Selected Factors Determining Inward of Foreign Direct Investment in the Czech Regions in Years 2002 to 2012

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Abstract

This study aims at the research of the influence of unemployment rate (Un), exchange rate of CZK/USD (Ex), inflation rate (Inf), expenditures on research and development (RaD), size of wages and environmental pollution on inward foreign direct investment (FDI) into regions in the Czech Republic in the period 2002–2012. The study dealt with the whole period, then the pre-crisis and crisis period, altogether with the inclusion or elimination of Prague in or out of the group of Czech regions. Models without and with dynamic parameter were checked. For estimation of influence of the above mentioned parameters the fixed effects model, random effects model and pooled ordinary least squares (POLS) were used. For dynamic model the generalized method of moments and POLS were applied. The results showed that Wage, appreciation of Ex and RaD positively determined the inflow of FDI to Czech regions and no negative determinant of inward FDI has been found. On the other hand, results of dynamic model imply that inward FDI in preceding year, appreciation of Ex, RaD have positive impact on inward FDI in current year. However, negative impact of Un and Inf on inward FDI were detected. Results of this research enable the policy makers or decision makers try to focus their attention on specific factors and eliminate to consume scarce funding.

Keywords

Foreign direct investment, unemployment, inflation, expenditure on research and development, pollution, panel data

JEL code

E22, E24, F21

INTRODUCTION

Foreign direct investment (FDI) is one of the driving forces of the economy and has always been a widely-discussed topic by politicians, economists but also by the public. The Czech Republic as the recipient of FDI used the investment to transform the economy. After the transformation period Czech got fully integrated in the global economy and now it is strongly interlinked with the neighbouring

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countries and, as was proved by comparison, the Visegrad Group countries and their main business partners account for the identical inward FDI per capita (Babuněk, 2012).

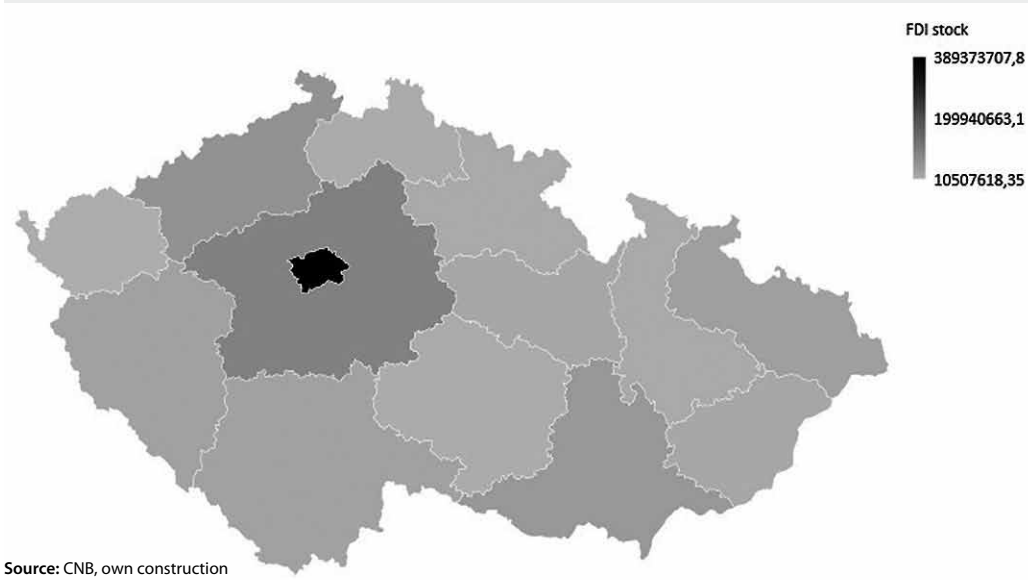
Almost all governments have an enormous interest in attracting FDI as it can create new job opportunities, new technologies and, in a broader sense, it can support the growth of competitiveness. FDI positively influences domestic competitiveness by introducing new technologies and improving human capital (skills) by raising wages of employees (Feenstra, 1997). In Czech, inward FDI is supported not only by domestic institutions (e.g. CZECHINVEST and others), but also by the geographical location of Czech within Europe. The location is also one aspect of the so called Dunning Eclectic Paradigm (Dunning, 2001), which was worked out by Dunning in the year 1988.

The inward FDI in Czech regions is uneven. The financial and later the economic crises that hit the Czech economy in the years 2008–2012 highlighted these disproportions even further. The Olomouc, Karlovy Vary and Zlin regions can be classified as the regions with the smallest inward FDI. On the contrary, regions like Prague, Central Bohemia, Moravia, Silesia and South Moravia received more than four times as much investment as the "worst" regions. More than half of all FDI that "flowed" into the Czech Republic headed for Prague (see Figure 1 to Figure 4). The privileged position of Prague is caused not only by the agglomeration effect (Budd, 2004) but mainly by its central location within the geographical structure of the Czech Republic. The policy of towns or regions that is inclined towards the FDI inflow has a better chance of attracting the investment if the town or region is economically (and administratively) near other urban or regional localities (Blanc-Brude, 2014).

The aim of the research is an analysis of the chosen determinants influencing the FDI flow into Czech regions, and later, their comparison in both the pre-crisis and crisis period, together with the inclusion or elimination of Prague in or out of the set of regions. An analysis of aspects influencing the FDI flow into the Czech Republic has already been worked out many times, nevertheless, the research of determinants of the FDI flow based on the panel data of Czech regions in the period 2002–2012 has not been done yet.

The study has the following structure: In the next part the existing literature dealing with determinants influencing inward FDI is described. The third part contains methodology and collected data necessary for analysis. The fourth part deals with the results and the last one is devoted to the conclusion.

Figure 1 FDI stock in 2000 in Czech regions



Source: CNB, own construction

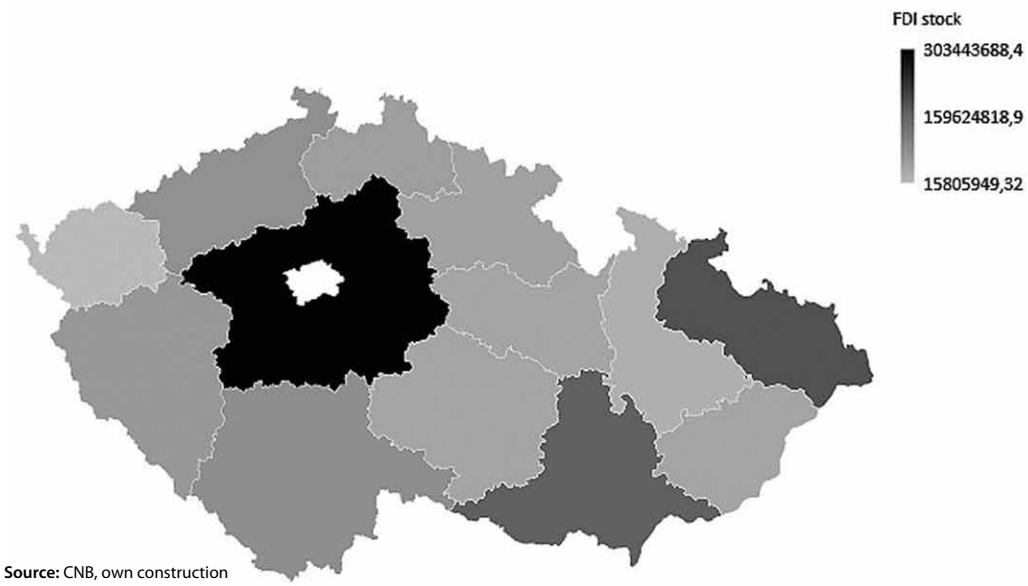
Figure 2 FDI stock in 2012 in Czech regions

Source: CNB, own construction

Figure 3 FDI stock in 2000 in Czech regions without Prague

Source: CNB, own construction

Figure 4 FDI stock in 2012 in Czech regions without Prague



Source: CNB, own construction

1 LITERATURE REVIEW

Large numbers of factors determining the inward FDI flow can be found anywhere but the study deals with aspects that should be significant.

1.1 Wages and unemployment

By the FDI flow into regions the demand for skilled workforce grows and in the regions where inward FDI is concentrated wages grow roughly by 50% faster than in the regions recording basically no FDI flow (Feenstra, 1997). This fact also deepens the structural differences in earnings (Nakamura, 2013). As seen from the global point of view, it can be said that inward FDI increases wage disproportions in the business sector (Chen, 2011), nevertheless, trade unions often make governments support inward FDI as much as they can. This pressure results in the fact that the governments offer foreign companies a tax discount (or a subsidy bonus) and go beyond the usual routine consisting in stipulation what should be done to attract investors because of higher wages demanded by trade unions (Haufler, 2011). Higher wages raise the price of the workforce and can lead to the growth of unemployment as the domestic companies usually show lower level of competitiveness. Higher wages of companies with foreign capital can cause internal tension in some companies without foreign capital (employees basically demand the same wage level as in the companies with foreign capital).

Özkan-Günay (2011) dealt with the identification of the basic factors necessary for obtaining FDI within the EU countries and two candidate countries (Croatia and Turkey) in the period 1998–2008. According to his study the unemployment rate is not a significant factor for inward FDI in the EU-15 countries but after the entry of the new member states from Central and Eastern Europe and the two candidate countries it became obvious that the unemployment rate has a positive impact on inward FDI (in this sense see also Lessmann, 2013; Long, 2015). When taking a complex look at the influence of the unemployment rate on the FDI inflow one cannot neglect the studies claiming that the unemployment rate has a negative impact on inward FDI (Boateng, 2015). The studies of Chen (2011), Olney (2013) and Huang (2013) also found out that the size of wages and the protection of employment by legal measures have a negative impact on inward FDI.

1.2 Exchange rate

Schiavo (2007) verified that the long-term fixed exchange rates have a positive impact on inward FDI, because in the fixed rate mode the volatility is usually eliminated. The empirical influence of the exchange rate in case of the FDI flow into the developing countries indicates that these countries de facto accept fixed exchange rate which substantially improves inward FDI, rather than those countries which opted for the floating exchange rates (Abbott, 2012). Kiyota (2004) pointed out that the level of exchange rate had a negative impact on inward FDI and he inferred that the depreciation of the currency of the host country contributed to the FDI inflow into its economy. The devaluation (depreciation) has a robust positive impact on the flows of FDI, while the average devaluation (depreciation) and its volatility do not have these impacts (Chakrabarti, 2002). When looking at the Eurozone it appears that the single currency and stability of the exchange rate are the main factors which helped the FDI inflow into the Eurozone countries (Usman, 2012).

1.3 Inflation

Boateng et al. (2015) also examined factors influencing inward FDI. He found out that the factors, such as money supply, inflation and interest rate seemed to have a negative impact on inward FDI. Kolstad (2008) and Li (2005) found out that the negative effect of inflation is statistically significant only in the developing countries, nevertheless, in the developed countries it is not significant. This may be caused by the fact that in the developed countries the economic development is lower than in the developing countries. Sánchez-Martin (2014) et al. also came to the conclusion of the insignificance of the factor of inflation and nominal interest rate, nevertheless, the results showed that it was not possible to determine negative or positive effects of inflation on inward FDI unambiguously. The inflation rate is often used as a proxy variable of the internal economic stability.

1.4 Research and development (RaD)

Even the business environment and infrastructure can be included in the set of key determinants influencing the attractiveness of inward FDI (Groh, 2012; Castiglione, 2012). The factor of infrastructure holds possible perils. There are several studies dealing with the influence of infrastructure on inward FDI. These studies found that the size or density of infrastructure had a positive effect on inward FDI (Yu, 2011; Castiglione, 2012; Long, 2015), but they were focused on the density of the network of motorways or railways. If the density of the network of motorways or railways was also included in the chosen determinants, this paper would more or less only follow the above studies. This article is going, instead of the generally included infrastructure variables, to try and explain the influence of expenditures on RaD. The RaD expenditures can be considered to be proxy variable of the technological infrastructure (Özkan-Günay, 2011). It has been found that the RaD expenditures are one of the main factors that helped the FDI inflow into the Eurozone (Usman, 2012). The growth of the public spending on RaD, and on education in general, influences the FDI inflow positively (Ramirez, 2013), but if the FDI inflow into the host economy increases, the innovation activities of the domestic companies are usually attenuated, which can be seen as a negative element.

1.5 Environment

It has been found that the long-term limitation of the environment in one country, which is caused by making standards of the environment protection stricter, may cause that the environmental pollution moves to the countries which do not try to reduce the environmental pollution (Kayalica, 2005). Low (1992) came to the conclusion that during the 70s and 80s a lot of multinational corporations moved their production capacities in the form of FDI into low income countries with no strict standards concerning the environmental protection. The production of highly polluting waste, such as pesticides and heavy

metals (e.g. copper and zinc) was also moved to areas with mild environment protection (Anderson, 1995), nevertheless, Javorcik (2004) did not confirm the results of Anderson´s study. Rezza (2013) pointed out the fact that a high rate of the environment protection and its enforcement did not seem to be a significant factor influencing the FDI inflow. The environment protection can be mainly observed in the effort to reduce the production of greenhouse gases, e.g. CO_2, but not in the production of community waste. The influence of the greenhouse gases production on inward FDI has been a subject of a number of research studies (see especially Pao, 2011; Omri, 2014a, 2014b), nevertheless, it has not been processed yet as a proxy variable of the environment protection in the form of community waste production.

1.6 Tested hypotheses

Six hypotheses are tested in this article. Tested hypotheses are mentioned below and all hypotheses are tested at $\alpha = 5\%$ significant level. Hypothesis is rejected if parameter does not show an assumed impact on inward FDI and, contemporaneously, if parameter shows an assumed impact, but is significant only at $\alpha = 1\%$ significant level.

H1: Increasing the regional unemployment rate shows a positive influence on the FDI flow into Czech regions.

H2: Increasing regional wages influence inward FDI into Czech regions negatively.

H3: Appreciation of the rate CZK/USD has a positive impact on the FDI flow into Czech regions.

H4: The inflation rate influences the FDI flow into Czech regions negatively.

H5: Growth of the RaD expenditures in regions has a positive impact on inward FDI into Czech regions.

H6: Inward FDI into Czech regions is negatively influenced by the growth of pollution of the environment in Czech regions.

2 METHODS A METHODOLOGY

2.1 Data

The data verifying the hypotheses were collected from the statistics of the Czech National Bank (CNB) and the Czech Statistical Office (CZSO). The years 2002 up to 2012 are the period under review.

Regarding the situation when the Czech Republic was hit by the financial or economic crisis in the year 2008, it is, according to the development of individually included variables, necessary to examine not only the period 2002–2012 but also the pre-crisis period, i.e. the years 2002 up to 2007 and the crisis period, i.e. the years 2008 up to 2012.

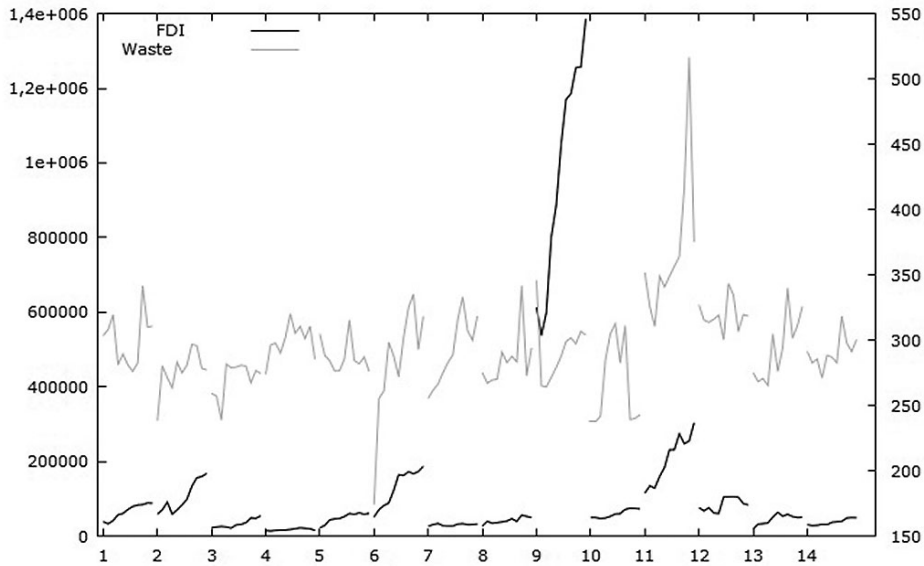
The Prague region is a problematic part of the research as the FDI inflow into Prague includes roughly one half of all FDIs in the Czech Republic. At the initial stage of the research the congruence of inward FDI per capita for the whole Czech Republic was analysed. As became obvious from the analysis (the results are fully available from the author upon request), this inflow is not identical in all regions and is not identical even after combining the Prague region and the Central Bohemian region into one "natural central Bohemian metropolitan area" (Viturka, 2010; Hampl, 2011). It is therefore necessary to eliminate Prague from the set of regions, nevertheless, the aim of the study is to examine all Czech regions, and that is why the research has to be divided into several parts.

The first area includes all the regions including Prague in the years 2002–2012. The second area includes all Czech regions with the exception of Prague. The third area includes all Czech regions in the pre-crisis years (i.e. 2002–2007). The fourth area includes all Czech regions with the exception of Prague in the pre-crisis years (i.e. 2002–2007). The fifth area includes all Czech regions in the crisis period (i.e. 2008–2012) and the last area includes all Czech regions with the exception of Prague in the crisis period (i.e. 2008–2012).

The collected data from CNB about inward FDI into the individual regions have a structure of timelines (see Figure 5 and Figure 6); nevertheless, in accordance with the aims of the research the data have

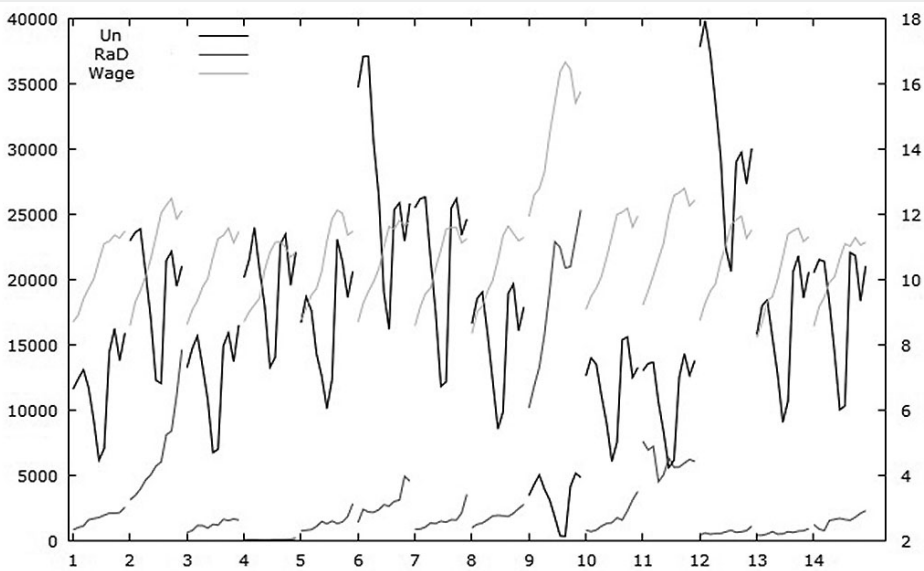
to be transformed into panel data. With regard to more suitable application and in accordance with the generally accepted paradigm the data have been transformed logarithmically. After the logarithmical transformation, the estimated parameters have a form of elasticities which indicate by how much the value of the explained variable changes in case of 1% change of the explanatory variable (Greene, 2003).

Figure 5 Time series of FDI and Waste



Note: FDI in millions, waste on the right axis, kg per capita.
Source: CNB and CZSO, own construction

Figure 6 Time series of Un, RaD and Wage



Note: RaD in millions; Un on the right axis.
Source: CNB and CZSO, own construction

2.2 Determinants

In accordance with the studies of Abbott (2012), Huang (2013) and Lessman (2013) the unemployment rate (Un) has been included in the determinants influencing the FDI inflow. The unemployment rate is considered to be a proxy variable of the workforce availability. The wage size works, among other things, against the workforce availability. In the model the average brutto wage in the region has been applied as a proxy variable of wage size (Wage).

Moreover, another variable has been included which is considered to be a proxy variable of the external economic stability, i.e. the exchange rate (Ex). For a more complex view, it was appropriate to include one more variable which is considered to be a proxy variable of the internal economic stability, i.e. inflation rate (Inf).

For the purposes of the paradigm of inclusion of at least one infrastructure variable, a variable of government spending on research and development (RaD) has been applied as it is considered, among other things, to be a technological infrastructure variable.

Contrary to the above studies including the CO_2 emissions, this study applies the size of communal waste production per capita as the variable for the environmental protection (Waste).

2.3 Model

In the preliminary stage of the research other variables were included in the model than those above mentioned, such as crime rate, motorway network density, the size of the region population and the number of newly reported cases of inability to work. When including all these variables the model contained collinearity. Gradual elimination of the variables obtained the final shape of the model. In some models´ heteroscedasticity and autocorrelation of the residua were detected and in this case the robust co-variation matrix – Heteroscedasticity and Autocorrelation Consistent (HAC) was applied to remove them. The application of this method does not change the estimated values of parameters themselves and enables to remove the distortion of the test statistics in case of the presence of heteroscedasticity and autocorrelation in the model.

The applied model has the below general form:

$$FDI_{it} = \beta_0 + \beta_1 Un_{it} + \beta_2 Wage_{it} + \beta_3 Ex_{it} + \beta_4 Inf_{it} + \beta_5 RaD_{it} + \beta_6 Waste_{it} + e_{it}\,, \tag{1}$$

where: $i = 1, ..., 14$, β_j are unknown (non-random) parameters, $j = 1, 2, \ldots, 6$, e_{it} is a random mistake in the i-th observation in year t, t is the year 2002, 2003, … , 2012 (Lind 2005).

Regarding the fact that the obtained data have the panel structure, Fixed Effects Model (FEM) (see Formula 2) and Random Effects Model (REM) (see Formula 3) were used. FEM, unlike Pooled Ordinary Least Squares (POLS), contains α_i, which is a unit specific and time independent term, while α_i is also considered a fixed parameter that is estimated. This may be implemented by including a dummy variable for each cross-section unit (and each suppressing global constant). Sometimes this model is called Least Squares Dummy Variables (LSDV). REM contains a random mistake $u_{it} = \nu_i + \varepsilon_{it}$, and unlike FEM in the REM there is the term ν_i, which cannot be considered a fixed parameter but a random component, and terms ν_i and ε_{it} are mutually independent (Nerlove, 1971; Cipra, 2013).

$$y_{it} = \alpha_0 + X_{it}\beta_i + \alpha_i + \varepsilon_{it} \tag{2}$$

$$y_{it} = \alpha_0 + X_{it}\beta_i + \nu_i + \varepsilon_{it} \tag{3}$$

It should be considered that in economics many of phenomena have a dynamic character. Hence, apart from the above stated form, for checking the above mentioned hypotheses dynamic panel data model was used (see generalized form of dynamic panel data model Formula 4). For the estimation

of the dynamic panel data model Generalized Method of Moments (GMM) (Arellano, 1995, Blundell, 1998) and POLS were used. For the estimation of the dynamic panel data model a 2-step system GMM was applied including an asymptotic standard error.

$$y_{it} = \alpha + X_{it}\beta_i + \delta y_{i,t-1} + \nu_i + \varepsilon_{it} \quad (4)$$

For estimating of models were used econometric software Gretl.

3 RESULTS

3.1 General form of the model

From the results of the general form emerged for the whole-time, both including and excluding Prague, that the Ex, RaD, Wage and Waste were statistically significant determinants. Results showed that no factor which statistically negatively influenced inward FDI for the whole-time was found.

Similar results were identified for the pre-crises period but with one exception that was the Waste. Waste was not significantly positively influenced by inward FDI in comparison for the whole-time.

The results of the general form covering the crises period, both including and excluding Prague, show that the RaD, Wage and Waste were statistically significant determinants. Results exposed that only one factor was found showing significantly negative impact on inward FDI for the crises period. The Ex was this factor but only in REM including Prague.

The statistical verification speaks about the suitability of the applied models and their high information value (the adjusted coefficients of determination or LSDV are in the range 0.70 up to 0.88), nevertheless, in case of the founded results it is necessary to consider the applied methods.

In accordance with premises of the tested hypotheses it was stated that the Ex and RaD had positive impact on the FDI inflow. Hypotheses H3 was not rejected for the whole time, both including and excluding Prague, and for the pre-crises period. Hypotheses H5 was not rejected for the whole time, both including and excluding Prague, for the pre-crises period, both including and excluding Prague, and for the crises period, both including and excluding Prague. On the other hand, no other factor was found showing negative impact on inward FDI. Other hypotheses were rejected.

Results of Hausmann´s tests found out that GLS estimates were not available but if HAC were eliminated, results of Hausmann´s tests indicated that GLS estimates were inconsistent. Hence, results of REM were not desirable for later treatment. Results of FEM should be preferred to REM.

3.2 Dynamic panel data model

It was obvious from results for the whole-time that inward FDI is determined positively significantly by the variables of inward FDI in the preceding period, Ex, RaD and Wage. If Prague was eliminated from the examined sample of regions, it was evident that inward FDI is determined positively significantly by the variables of inward FDI in the preceding period, Ex and Wage but negatively significantly determined by the Un.

The results for the pre-crises period, both including and excluding Prague, show that inward FDI is positively significantly determined only by inward FDI in the preceding period but negatively significantly determined by the Inf.

The results for the crises period show that inward FDI is positively significantly determined by the variables of inward FDI in the preceding period, RaD, Wage and Waste. However, results were ambiguous about the Ex and Inf, because the results may be influenced by the estimated methods. If Prague was eliminated from the examined sample of regions, it was evident that inward FDI is positively significantly determined by the variables of inward FDI in the preceding period, Ex and Wage but Inf was determined negatively significantly by inward FDI. However, Ex results were ambiguous, because they should be influenced by the estimated methods.

Table 1 Results of general form in whole time

	Whole time			Whole time without Prague		
	FEM	**REM**	**POLS**	**FEM**	**REM**	**POLS**
	Coefficient (t-ratio)	**Coefficient (z)**	**Coefficient (t-ratio)**	**Coefficient (t-ratio)**	**Coefficient (z)**	**Coefficient (t-ratio)**
const	−9.0638** (−2.4800)	−19.4892*** (−3.7220)	−56.4779*** (−6.2990)	−9.3201* (−2.0980)	−12.3068** (−2.4420)	−41.0331*** (−3.3350)
l_Un	0.1170 (1.1240)	−0.0525 (−0.5620)	0.1324 (0.4953)	0.1008 (0.8121)	0.0437 (0.3856)	0.2388 (0.7670)
l_Ex	0.0941 (0.5848)	0.8052*** (2.6710)	2.6931*** (6.1620)	0.1199 (0.6298)	0.3551 (1.4920)	1.8313** (2.6130)
l_Inf	0.0003 (0.0347)	−0.0100 (−1.0370)	0.0179 (0.6707)	−0.0045 (−0.4463)	−0.0082 (−0.7746)	0.0212 (0.7052)
l_RaD	0.0793 (0.9394)	0.2638*** (3.5010)	0.3483*** (6.6850)	0.0715 (0.8172)	0.1924*** (2.9680)	0.3668*** (6.5640)
l_Wage	1.8494*** (6.1230)	2.5283*** (5.8390)	5.0544*** (7.8350)	1.8846*** (5.5590)	1.9690*** (4.8790)	3.5875*** (3.5640)
l_Waste	0.0989 (0.3031)	0.1766 (0.6279)	1.0367** (2.8580)	0.0592 (0.1646)	0.1776 (0.5671)	1.2937** (2.9240)
n	154	154	154	143	143	143
Adj. R-squared			0.8576			0.6993
F			122.7565			41.9741
P-value(F)			<0.0001			<0.0001
LSDV R-squared	0.9759			0.9483		
Within R-squared	0.7161			0.7008		
Hausman test (p-value)		NA			NA	

Note: NA – not available; *** significant level α = 10%, ** significant level α = 5%, * significant level α = 1%.
Source: Own construction

Table 2 Results of general form in pre-crises period

	Pre-crisis period			Pre-crisis period without Prague		
	FEM	**REM**	**POLS**	**FEM**	**REM**	**POLS**
	Coefficient (t-ratio)	**Coefficient (z)**	**Coefficient (t-ratio)**	**Coefficient (t-ratio)**	**Coefficient (z)**	**Coefficient (t-ratio)**
const	−11.4045 (−0.7861)	−48.9235*** (−4.6070)	−66.4082*** (−6.8530)	−8.5548 (−0.5043)	−35.3360** (−2.0000)	−65.7924*** (−3.2040)
l_Un	0.0847 (0.4316)	0.3472*** (2.9910)	0.5069* (2.0820)	0.0647 (0.2979)	0.3192*** (2.9230)	0.5065* (2.1290)
l_Ex	0.2879 (0.4292)	2.1355*** (4.0130)	2.7846*** (5.8770)	0.1507 (0.1974)	1.4232* (1.6970)	2.7498** (2.5710)
l_Inf	0.0009 (0.0826)	−0.0057 (−0.4567)	−0.0066 (−0.4009)	−0.0036 (−0.3338)	−0.0071 (−0.4976)	−0.0085 (−0.4632)
l_RaD	0.0141 (0.1273)	0.3023*** (4.1190)	0.3419*** (6.6260)	−0.0098 (−0.0883)	0.2613*** (3.5050)	0.3412*** (6.4950)
l_Wage	2.1611 (1.6290)	5.0604*** (5.6130)	6.0821*** (8.4420)	1.9597 (1.2620)	3.9627*** (2.6350)	6.0006*** (3.4080)
l_Waste	−0.0492 (−0.1072)	−0.0064 (−0.0165)	0.8187 (1.7700)	−0.1111 (−0.1967)	−0.300 (−0.0679)	0.8729 (1.6230)
n	84	84	84	78	78	78
Adj. R-squared			0.8778			0.7053
F			238.4391			18.4479
P-value(F)			<0.0001			<0.0001
LSDV R-squared	0.9718			0.9338		
Within R-squared	0.4986			0.4740		
Hausman test (p-value)		NA			NA	

Note: NA – not available; *** significant level α = 10%, ** significant level α = 5%, * significant level α = 1%.
Source: Own construction

Table 3 Results of general form in crisis period

	Crisis			Crisis without Prague		
	FEM	**REM**	**POLS**	**FEM**	**REM**	**POLS**
	Coefficient (t-ratio)	**Coefficient (z)**	**Coefficient (t-ratio)**	**Coefficient (t-ratio)**	**Coefficient (z)**	**Coefficient (t-ratio)**
const	−7.2863 (−0.7015)	−32.4417*** (−4.3290)	−59.7786*** (−4.9340)	−7.4156 (−0.5796)	−24.6682*** (−3.3930)	−58.7216*** (−3.1860)
l_Un	0.3865** (2.1790)	0.3437* (1.9180)	0.3633 (0.7879)	0.5699 (1.4650)	0.3688 (1.0250)	0.3443 (0.6285)
l_Ex	−0.7355 (−1.2880)	−1.4564*** (−3.2300)	−1.5472 (−1.4270)	−1.1301 (−1.6960)	−1.3682* (−1.9430)	−1.6028 (−1.2820)
l_Inf	0.0219 (0.7287)	−0.0063 (−0.1896)	0.0314 (0.4804)	0.0486 (0.6983)	0.0005 (0.0089)	0.0259 (0.3266)
l_RaD	0.1312 (0.9742)	0.3756*** (5.9850)	0.3205*** (5.3920)	0.1068 (0.6263)	0.3075*** (6.0630)	0.3185*** (4.0780)
l_Wage	1.8608 (1.7480)	4.2432*** (5.3210)	6.3852*** (4.6410)	1.9775 (1.6100)	3.5156*** (4.1610)	6.2990*** (3.0950)
l_Waste	0.0192 (0.0946)	0.2660 (1.4160)	1.3661*** (7.5400)	−0.0334 (−0.1265)	0.2144 (1.2570)	1.3722*** (4.6720)
n	70	70	70	65	65	65
Adj. R-squared			0.8765			0.7227
F			691.8692			277.0459
P-value(F)			<0.0001			<0.0001
LSDV R-squared	0.9918			0.9822		
Within R-squared	0.2606			0.2758		
Hausman test (p-value)		NA			NA	

Note: NA – not available; *** significant level α = 10%, ** significant level α = 5%, * significant level α = 1%.
Source: Own construction

Table 4 Dynamic panel data model in whole time

	Whole time		Whole time without Prague	
	GMM	POLS	GMM	POLS
	Coefficient (z)	Coefficient (t-ratio)	Coefficient (z)	Coefficient (t-ratio)
l_FDI_{t-1}	0.8006*** (6.9010)	0.9276*** (21.3500)	1.5066*** (3.0140)	0.9360*** (21.3700)
const	−3.1726 (−1.4250)	−2.8487 (−0.9375)	−8.8849** (−2.4390)	−4.3262 (−1.2780)
l_Un	−0.0871* (−1.9000)	−0.0526 (−1.0930)	−0.3041** (−2.1310)	−0.0719 (−1.3330)
l_Ex	0.2881*** (3.6990)	0.2579* (1.9780)	0.8914** (2.2410)	0.3409* (2.1690)
l_Inf	−0.0184 (−1.5450)	0.0019 (0.1100)	−0.0158 (−1.4350)	−0.0058 (−0.3463)
l_RaD	0.0608 (0.9296)	0.0408** (2.7970)	−0.2398 (−1.1430)	0.0340* (2.0420)
l_Wage	0.8412** (2.3670)	0.1907 (0.7450)	0.7477*** (2.9920)	0.3387 (1.0600)
l_Waste	−0.7252 (−0.9848)	0.1457 (1.0750)	−0.7641 (−1.4150)	0.1019 (0.5789)
n	140	140	130	130
Sargans test (p-value)	Over 0.9999		Over 0.9999	
Walds test (p-value)	<0.0001		<0.0001	
Adj. R-squared		0.9787		0.9541
F		9 937.9770		1 489.1710
P-value(F)		<0.0001		<0.0001

Note: NA – not available; *** significant level α = 10%, ** significant level α = 5%, * significant level α = 1%.
Source: Own construction

Table 5 Dynamic panel data model in pre-crises period

	Pre-crisis period		Pre-crisis without Prague	
	GMM	**POLS**	**GMM**	**POLS**
	Coefficient (z)	**Coefficient (t-ratio)**	**Coefficient (z)**	**Coefficient (t-ratio)**
l_FDI_{t-1}	1.0458*** (17.0900)	0.9726*** (11.6200)	1.0471*** (10.0700)	0.9738*** (11.5400)
const	3.8851 (0.4064)	0.5811 (0.0837)	3.6495 (0.1478)	3.4306 (0.3069)
l_Un	0.0128 (0.0967)	0.0128 (0.1375)	0.0157 (0.2711)	0.0186 (0.2087)
l_Ex	−0.6524 (−1.5890)	−0.4261 (−0.8732)	−0.6537 (−0.4195)	−0.6476 (−0.8750)
l_Inf	−0.0386** (−2.3710)	−0.0274 (−1.0230)	−0.0483*** (−2.6090)	−0.0375 (−1.3340)
l_RaD	0.0031 (0.1126)	0.0242 (0.7560)	−0.0059 (−0.1233)	0.0260 (0.8524)
l_Wage	−0.3183 (−0.4144)	0.0549 (0.1019)	−0.2507 (−0.1218)	−0.1970 (−0.2016)
l_Waste	0.1607 (0.7757)	0.0763 (0.2843)	0.0926 (0.2868)	0.1313 (0.4176)
n	70	70	65	65
Sargans test (p-value)	0.7963		0.8326	
Walds test (p-value)	<0.0001		<0.0001	
Adj. R-squared		0.9642		0.9170
F		1 078.2940		232.0862
P-value(F)		<0.0001		<0.0001

Note: NA – not available; *** significant level α = 10%, ** significant level α = 5%, * significant level α = 1%.
Source: Own construction

Table 6 Dynamic panel data model in crises period

	Crisis		Crisis without PHA	
	GMM	**POLS**	**GMM**	**POLS**
	Coefficient (z)	**Coefficient (t-ratio)**	**Coefficient (z)**	**Coefficient (t-ratio)**
l_FDI_{t-1}	0.3363* (1.7870)	0.9385*** (18.6800)	0.4151** (2.2800)	0.9346*** (20.5200)
const	−38.9526*** (−3.3260)	−2.5799 (−0.6678)	−34.6576*** (−2.9660)	−4.8017 (−1.2320)
l_Un	0.1779 (1.3760)	−0.0332 (−0.4899)	0.0924 (0.5528)	−0.0829 (−1.1660)
l_Ex	−1.5420* (−1.9590)	0.6896** (2.3670)	−1.2055 (−1.6150)	0.6597** (2.3020)
l_Inf	0.0889** (2.0240)	−0.0741** (−2.6180)	0.0339 (0.9358)	−0.0777*** (−3.1780)
l_RaD	0.1993*** (4.8430)	0.0608*** (3.7250)	0.1916*** (4.2270)	0.0542*** (3.4390)
l_Wage	4.3758*** (3.1200)	0.0296 (0.0722)	3.8215*** (2.7220)	0.2881 (0.6798)
l_Waste	0.8385*** (3.1810)	0.1103 (0.8176)	0.7907*** (3.1730)	0.0949 (0.6126)
n	56	56	52	52
Sargans test (p-value)	0.9248		0.9391	
Walds test (p-value)	<0.0001		<0.0001	
Adj. R-squared		0.9901		0.9787
F		9 701.5690		904.1397
P-value(F)		<0.0001		<0.0001

Note: NA – not available; *** significant level α = 10%, ** significant level α = 5%, * significant level α = 1%.
Source: Own construction

The statistical verification speaks about the suitability of the applied models and their high information value (the Sargans test (p-value) up to 0.05, Walds test (p-value) low to 0.05 and the adjusted coefficients of determination up to 0.91), but it is necessary to consider the applied estimation methods.

In accordance with premises of the tested hypotheses it was found out that the Ex, RaD and inward FDI for the preceding period had positive impact on inward FDI. Hypotheses H3 was not rejected for the whole time, both including and excluding Prague. Hypotheses H5 was not rejected for the whole time including Prague, and for crises period, both including and excluding Prague. On the other hand, it was stated that the Un and Inf had negative impact on inward FDI. Hypotheses H1 was not rejected only for the whole-time excluding Prague. Hypotheses H4 was not rejected for the pre-crises period, both including and excluding Prague, and for the crises period excluding Prague. Other hypotheses were rejected.

CONCLUSION

The aim of this study was to provide an analysis of some chosen determinants influencing inward FDI into Czech regions in the monitored period in the years 2002 up to 2012, in the pre-crisis period in the years 2002 up to 2007 and in the crisis period in the years 2008 up to 2012, with or without the inclusion of Prague in the set of regions. The chosen aspects were the following: unemployment rate (Un), exchange rate (Ex), inflation rate (Inf), expenditures on research and development (RaD), average brutto wages (Wage) and environmental pollution (Waste). The analysis of the aspects influencing inward FDI was based on the panel data from Czech regions. The following were opted: Fixed Effects Model (FEM), Random Effects Model (REM) and Pooled Ordinary Least Squares (POLS) for checking of hypotheses. There were opted 2-step system Generalized Method of Moments (GMM) including an asymptotic standard error and POLS for estimation of dynamic model. The comparison of results was carried out after the completion of the analysis.

Results of general form imply that the appreciation of Ex, RaD and Wage determined inward FDI to Czech regions positively for the whole-time, pre-crises and crises period, both including and excluding Prague. Ex and RaD results are consistent with defined premises and articles of Usman (2012) and Ramirez (2013). However, results of Wages were not confirmed presumption of negative influence on inward FDI that were inferred from the studies of Chen (2011), Olney (2013) and Huang (2013). Certain "paradox" was detected in the Czech environment showing that inward FDI was positively determined by Wages. Wages results may indicate that the Czech government should give support to increasing of Wages for inward FDI. However, high level of Wages increases the price of labour force and therefore goods and services should be more expensive. On the other hand, high level of Wages should contribute to higher consumption in Czech regions. Some question remains what is beyond this finding. The above mentioned question has several explanations. One of them is that inward FDI (with elimination of Prague) goes to regions with lower Wages and with higher support of national institutions, for example the Moravia-Silesia region. Other explanation is that development of average Wages in Czech has showed slightly slow increase in selected term with one exception which is crises period when average Wages were decreased. Other explanation should be that the average of Wages in the Czech Republic is one third of the average of Wages in OECD countries. The crisis began in 2008 and now nine years passed after the start of crises. The Czech Republic should be in front of a gate of new crises and the Czech government need to reflect this situation. No aspect which has had negative impact on inward FDI for the whole-time, pre-crises and crises period, both including and excluding Prague was found.

Results of dynamic model imply that Wages have positive impact on inward FDI for the whole-time and crises period, both including and excluding Prague. The Czech government should push up wages and thus to stimulate the future inward FDI and should also indicate positive effect on economic development and consumption. Conclusions about Wages are not final because it is necessary to reflect economic reality. High Wages mean that labour costs increase and so do the production costs.

The Czech government should be very sensitive to wage increase because the Czech firms may have lost their competitive advantage. Appreciation of Ex have had positive impact on inward FDI for the whole time however appreciation of the Ex generally marks up the costs of the FDI inflow from investor´s country but should be compensated by future profit from proceeded investment and future appreciation of the Ex in host country. Appreciation of the Ex is obviously included to the calculation of net present value, indicating convenience of investment. The RaD determined the FDI positively for the whole time including Prague, and for crises period, both including and excluding Prague. Hence, the Czech government should promote the RaD but it has not been done yet. The RaD continuously grew in selected time periods with one exception which was crises period because the Czech government dramatically cut down the budget of the RaD in crises which appears as a big mistake. These findings are consistent with defined premises and articles of Yu (2011), Castiglione (2012), Usman (2012), Ramirez (2013) and Long (2015). If the RaD budget decreased dramatically foreign investors may notice this situation as an upset of investment atmosphere. On the other hand, negative impacts the Un and Inf on the FDI inflow were identified. It was found out that the Un has negative influence on inward FDI flow in Czech regions excluding Prague only for the whole-time. The Czech government should focus on the Un elimination. The Czech regions excluding Prague have obviously higher Un than Prague. Higher Un should currently promote the FDI inflow but the above mentioned findings evoke that better higher availability of labour force deter foreign investors from investment to Czech regions. One of possible explanations is that foreign investor prefers lower Un because lower Un should indicate better internal situation of Czech economy (for example Czech economy should not experience internal pressure to decrease the wage level). These findings are consistent with defined premises and articles of Chen (2011), Olney (2013), Huang (2013) and Boateng (2015) but they do not comply with articles Lessmann (2013) and Long (2015). The Inf reduced the FDI inflow for the pre-crises period, both including and excluding Prague, and for the crises period excluding Prague. The Inf debase the feasible value of the FDI but sensitivity of the FDI inflow on increase of the Inf is relatively small (values of sensitivity are between 0.03 and 0.07). Foreign investor reflects the Inf, however, the Inf reduces their investment very slowly. Czech Inf is signalized by lower volatility in selected term and it shows that Czech economy is relatively stable even if Czech economy was involved economic crises in 2008. These findings are consistent with articles of Boateng (2015), however, articles of Li (2005) and Kolstad (2008) have not confirmed the above mentioned results because articles of Li (2005) and Kolstad (2008) confirmed negative effect of Inf only in developing countries and no in developed countries where Czech should be subsumed.

It was found out that the applied methods were chosen appropriately but it is always necessary reflect the applied estimation method because results may be influenced by the estimation methods used. For the future research, the number of determinants and time range should be extended by including for example gross domestic product, inflation, law environment, political risk, etc. of Germany, Austria, Slovakia, and Poland, respectively.

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