sa(-2))	-0.330	-0.089	-0.549	-1.094	D(L_FDI(-2))	-0.096
	(-1.985)	(-0.183)	(-0.920)	(-2.730)		(-0.981)
C	0.015	0.017	0.019	0.029	D(L_FDI(-3))	0.021
	(2.295)	(1.167)	(1.876)	(1.284)		(0.223)
R-squared	0.284	0.515	0.379	0.471	D(L_FDI(-4))	0.093
Adj. R-squared	0.190	0.315	0.229	0.339		(0.981)
Sum sq. resids	0.074	0.029	0.030	0.045	D(L_GDP_sa(-1))	0.502
S.E. equation	0.037	0.041	0.032	0.040		(1.832)
F-statistic	3.012	2.580	2.534	3.571	D(L_GDP_sa(-2))	0.201
						(0.734)
					D(L_GDP_sa(-3))	-0.704
						(-2.711)
					D(L_GDP_sa(-4))	0.144
						(0.493)
					C	-0.002
						(-0.265)
					R-squared	0.522
					Adj. R-squared	0.371
					Sum sq. resids	0.089
					S.E. equation	0.046
					F-statistic	3.455

Table 4 Vector Error Correction Model

The Table 4 shows t-statistics in the brackets. Index “a” means the coefficient importance of the error correction (CointEq1) on the 1% importance level. From the statistic point of view it is proved that this coefficient is

important in equations with the explained EXP variable only in case of one country – Estonia. In other countries such importance of the model was not proved. According to this we can state that, in respect to short term deviations, the model fails to explain adequately the convergence for long term balance in countries where the vector error correction coefficient is not important from the statistic point of view. Consequently, the next chapter shall include the results of causal relationships model between FDI, EXP and GDP only for those countries where the coefficient proved to be statistically important.

6 Results of the causal relationships model between FDI, EXP and GDP

On the basis of the above test, the existence of long term relationships between variables was proved in five countries. Subsequently, the results of VECM proved statistical importance of the correction model for the dependent variable only in Estonia. Arising from such findings, the following sub-chapter includes the analysed results of the causal relationships model for Estonia.

On the basis of cointegration equation for Estonia, as follows:

$$LEXP_{sa} = \underset{(0.480)}{-0.490}LFDI + \underset{(0.958)}{2.576}LGDP_{sa} - \underset{(3.709)}{8.835} \tag{4}$$

the long term positive relationship in the country was not proved between foreign direct investment and export. Based on the equation, as a consequence of FDI growth by 1 % with the lag length of four months the export decreased by 0.49%. It means that foreign direct investment in Estonia do not contribute to the export growth. This might be due to the FDI types that are aimed to seek markets. This FDI types flow into the country with the aim to get a part on a market abroad and reduce the costs to supply such market. Such FDI are not export oriented and for this reason they do not contribute to the export growth.

The statistical importance of the error model coefficient in the chapter five proves that the model can explain the short term dynamics, as well as convergence for the balance condition. In case of Estonia and EXP dependent, the results of adjusted coefficient are high and they prove that 34.7% of short term deviations from the balance condition are adjusted by changes in the model dependent variable with the lag length of four quarters. The result is that the rate of convergence towards the balance condition is very satisfying in this case.

On the basis of the research method and by means of available time series, the generally accepted opinion about the FDI positive effect on foreign trade of a country was not proved. The method of research led to the result analysis of causal relationship models between variables only within one country – Estonia. Other countries failed to prove statistic importance of the VECM correction model and consequently the results analysis of causal relationships model between FDI, EXP and GDP was not performed.

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