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Analysis of the Cobb-Douglas Production Function as a Tool to Investigate the Impact of FDI Net Inflows on Gross Domestic Product Value in Poland in the Period 1994–2012

JEL classification: *F43; C52*

Key words: *FDI, GDP; Cobb-Douglas production function; VECM (Vector Error Corection Model)*

Abstract: *The purpose of this paper is to analyse the impact of foreign direct investments net inflows on changes in GDP value in Poland in the period between 1994 and 2012 with the use of the Cobb-Douglas production function. The paper consist of five parts. Parts I and II present some aspects of the FDI influence on economic growth from the theoretical and empirical point of view. Part III defines conditions indispensable for the positive FDI impact on the economy of the host country. Part IV outlines changes of FDI flows in Poland in the period of 1994-2012. Part V includes the main assumptions of the Cobb-Douglas production func-*

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tion and an estimate of changes in GDP value for Poland in the period 1994–2012 with the use of the VECM. The factors significant for economic growth are also identified, including the significance of the net FDI inflows. Eventually, the effect of gross fixed capital formation, employment, FDI net inflows, exports and R&D on changes in the GDP value are determined.

Introduction

The main purpose of the paper is to investigate significance of the factors of production on economic growth in Poland in the years 1994–2012, with particular attention given to the influence of FDI net inflows. A decision to take FDI net inflows into account as an explanatory (independent) variable of changes in the GDP value resulted from a number of preconditions including increased FDI inflows as well as outflows in Poland, especially in the period of the financial crisis, slowly growing significance of Polish foreign investments and the process of disinvestment. The paper took advantage of the methods used in the international economic literature, including econometric methods (V*ector Error Correlation Model – VECM*). Investigation of the FDI impact on growth of the GDP value was carried out with the use of the Cobb-Douglas production function. Statistical data came from the OECD and UNCTAD databases. The reason for which the research into the FDI influence on economic growth in Poland was undertaken was to define the influence of these investments on economy over the transformation period of more than 20 years.

Theoretical aspects of FDI impact on economic growth

Some authors argue there are several potential ways in which FDI can influence economic growth. Growth models have started with the neoclassical models (Solow and Swan) in the 1960s and relied on capital and labour, FDI being considered not to influence long-term economic growth, but only the income level. In neo-classical growth models, FDI increases the capital stock and finance capital formation contributing to economic growth. In this case, the effects of foreign investments are the same as domestic capital influence. But these models predict only a short run effect on economic growth, due to the diminishing returns of capital.

On the other hand, in the new growth theory FDI is assumed to have a positive impact on economic growth both in short and long term (Herzer *et al*., 2008, pp. 793-910). They argue that FDI is more productive than

domestic capital and related to spillover effects the impact of capital diminishing returns is low and economy continues to grow in the long run.

The causality relation between FDI and growth is not necessarily unidirectional; causality can work in both directions. The standard economic theory offers explanations for FDI influence on growth. The reverse causality (i.e. from economic growth to FDI) is based on the process of "cumulative causation" that in the long run causes that the economic growth based on the development of capital stock may create new economic activities, a higher demand for new consumer products that will attract an increased level of FDI.

Moreover, theoretical literature suggests in some papers that the positive relationship between FDI and growth is not necessarily true. For example, Herzer *et al*. (2008, pp. 793-910) argue that if FDI considerably "crowd out" domestic investments, then it is possible to have a growth decelerating impact on recipient country.

The positive impact of FDI inflow on economic growth depends on various factors such as the human capital, the degree of trade openness, the depth of financial market or the income per capita level (see: Aizenman & Noy, 2006, pp. 317-337).

Results of selected empirical analysis of the FDI influence on economic growth

Empirical studies have generally led to conflicting results regarding the role and impact of FDI on host states. In general, when we speak of the link FDI-economic growth we usually assume that FDI are those that influence the growth rate. Such a hypothesis is based on the ability of foreign direct investment to influence the growth factors such as: investment, technological progress, human capital. But the link FDI – economic growth may be a bi-directional one, rapid economic growth leading to an increase in FDI (Vintila & Zaharia, 2012, p. 248).

In a relatively early study including some OECD developed countries, Barrell and Pain (1997,) suggest that there is evidence for significant spillovers and increased export performance from the presence of inward FDI. In a related work, Borensztein *et al.* (1998), using a panel of 69 developing countries in the 1970s and 1980s, found a positive and significant FDI effect on growth, only for countries holding a minimum threshold stock of human capital. These results suggest the importance of the absorptive capacity of the host economies in assimilating the advanced technologies

transferred, usually from developed countries, a hypothesis thoroughly explored in relevant micro-studies.

According to Hejazi and Safarian (1999, p. 491-511), FDI is a dominant channel for R&D diffusion in OECD countries, with its importance being higher than that of trade. However, de Mello (1999, p. 133-151) argues that FDI is expected to boost long-run growth in the recipient economy and provides evidence that the extent to which FDI is growth-enhancing depends on the complementarity or substitutability between FDI and domestic investment. Furthermore, Balasubramanyam *et al*. (1999, p. 27-40) suggest that an important role is exerted by the size of the local market, the competitive environment and the availability of human capital in order for FDI to promote economic growth, while Elahee and Pagan (1999, p. 59-67) find positive evidence for the role of FDI in East Asian and Latin America countries, over the period 1985–1993.

The research of Barthelemy and Demurger (2000, p. 140-155), using panel data on 24 Chinese provinces in the period 1985–1996, provides evidence for a positive and mutual relationship between FDI and economic growth. Furthermore, they stress the importance of human capital for the adoption of foreign technologies and economic growth. Haveman et al. (2001, p. 289-311), using data from 1970 to 1989 and 74 countries, find evidence for a positive growth effect of international integration indicators, such as openness, membership in a trade block or FDI.

By contrast, Zhang (2001, p. 175-185), in a study of 11 East Asian and Latin America countries during the period 1960–1997, finds that there is a strong variation in the growth enhancing impact of FDI. According to his findings, FDI is more likely to boost economic growth in countries with particular characteristics like liberalised trade regimes, improved education, large export-oriented FDI and macroeconomic stability, for example Hong Kong, Indonesia, Singapore, Taiwan and Mexico.

Further evidence in favour of a positive growth FDI effect is provided by Ram and Zhang (2002, p. 205-215) using a cross section of 85 countries between the years 1990 and 1997, Campos and Kinoshita (2002, p. 398-419) utilising panel data from 25 transition economies in the period 1990-1998, and Hansen and Rand (2006, p. 21-41) in a sample of 31 developing countries during 1970–2000. We should also note that the studies of Dollar and Kraay (2003, 2004) have provided us with evidence that the effects of globalisation were positive on growth, in a panel of developing countries that followed liberalised trade policies in the 1980s (Dimelis & Papaioannou, 2010 pp. 80-81).

Using a VAR model, Misztal (2010, pp. 39-53) shows that foreign direct investments was one of the key factors which substantially influenced GDP growth in Romania during 2000–2009.

Using a production function approach employed with a panel data for 1992-2007 period, Verhorn and Vasarevici (2011, p. 23-34) prove that FDI and domestic investment are statistically significant determinants of economic growth; as well as prudent fiscal and monetary policy in Central and East European countries.

The existing empirical evidence shows the importance of FDI in fostering investment in ICTs in developing economies (Gholami, *et al*., 2006, pp. 43-62). While developed countries are expected to adopt more quickly general purpose technologies (GPTs), the developing countries tend to imitate them with lower costs because of learning and experience effects. Furthermore, ICT is expected to have a positive impact on FDI as it creates opportunities, especially for developing countries that are located away from technologically advanced countries, to free themselves from geographical limitations and become more attractive to foreign investors (Dimelis & Papaioannou, 2010, p. 82).

Dimelis and Papaioannou researched possible effects stemming from FDI and Information and Communication Technologies (ICT) on productivity growth. Their analysis is based on panel data covering a sample of 42 developing and developed countries during the period 1993–2001. The growth accounting results indicate that the growth contribution of ICT was quite high for both developed and developing countries. On the contrary, the FDI contribution was relatively low. The econometric results showed a positive and significant impact of ICT in all groups, the effect being larger among developing countries. Positive and significant FDI effects were found in the group of developed countries, and positive but insignificant, among the developing ones (Dimelis & Papaioannou, 2010, pp. 79-96).

From the point of view of a domestic company, FDI is one of the instruments for production stimulus, import of know-how, employment growth, infrastructure development, poverty reduction etc. From the aspect of a foreign company, the abovementioned investments can be defined as any form of capital investment in a foreign company, which enables achieving the ownership control. The operating mechanism of FDI considers establishing a subsidiary of parent firm in a foreign country, which can be investor's full ownership or partial foreign ownership. Significant variables in this aspect of FDI are financial capital flows, value of investor's accumulated capital and income flows from the investment. According to the International Monetary Fund, FDI is a category of cross-border investments which represent intention of a subject from one country to achieve

permanent interest in a company with the residence in another country. Permanent interest implicates long term connection between investor and domestic company and level of investor's influence on managing the company. Level and control and managing rights do not have to be complete and absolute, but such that can allow certain influence on business politics of the company, in which capital is invested. It can be concluded that the spread of potential effects (direct and indirect) from FDI is wide and the effects are mutual (table 1).

Table 1. Spread of FDI potential effects

Effects	Direct		Indirect	
	Positive effects	**Negative effects**	**Positive effects**	**Negative effects**
Quantity	Capital inflow and employment growth in propulsive industries	FDI that take place through Brownfield investments can rationalize and minimize number of working places	New working places throughout linking with suppliers and buyers	Importing from domestic country or moving company to another country
Quality	Contributing to productivity growth	Implementing practice of cutting working places and promotions	Sharing experience and best practices among domestic companies	Lowering salaries if domestic companies decide to compete with low salaries
Location	New and probably better working places in the industries with great unemployment	Contributing to further development of regional centers and strengthening regional inequality	Strengthening companies' determination to migrate from regional centers	Creating local monopole

Source: Petrović, Stanković (2009, p. 15).

Preconditions of positive impact of FDI on economic growth in the host country

The macro empirical literature indicates that local structures, institutions and capital endowments are important for a host country to take advantage of FDI (Alfaro *et al*., 2006). In particular, there is evidence that FDI contributes to host country's productivity when technology gap is not large and when a sufficient level of absorptive capacity exists in the host country (Kokko, 1994, pp. 279-293; Borensztein *et al*., 1998; Kinoshita, 2000). Other recipient country's conditions for the growth effect of FDI include the level of financial development, local credit constraints and (OPEN) openness of trade (Hermes & Lensink, 2003; Alfaro *et al*, 2004; Aghion *et al*., 2005, pp. 173-222).

Overall, the econometric results indicate that developing countries have the potential to benefit from ICT. With respect to FDI, Lall and Narula (2004) note that FDI cannot drive long-run economic growth of the host county without the existence of local capabilities and without the assistance of governments in promoting policies favourable for FDI. Such policies might be oriented to (OPEN) openness of trade and financial development. Further policies will lead to the increase of competition in the high-technology sector, the increase of Internet diffusion, the development of telecommunications infrastructure, and the establishment of an adequate legal and regulatory framework. Moreover, special focus should also be placed to high-level specialised training, without, however, overlooking basic education because the encouragement of training is more effective when basic skills are already available (Dimelis & Papaioannou, 2010, p. 93).

The level of education (qualification), a minimum level of technology and macroeconomic stability, favourable business environments, low country risk, even the sector where FDI take place can influence the link FDI-economic growth.

FDI flows in Poland in the period of 1994–2012

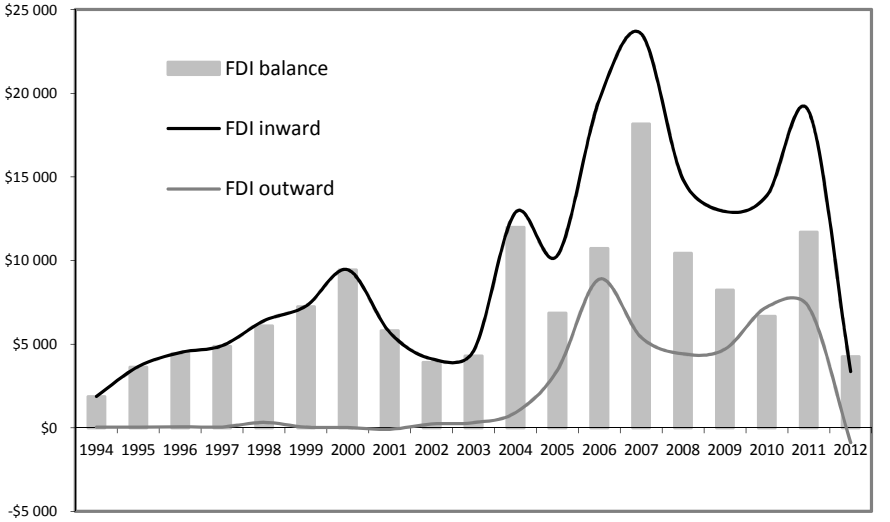
The data of the UNCTAD (UNCTADStat, 2014) concerning FDI inflows and outflows in Poland over the period 1994–2012 indicate that in the 1990s these flow were characterized by a relatively stable upward trend. However, in the 2000s strong short-term fluctuations occurred, both upward and downward. The FDI inflows to Poland increased from USD 1 875 million in 1994 to USD 9 445 million in 2000. During the period 2001-

2012, which was characterized by a fairly strong amplitude of changes, the upward trends in FDI inflows covering the years 2002–2004, 2006–2007 and 2012. The highest value of FDI inflows was noted in Poland in 2007 and it stood at the level of USD 23 561 million. What is more, while comparing the absolute values of FDI inflows in the entire market of the CEE countries it is evident that Poland was the main destination of FDI inflows next to such countries as Hungary, Czech Republic or Slovakia.

The role of Poland as an exporter was negligible, but it was growing in the 2000s. An increase in the value of the Polish foreign investments was noted in the years 2002–2011. In that period, it grew from USD 229 million to USD 7 211 million, reaching the record level of USD 8 883 million in 2006. In 2012 disinvestment occurred, i.e. a withdrawal of capital from abroad and repatriation of Polish investors' profits at the level of USD 894 million.

Over the entire analyzed period Poland was a net FDI 1 846 million in 1994 reaching USD 9 428 million in 2000 and then USD 11 974 million in 2004, USD 18 156 million in 2007 and USD 4 250 million in 2012. Like in other CEE countries, the 2001–2002 recession, the EU accession in 2004 and the outbreak and occurrence of the global financial crisis entailed changeability in FDI inflows and outflows in Poland (Figure 1).

Figure 1. Inward and outward FDI flows and balance in Poland in the period 1994-2012 (in million USD)



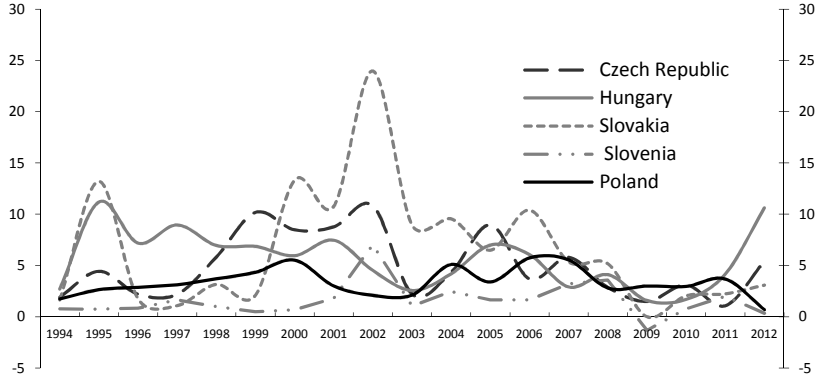
Source: authors`s own calculations on the basis of UNCTAD (UNCTADStat, 2014).

While analyzing the relative size of FDI inflows to Poland in the years 1994–2012 it must be noted that the percentage of these inflows to Poland in global FID inflows oscillated around 1.0%. This percentage stood at 0.73% in 1994 falling to 0.25% in 2012. Poland reached the highest FDI inflow in comparison to global inflows (1.75%) in 2004. In the case of other CEE countries in the years 1994–2012 these shares stood at 0.44% and 0.99% respectively for Hungary, 0.33% and 0.78% for the Czech Republic, 0.09% and 0.21% for Slovakia and 0.04% and 0.01% for Slovenia.

While analyzing FDI inflows to the countries undergoing transformations (Kraszewski & Sudoł, 1997) (including CEE countries) in global inflows of these investments, the importance of this group of countries was growing. According to UNCTAD their share in global FDI inflows had grown from 0.79% in 1994 to 6.47% in 2012.

The UNCTAD data concerning the FDI inflow to GDP ratio in the years 1994–2012 indicate that the inflow was relatively low, taking the economic potential of Poland into consideration. This ratio for Poland stood at 1.73% in 1994 and 0.69% in 2012 at the growth of 5.09% in 2004, 5.74% in 2006 and 5.54% in 2007. In the case of the Czech Republic the FDI inflow to GDP ratio was 1.90% in 1994 and 5.40% in 2012 reaching the highest value of 10.81% in 2002. In Hungary this ratio stood at 2.67% in 1994 and 10.62% in 2012. In Slovakia in the years 1994–2012 the ratios were 1.63% and 3.08%, respectively, whereas for Slovenia – 0.77% and 0.32%, respectively (Figure 2).

Figure 2. FDI-to-GDP ratio in Poland, Czech Republic, Hungary, Slovakia and Slovenia in the period of 1994-2012 (as Percentage of GDP)



Source: authors`s own calculations on the basis of UNCTAD (UNCTADStat, 2014).

The UNCTAD data concerning the international position of Poland as far as investments are concerned in the years 1994–2012 indicate that the value of inward FDI stock amounted to USD 3 789 million in 1994 and grew reaching USD 230 603 million in 2012. As regards the value of outward FDI stock, in the examined period it grew from USD 461 million USD to USD 57 525 million.

Cobb-Douglas production function model

An aggregate Cobb-Douglas production function is specified, which incorporates four inputs, domestic capital (K), labour (L), foreign capital (F) and ICT capital:

$$Y_{it} = A_{it} e^{ct} (K_{it})^{\propto} (L_{it})^{\beta} (F_{it})^{\gamma} (ICT_{it})^{\delta} e^{uit} \quad (1)$$

where the subscripts of i and t denote country and year, respectively; Y measures gross output of each country, while K and F are taken to represent non-ICT capital. Furthermore, A and c are constant terms, the parameters α, β, γ and δ are the elasticities of domestic capital, labour, foreign capital and ICT with respect to output and finally u_{it} is the error term capturing unobserved variations between countries and over time.

After taking logarithms and following the assumption of constant returns to scale, the level of output per worker can be expressed as a function of domestic, foreign and ICT capital to labour ratios.

Following common practice in the growth literature, equation is further augmented by the lagged level of the dependent variable (lagged level of output per worker in its logarithmic scale) to capture convergence effects among countries (Barro, 1991, p. 407-433). The factors used in the augmented function can be transparency index (TI), government consumption (GOV) and openness of trade (OPENNESS) (imports plus exports as a share of GDP).

The transparency indicator reflects an assessment by business people and institutions of the degree of corruption in each country and the general idea for using this indicator is to proxy for institutional effects on economic growth.

Regarding GOV (as a share of GDP), economic theory has not come to definite conclusion about its impact on economic performance. Proponents of government presence argue that if government spending is low, there will be slow economic growth because operation of the rule of law and

providence of public infrastructures will be very difficult. On the other hand, opponents of government presence suggest that high government spending undermines economic growth by transferring resources from the productive sector of the economy to government, which uses them less efficiently.

The variable of trade openness (Openness) is defined as the ratio of total imports and exports to GDP. Higher trade volumes allow countries to specialise and gain comparative advantage that in turn leads to scale economies and higher efficiency. International trade is also considered as an important channel of technology transfer through imports of intermediate inputs and capital equipment (Feenstra *et al.*, 1992, pp. 415-421). Furthermore, trade induces local firms to become more innovative and productive in order to compete efficiently with foreign firms. The expected sign of this variable is positive.

Estimation of the Cobb-Douglas production function models for Poland in the period 1994–2012

In this paper the Cobb-Douglas production function was used to analyse the effect of domestic expenditure and foreign investment on changes in the GDP value. The Cobb-Douglas production function used is expressed by the following formula:

$$Y_t = f(GFCF_t, Employ._t, FDI_t, Exports_t, R\&D_t) \quad (2)$$

where:
Y – Gross Domestic Product, GDP (million USD, constatnt prices 2005);
GFCF – Gross Fixed Capital Formation (million USD);
Employ. – Employment (thousand person);
FDI – annual Foreign Direct Investment net inflows (million USD);
Exports – Exports goods and services (million USD);
R& D – Gross Domestic Expenditure on R&D (million USD, constant prices 2005 and PPPs);
t – analyzed period.

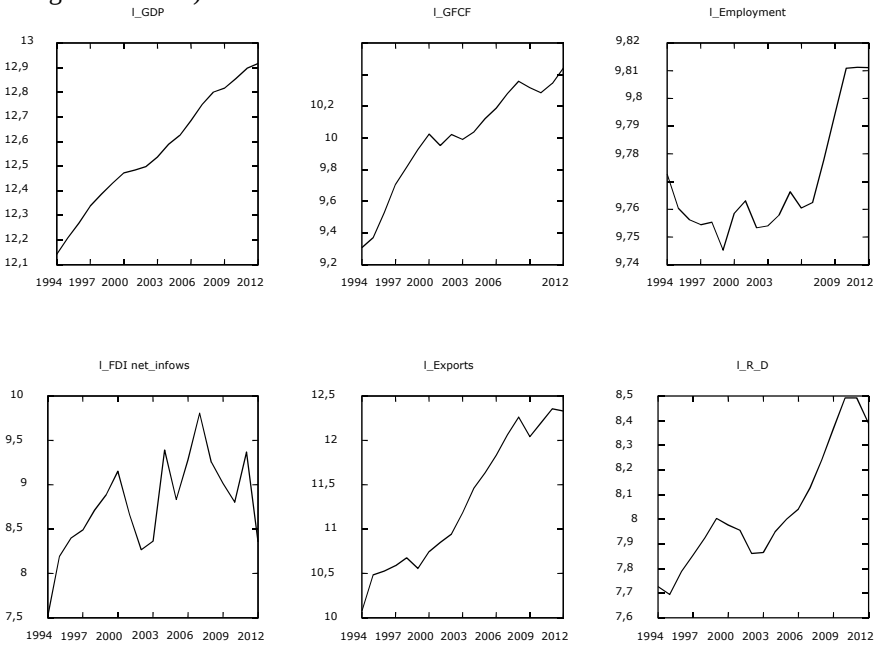
The time series of the above variables were taken from the OECD and UNCTAD Internet databases and they were the annual data. I employ FDI net, defined as net inflows of investment to acquire lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other that of the investor. It includes equity capital, reinvestment

of earnings and other long term and short capital as shown in the balance of payments.

Adoption of independent variables for GDP results from the assumptions of the Cobb-Douglas component functions and from similar investigations taking into account the FDI impact on economic growth in the country hosting investments, e.g. investigations of Dimelisa and Papoioannou (2010, pp. 79-96); Roman and Padureanu (2012, pp. 25-29); Driffield and Jindra (2012, pp. 32-37).

Prior to the estimation of the model the variables were logarithmed, the significance of structural parameters was examined as well as the goodness of fit of the model and selection of variables for the model (Figure 3).

Figure 3. Changes of GDP value, GFCF, Employment, FDI net inflows, Exports, R&D in Poland in the period 1994-2012 (million USD, thousand person, in logarithms data)



Source: authors`s own calculations on the basis of OECD (2014) and UNCTAD (2014).

In order to analyse the relationships between the dependent variable being GDP and independent variables, Pearson's correlation coefficient was calculated. The highest positive linear correlation occurred between Exports and GDP, at the level R^2=0.9752, as well as GFCF and GDP, at the

level R^2= 0.9681, compared with a lower correlation between expenditure on R&D and the GDP value, where R^2= 0.9255 (Table 2).

Table 2. Correlation coefficient of GDP, GFCF, Employment, FDI net inflows, Exports and R&D in Poland in the period 1994–2012

l_GDP	**l_GFCF**	**l_Employment**	**l_FDI net**	**l_Exports**	**l_R_D**	
1.0000	0.9681	0.7083	0.6224	0.9752	0.9255	**l_GDP**
	1.0000	0.5473	0.6799	0.9113	0.8557	**l_GFCF**
		1.0000	0.0920	0.7094	0.8493	**l_Employment**
			1.0000	0.6195	0.5129	**l_FDI_net**
				1.0000	0.8807	**l_Exports**
					1.0000	**l_R_D**

Source: authors`s own calculations on the basis of OECD (2014) and UNCTAD (2014), Gretl program.

In order to analyse stationarity of the analysed variables, an Augmented Dickey-Fuller test (ADF) was employed.

$$\Delta\hat{e}t = \hat{\rho}\, e_{t-1} + \sum_{j=1}^{k} \beta_j \Delta\hat{e}_{t-j} + v_t \qquad (3)$$

The lag length *k* in the ADF regression is determined using the *t*-sig method, i.e. downward testing beginning with an arbitrary large number of lags – in my analysis one. For all analysed variables a unit root a = 1 was noted; integration row I(1), which indicates non-stationarity of time series (Table 3).

Table 3. Test the residuals for stationary using the ADF regression

Times series	**A unit root**	**Integration row**
GDP	a =1	I(1)
GFCF	a =1	I(1)
Employment	a =1	I(1)
FDI net	a =1	I(1)
Exports	a =1	I(1)
R&D	a =1	I(1)

Source: authors`s own calculations on the basis of OECD (2014) and UNCTAD, (2014), Gretl program.

The conducted Johannes test confirmed cointegration between these variables. The Johansen procedure is based on a vector error correction model (VECM) given by:

$$\Delta y_t = \sum_{i=1}^{k-1} \Gamma_i \Delta y_{t-1} + \propto \beta` y_{t-1} + \psi D_t + \varepsilon_t \quad (4)$$

where:
y_t – $n\ x\ 1$ vector of endogenous variables ($Y_t = f(GFCF_t, Employ._t, FDI_t, Exports_t, R\&D_t)$,
β – $n\ x\ r$ matrix whose r columns represent the cointegrating vectors among the variables in y_t,
α – $n\ x\ r$ matrix whose *n* rows represent the error correction coefficients,
Γ – $n\ x\ r$ matrix of short-run coefficients,
ψ – n × r matrix of coefficients on D_t — a vector of deterministic terms, such as a constant term and a trend.

In order to test for cointegration, we use the trace test, which tests the rank r of the $n\ x\ n$ product matrix $\alpha\beta`$ such that the reduced rank, $r < n$, implies cointegration.

Thus, in accordance with Granger's claim about representation if variables y_t and x_t are 1st degree integrated I(1) and cointegrated, then the dependence between them can be represented as the error correction model (ECM) (Górecki, 2010, p. 219).

For the reason above, to analyse the factors determining changes in the GDP value in Poland, with particular attention given to foreign direct investment, the Vector Error Correction Model (VECM) was used which pointed to long-term cause–and-effect correlations between the analyzed variables. The general formula for this model is presented below:

$$\Delta Y_t = \propto + \beta_t + \lambda E_{t-1} + \gamma 1 \Delta_{t-1} + \cdots + \gamma p \Delta Y_{t-p} + \delta 0 \Delta X_t + \cdots$$
$$\ldots + \delta p \Delta X_{t-p} + \varepsilon_t + \quad (5)$$

where:
Yt – dependent variable;
Xt – independent (explanatory) variable;
Et–1 – error from the regression model estimate;
δp – parameters of long-term dependence (balance) *Yt–p* on *Xt–p*, (multiplier *Yt–p* in regard to *Xt–p* informing about *Yt–p* response to a unit change *Xt–p*);
γt–1 – parameter indicating the speed with which balance is restored (response to the difference between *Yt–p* and *Xt–p* in the previous period);

t – analyzed period;
p – lag order of model variables.

In the VECM the dependent variable increment *Yt* depends not only on the independent variable increment *Xt*, but partially also on the error magnitude by which *Yt*–1 deviates from the long-term balance (Piłatowska, 2003; Górecki, 2010, p. 219).

In the estimated model we assumed the time lag of 1 year between independent variables and the dependent variable. The lag order was selected in line with the results of the information criteria of the Akaike, Schwartz-Bayesian and Hannan-Quinn model.

The next stage in the analysis was estimating structural parameters of the Vector Error Correction Model. The results of this are included in Appendix 1. Then, in order to estimate the effect of independent variables (GFCF, Employment, FDI net inflows, Exports and Gross Domestic Expenditure on R&D) on changes in the GDP value in Poland, the residual variance was decomposed. In decomposition we adopted the forecast horizon for 9 periods .

Table 4. The error variance decomposition in the GDP equation for Poland (in %)

The number of quarter after shock	l_GDP	l_GFCF	l_Employment	l_FDI_net	l_Exports	l_R_D
1	100.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	94.7883	0.3396	1.8924	0.7888	0.7557	1.4352
3	93.3637	0.4324	2.4097	1.0044	0.9623	1.8275
4	92.7613	0.4716	2.6284	1.0956	1.0497	1.9934
5	92.4386	0.4926	2.7456	1.1444	1.0964	2.0822
6	92.2389	0.5057	2.8181	1.1747	1.1254	2.1373
7	92.1033	0.5145	2.8674	1.1952	1.1451	2.1746
8	92.0052	0.5209	2.9030	1.2100	1.1593	2.2016
9	91.9310	0.5257	2.9299	1.2213	1.1701	2.2220
10	91.8728	0.5295	2.9510	1.2301	1.1785	2.2380

Source: authors` own calculations on the basis of OECD (2014) and UNCTAD (2014), use GRETL program.

The calculations included in Table 4 indicate that changes in gross fixed capital formatione accounted only for 0.3396% of the changes in the GDP value in Poland two years after the occurrence of a shock and for 0.5295% of the changes after 10 years. The degree to which the changes in the GDP were explained by the changes in GFCF was the lowest among the examined independent variables. The size of employment in Poland had the strongest effect on the changes in the GDP value. It accounted for 1.8924% of changes in the GDP value two years after the occurrence of a shock and for 2.9510% of changes in GDP 10 years after a shock. The effect of other variables on changes in the GDP value after 2 and 10 years looked as follows (from the strongest to the lowest impact, respectively): expenditure on R&D (1.4352; 2.2380), FDI net inflows (0.7888; 1.2301) and exports of goods and services (0.7557; 1.1785) (Table 4).

This result can testify to low effectiveness of FDI on the Polish market, lack of reinvestment, transfer of income abroad, hence a current account balance for Poland is negative. The reason for that is unfulfilled conditions of the positive FDI impact on the economy of the host country, e.g. a technological gap.

The research results obtained for Poland for a fairly long period of 19 years (1994–2012) are less optimistic than those obtained for the time from the beginning of transformations until the outbreak of the 2007/2008 financial crisis, or the years 2004–2007 when the FDI inflows were particularly high. Furthermore, these results correspond with the research results obtained in this field by other authors who investigated the years: 1996–2004 (Szczepkowska-Flis, 2006), 2000–2009 (Misztal, 2012) and the research into the effect of FDI on the balance of payments, modernisation of economy (Witkowska 2011), increase in productivity, transfer of knowledge, technology, know-how and innovations (Weresa, 2008; Pangsy-Kania, 2010) or regional development (Kłysik-Uryszek, 2010), competitiveness (Bieńkowski et al., 2010), investment climate (Cukrowski & Jakubiak, 2004) in the situation of trade liberalisation (Molendowski, 2007) and other key areas determining economic growth.

Conclusions

In theoretical literature and empirical research there are many different explanations of the role and impact of FDI on host states. Empirical studies in the 1990s showed mainly a positive FDI impact on economic growth. But that research concerned developed countries. Instead, empirical studies

in the 2000s involving both developed and developing countries showed different effects: positive, negative, bi-directional as well as no effects.

The research in question showed one important fact, namely, that ability of individual economies to use positive externalities related to the inflow of FDI are limited by conditions prevailing in the host country, such as: the existence of a minimum threshold level of human capital, of improved domestic infrastructures, as well as of a developed local financial system. There is evidence that FDI contributes to the host country's productivity when the "technology gap" is not large and when a sufficient level of absorptive capacity exists in the host country.

The research conducted in Poland reveals that in the period 1994–2012 a linear correlation existed between the FDI inflow and growth (Pearson's coefficient R = 0.6224).

The research results obtained with the use of VECM reveal that GDP changes were much more accounted for by changes in employment in economy and gross domestic expenditure on R&D than by changes in FDI net inflows. In the examined period FDI net inflows had a positive impact on changes in the GDP value but it was not the strongest influence. The degree to which changes in the GDP value was explained by changes in FDI net inflows oscillated around 1.2%

In my opinion that FDI as a share of GDP, particularly in the 1990s and 2001–2003, 2008–2012 is rather small, often amounting to less than 2.5% of GDP (Figure 2) and thus also constituting only an insignificant share of total investment. Thus, FDI might simple be too marginal to have a serious growth impact.

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Appendix 1. Results of parameter estimate (VECM)

VECM system, lag order 1; Observations 1995-2012 (T = 18) Order of co-integration = 1					
Case 3: Unlimited absolute term (const)					
β (beta) (Co-integrating vectors. Estimate errors in parentheses)			α (alpha) (adjusted vectors)		
L_GDP	1.0000	(0.00000)	l_GDP	0.22606	
L_GFCF	-0.82574	(0.021056)	l_GFCF	1.1624	
L_Employment	-7.2025	(0.34425)	l_Employment	0.066585	
L_FDI_net	-0.018918	(0.0065902)	l_FDI_net	1.9659	
L_Exports	0.027112	(0.0079607)	l_Exports	-0.27838	
L_R_D	0.49196	(0.035661)	l_R_D	0.79490	
Logarithm of the likelihood = 214.0619 Determinant of covariance matrix = 1.8862927e-018 AIC = -19.1180; BIC = -17.0405; HQC = -18.8315					
Equation 1: d_l_GDP					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	14.05	5.88536	2.3873	0.02966	**
EC1	0.226061	0.094985	2.3800	0.03009	**
Arithmetic mean of dependent	0.043048	Standard deviation for dependent variable		0.018269	
Sum of squared residuals	0.004191	Residual standard error		0.016184	
Coefficient of determination of R^2	0.261456	Corrected R squared		0.215297	
Residual autocorrelation - rho1	0.182134	Durbin-Watson statistic		1.312090	
Equation 2: d_l_GFCF					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	72.0855	17.9574	4.0142	0.00100	***
EC1	1.16239	0.289819	4.0107	0.00101	***
Arithmetic mean of dependent	0.063037	Standard deviation for dependent variable		0.067839	

Sum of squared residuals	0.039013	Residual standard error		0.049379	
Coefficient of determination of R^2	0.501340	Corrected R squared		0.470174	
Residual auto-correlation - rho1	0.416417	Durbin-Watson statistic		1.104464	
Equation 3: d_l_Employment					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	4.12781	3.2347	1.2761	0.22013	
EC1	0.0665852	0.0522056	1.2754	0.22036	
Arithmetic mean of de-pendent	0.002130	Standard deviation for de-pendent variable		0.009057	
Sum of squared residuals	0.001266	Residual standard error		0.008895	
Coefficient of determination of R^2	0.092289	Corrected R squared		0.035557	
Residua auto-correlation – rho 1	0.336986	Durbin-Watson statistic		1.214016	
Equation 4: d_l_FDI_net					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	121.858	192.987	0.6314	0.53668	
EC1	1.96594	3.11466	0.6312	0.53683	
Arithmetic mean of de-pendent	0.046322	Standard deviation for de-pendent variable		0.521201	
Sum of squared residuals	4.505858	Residual standard error		0.530675	
Coefficient of determination of R^2	0.024295	Corrected R squared		-0.036686	
Residual auto-correlation - rho1	-0.339726	Durbin-Watson statistic		2.171813	
Equation 5: d_l_Exports					
	Coefficient	*Std. Error*		*t-ratio*	
Const	-17.1232	54.5941		-0.3136	
EC1	-0.278376	0.881106		-0.3159	
Arithmetic mean of de-pendent	0.125274	Standard deviation for de-pendent variable		0.146094	
Sum of squared	0.360590	Residual standard error		0.150123	

residuals					
Coefficient of determination of R^2	0.006200	Corrected R squared		-0.055913	
Residual auto-correlation - rho1	-0.091309	Durbin-Watson statistic		1.896090	
Equation 6: d_l_R_D					
	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	49.2895	23.3903	2.1073	0,05122	*
EC1	0.7949	0.377501	2.1057	0,05138	*
Arithmetic mean of de-pendent	0.036817	Standard deviation for de-pendent variable		0.070516	
Sum of squared residuals	0.066190	Residual standard error		0.064319	
Coefficient of determination of R^2	0.216989	Corrected R squared		0.168051	
Residual auto-correlation - rho1	0.152438	Durbin-Watson statistic		1.499117	

Source: own estimation.