Does FDI Generate Knowledge Spillovers in the Czech Republic? Evidence from Patent Applications and Utility Models

Abdelwalid Rouag and Jan Stejskal
Department of Economic Sciences, University of Pardubice, Pardubice, Czech Republic
Email: {abdelwalid.rouag, jan.stejskal}@upce.cz

***Abstract*—Foreign Direct Investments (FDI) has been considered by many scholars as the most important channel for the transfer of knowledge and technology to firms of the host country. However, whether this knowledge and technology are hypothesized to spill over depends on the absorptive capacity of the host country which stems from well-equipped human resources such as scientists and cumulative expenditure in Research and Development (R&D). In this paper, we examine for the single time the extent of knowledge spillovers and the absorptive capacity of the Czech Republic regions using patent micro-data of the Czech statistical office. The paper finds that there is a significant knowledge inflow from the FDI to local firms. Furthermore, we detect that the hypothesis of the crowding out effect of FDI on domestic absorptive capacity is not rejected to the Czech Republic.**

***Index Terms*—foreign direct investment, knowledge spillovers, absorptive capacity, patent application, utility model, Czech republic**

I. Introduction

In recent years it has increasingly recognized in the literature that spillovers of knowledge from external sources may have an important impact on innovation processes and economic development as an important issue in recent approaches to growth theory and innovation systems. In this context, the foreign direct investments (FDI) spillovers are probably the most extensively analyzed channel of knowledge spillovers. Scholars as well as policy makers increasingly treat FDI spillovers as very or the most important development effect for host country.

The way how knowledge spills over via the inflow of FDI is hypothesized to happen when the entry or presence of foreign affiliates with better technology and organizational skills and their proximity to domestic firms increases the rate of technical change and technological learning in the host economy indirectly through knowledge spillovers to the domestic firms.

However, the higher spillovers of FDI hold only when host country has a minimum threshold stock of human capital. Thus, FDI contributes to economic growth only when sufficient absorptive capacity of an advanced technology is available in the host country. Such absorptive capacity created by investments in research and development (R&D) or human capital provides the basis of fundamental knowledge necessary to assimilate and exploit external knowledge.

The Czech Republic is one of the most successful transition economies in term of attracting FDI. As an earlier reformer in central and eastern European country, the Czech Republic led the way in the early 1990 ś in adopting far reaching stabilization, liberalization and privatization programs. The introduction of the investment incentives in 1998, the implementation of the European Union (EU) rules and regulations and then the implementation of regional innovation systems [1] have improved the business environment and attract FDI. The Czech Republic has consistently attracted a high rate of FDI per capita since 2000 and that confirms the high degree of attractiveness of the Czech Republic for foreign investors [2]

The aim of this paper is to examine the role FDI and absorptive capacity play in mediating knowledge spillovers at the regional level of the Czech Republic. Following the aim of this work, we assume first, that the inflow of FDI in the fourteen regions of the Czech Republic plays a key role in the diffusion of knowledge. Second, the absorptive capacity in the form of expenditure and labor in R&D highly determines the extent to what FDI diffuses knowledge and technology in the Czech Republic.

The reminder of this paper is structured as follow; section 2 discusses some general aspects of knowledge spillovers of FDI inflow related in previous literature. Section 3 will discusses the role of absorptive capacity of the host country Section 4 will be dedicated to explain our methodology and the used data. When section 5 will discusses the main findings and conclusion

II. Motives for FDI

FDI is an alternate potentially equally important channel for the mediation of such knowledge spillovers [3] his results show an evidence that FDI increase the flow of knowledge spillovers both from and to the investing firm. Investment climate is an important factor for the dimension of knowledge spillovers; it ś assumed

Manuscript received July 2, 2014; revised September 17, 2014.

doi: 10.12720/joams.4.1.16-21

that liberal climate tends to generate massive knowledge spillovers when attracting the higher type of FDI these are multinational companies (MNC ś) relatively large, achieving economies of scale and operating within the best managerial skills and organizational practices. The latest are hypothesized to spill over through the diffusion of modern management practices [4] provides empirical evidence regarding to their size and transmission mechanism and concludes that there are significant vertical and horizontal spillovers of management practices from foreign to local firms. His analysis then suggests that vertical spillovers within supply chains are the most effective transmission channel.

For answering the question: what kind of FDI? And what is the nature of MNC ś activity in the local market? Scholars were divided into two main groups. Some of them examine the relation between MNC ś and knowledge spillovers. Others analyze the relation between the nationality of the foreign investor and knowledge spillovers. Ref. [5]-[6] analyze the effect of a potential spillover on technology transfer of a Multinational enterprise and on the host country policy, they find out a tradeoff in which a larger ownership she induce the multinational enterprise to transfer more technology to its subsidiary. Ref. [7] conclude after combining the three established microeconomic concepts; spillovers channels, tacit knowledge and absorptive capacity) that there is a non-linear relationship between multinational ownership and spillovers.

In this context, [8]distinguish between minority and majority FDI and reveals that both of them lead to spillovers [9] find out that majority owned foreign affiliates experience increase in productivity as a result of knowledge transfer and minority FDI are more hypothesized to produce knowledge spillovers.

In the other side, and considering the investment motivations and FDI spillovers, four kinds of motives were studied. First, technology sourcing studied by [10] relates to the technological and factor price determinants of inward and outward FDI to its potential productivity and labor market effects on both host and home economies. Their results show fewer technology spillovers. Simultaneously, technology sourcing FDI completes against local rivals in the local market. Second, and according to the same reference, technology-exploiting FDI based on cutting edge technology[1] induces positive spillovers to host country firms. Third, according to [11] respectively vertical efficiency-seeking positively spill over in developed host countries and do not spill over in developing countries. Fourth, horizontal FDI relation purchasing market-seeking according to [12] also positively spill over in developed host countries and do not so in developing countries.

III. Absorptive Capacity

Absorptive capacity refers to the ability to identify and acquire a new knowledge [13]. Two views exist in the literature on the role of the absorptive capacity of a firm, region, industry, or country in capturing knowledge spillovers. The first group of scholars claims that knowledge diffusion is perceptible only in case of technological backwardness of the host country [14]. In the other side, some scholars affirm that the host firm, region, industry or country should have a minimum of absorptive capacity enabling the diffusion of new knowledge though the FDI inflow. This view is enhanced by the study of [15] he states that knowledge spills over positively even without a necessary threshold of human capital, but the stock of human capital will highly determine the extent to FDI. Reference [16] highlights that productivity, absorptive and complementary capabilities are positively impacted by FDI knowledge spillovers. Ref. [17] notices a positive R&D intensity of local firms in case of absorptive capacity existence.

Such capacity can be generated by investment in R&D and human capital [18] explores absorptive capacity by measuring it as firm size, R&D investment, human resources and productivity gap. Reference [19] uses the intangible capital, human resources and investment in R&D. Ref. [20] the proportion of scientists and technicians in total employment.

In this paper, variables selected for the absorptive capacity are captured through the number of workers in R&D in both entrepreneurial and government sector and both private and government expenditure in R&D. the following section will give more details about our data and the used methodology.

IV. Data and Used Methodology

In order to give insight into the assumptions drawn above we apply an empirical multiple regression model. First, it is assumed that there is coherence between the rise of patent application and utility models with the increase of expenditure in both private and public labor force in R&D sector. The second analysis is based upon the assumption that knowledge spills over with the inflow of FDI to the Czech Republic regions and in this way impacts in the produced number of patent applications and utility models which both are considered as the output of new knowledge and innovation so that our two multiple regression models take the following forms:

$$P = \beta_0 + \beta_1\left(EXP_{firm}\ R\&D\right) + \beta_2\left(EXP_{gov}\ R\&D\right) + \beta_3\left(Labor_{firm}\ R\&D\right) + \beta_4\left(Labor_{gov}\ R\&D\right) + \beta_5\left(FDI_{reg}\right) + \varepsilon \quad (1)$$

$$U = \beta_0 + \beta_1\left(EXP_{firm}\ R\&D\right) + \beta_2\left(EXP_{gov}\ R\&D\right) + \beta_3\left(Labor_{firm}\ R\&D\right) + \beta_4\left(Labor_{gov}\ R\&D\right) + \beta_5\left(FDI_{reg}\right) + \varepsilon \quad (2)$$

where P and U are growth of patent and utility models, $EXP_{firm}\ R\&D$ is the growth of expenditure of entrepreneurial sector in *R&D*.

EXP_{gov} is the growth of government expenditure in R&D. The variable aggregates the expenditure in public

[1] Cutting edge technology consists on the technological devices, techniques or achievement that employ the most current and high level IT (information technology) development. In the other word, technology at the frontier of knowledge

universities, scientific institutes and the non-governement organizations (NGO ś)

$Labor_{firm}$ *R&D* is the growth of researchers in entrepreneurial sector.

$Labor_{gov}$ *R&D* is the growth of the number of researchers in government sector. The variable aggregates the expenditure in public universities, scientific institutes and the non-governement organizations (NGO ś)

FDI_{reg} is the growth of FDI inflow in regional level, β_0 to β_1 are coefficients and ε is the coefficient of disturbance.

Our empirical analysis is based on two main sources. First, the confidential micro-data derived from an annual census of R&D collected by the Czech statistical office (ČSÚ) with the collaboration of the Czech industrial property office (ÚPV) following the methodology advised by [21] The data measures inputs in R&D such as the financial means and human resources in the entire entities that carry out R&D and their primary and secondary activities. The mico-data includes also indicators about the R&D outputs in the form of new knowledge used in several practical applications such as patents and utility models. Patent according to the Czech statistical office is an official document issued by the relevant patent office which provides legal protection for an invention for up to 20 years to the territory for which it was issued. Patent is requested by filling up the patent application at the relevant patent office and are guaranteed for invention that are new and involve an inventive step and is industrially applicable. In the other hand, utility models is a useful way to protect technical solution and are the subject matter of the lower level inventive step or less economically important comparing to patent. Utility model protection can be used for technical solution susceptible of industrial application, exceeding common technical skill. The protection under utility model lasts four years extendable twice upon owner ś request for maximum of 10 years.

For the need of this paper we used the number of patent applications and utility models to capture effort of innovation in the 14 regions of the Czech Republic.

Fig. 1 depicts as well the evolution of the number of patent applications, utility models and number of patent from the year 2003 to 2013 in the Czech Republic.

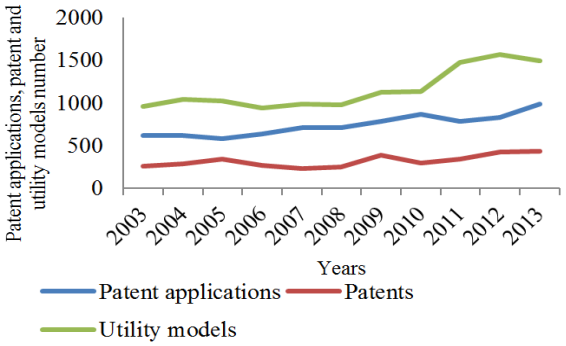

Figure 1. Evolution of patent applications, patents and utility models in the Czech Republic from 2003 to 2013

The graph shows a relative positive evolution of the R&D output along the time series. Accepted patents are in average of 43.6% on the total patent applications the weight of each R&D component are 14% for patent, 52% for utility models.

The second source of Data consists on the inflow of FDI at the regional level. The data is collected and published by the Czech National bank (ČNB) according to the international standards adopted by the Organization for Economic Cooperation and development (OECD), European commission and the International Monetary Fund (IMF) data compilation of balance of payments.

The dataset provides information about the foreign direct investment in the form of equity investment and their related loans and losses arising from such invested capital. With accordance to the OECD, EUROSTAT and IMF definition of the FDI, the Czech national bank compile FDI as the sum of registered capital, reinvested profit and other capital at the regional level of Nomenclature of Territorial Units for Statistics (NUTS2).

Fig. 2 shows the accumulated FDI inflow to the Czech regions NUTS2 from the year 2005 to 2012 as published by the Czech National Bank.

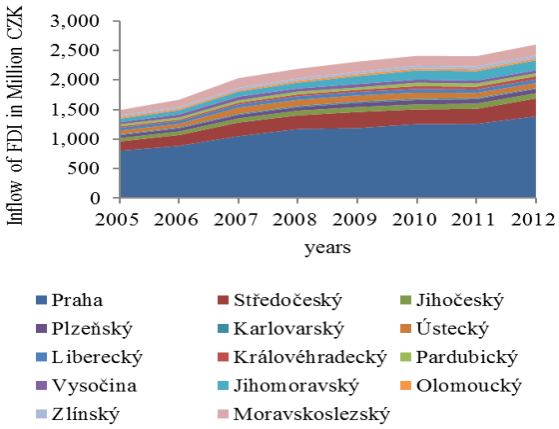

Figure 2. FDI inflow in NUTS2 region of the Czech Republic

Two main facts can be deduced from the Fig. 2. First, a positive trend from the year 2005 to the year 2012 which reflects the continuous attractiveness of the Czech Republic to foreign investors and Second, an unequal distribution of the FDI inflow concentrated mainly in the capital city Prague and the surrounding region of Central Bohemia. Then, in the third position came Moravia Silesia region and finally south Moravia region. Regions cited above are regions of the Czech Republic with high industrial concentration [22], [23]. The distribution of the FDI inflows through the Czech Republic is in line with the results obtained by [24] who identifies using spatial exploratory analysis the same clusters concentrating entrepreneurial and public R&D labor in the Czech Republic. This, enhance at the descriptive statistics level our assumption which says that knowledge spills over in regions where the FDI inflows. Table I. provides a summary of the variable and their measurement at national level. It is important to notice that in our models we used the same variables but at regional level. We used also the logarithm of private expenditure in R&D in order to have a normal distribution.

TABLE I. DEFINITION AND SUMMARY STATISTICS

Variable	Definition (variables at national level)	Mean	St. Dev.
Patent application	Changes in patent application 2005-2012	477.95	562.90
Utility models	Change in utility models 2005-2012	1527.6	16.78
Labor (private)	Change in the number of researchers 2005-2012 at entrepreneurial level	15173.7	4457
Labor (public)	Change in the number of researchers in public sector 2005-2012	27412	2674
Private expenditure on R&D	Change of private expenditure in R&D 2005-2012 (Mil. CZK)	26620	9679
Public Expenditure R&D	Change of public expenditure in R&D 2005-2012 (mil.CZK)	28632.8	14514
FDI inflow	Change in FDI inflow 2005-2012 (Mil. CZK)	2293	296.17
Regions included Into the study	Prague the Capital City, Central Bohemia region, Moravia-Silesia region, South Moravia region, Usti region, South Bohemia region, Plzen region, Liberec region, Vysocina region, Pardubice region, Zlin region, Hradec kralove region, Olomouc region, Karlovy Vary region		

Independent variables described earlier are included in the same models. A test of normality shows a normal distribution of all independent variables. The test of the multicollinearity of our variables using tolerance which is the regression of any independent variables in all the other independent variables with ignoring the dependant variable the result did not suggest any serious problem with multicollinearity and all variables are greater than 0.1. The results of our two multiple regressions are reported in the following section.

V. RESULTS AND DISCUSSION

OLS regression was used to test the growth of all variables of the two models between the year 2005 and 2012. Table II presents descriptive statistics, including means standards deviations and inter correlations for all the variables used in the analysis. Table II contains regression results. Table III and Table IV present the correlation matrix for both models.

TABLE II. REGRESSION RESULTS

Numbers represent the coefficients of model 1. And model 2.
Dependant variables are in model 1. Patent applications model 2. Utility models
Dependant variable : Ln (EXP_{firm})

	Patent applications	Utility models
EXP_{firm}	-40.69	-27.422
EXP_{gov}	-0.0644	-0.0524
$Labor_{firm}$	0.467	0.324
$Labor_{gov}$	0.999*	0,560*
FDI_{reg}	0,834*	0,367
R square	0,716	0.687
F-value	4,034	3.527

*Significant at p<0,05

The results largely confirm that all variable are related to the produced number of patent applications and utility models. They suggest that absorptive capacity (labor and investment in R&D) in both private and public sector and the inflow of the FDI have an influence on the growth of patent applications and utility models. The first model is relevant at 0.716 and the second at 0.687 which denotes the values of the R^2. The effect of FDI spillovers is statistically significant and positive and range at 0.834 for patent application and less for utility models at 0.36 which means that the increase of 1% in FDI inflow to the Czech Republic positively impacts at respectively at 83.4% increase of patent applications and 36% of utility models. This confirms our first assumption telling that FDI inflow to the host country induces knowledge to spill over. Noticeable is that government labor in R&D rank as the most important variable and is significant in patent applications and utility models at 0.27 and even significant in the second model at 0.56 this fact highlights the positive role played by the public universities, research institutes and NGO ´s in the growth of innovation in the Czech Republic.

We notice also that the coefficient of entrepreneurial expenditure in R&D is significantly negative at -40.69 and -0.06 for government expenditure.

TABLE III. A MEANS, STANDARD DEVIATION, AND CORRELATION MATRIX, PATENT APPLICATIONS GROWTH 2005-2012

	Mean	**S.D**	**Tolerance**	**EXP_{firm}**	**EXP_{gov}**	**$Labor_{firm}$**	**$Labor_{gov}$**	**FDI_{reg}**
EXP_{firm}	4.140	0.698	0.55	1.000	0.054	0.437	0.516	0.260
EXP_{gov}	159.526	135.456	0.72	0.0547	1.000	0.338	0.342	-0,232
$Labor_{firm}$	59.437	31.811	0.55	0.437	0.338	1.000	0.363	0.351
$Labor_{gov}$	21.879	50.902	0.48	0.516	0.342	0.363	1.000	-0,254
FDI_{reg}	65.252	48.468	0.56	0.260	-0.232	0.351	-0.254	1.000

TABLE IV. B MEANS, STANDARD DEVIATION, AND CORRELATION MATRIX, UTILITY MODELS GROWTH 2005-2012

	Mean	S.D	Tolerance	EXP_{firm}	EXP_{gov}	$Labor_{firm}$	$Labor_{gov}$	FDI_{reg}
EXP_{firm}	4.140	0.698	0.55	1.000	0.054	0.437	0.561	0.260
EXP_{gov}	159.526	135.456	0.72	0.054	1.000	0.338	0.342	-0.232
$Labor_{firm}$	59.437	31.811	0.55	0.437	0.338	1.000	0.363	0,351
$Labor_{gov}$	21.879	50.902	0.48	0.516	0.342	0.363	1.000	-0.254
FDI_{re}	65.252	48.468	0.56	0.260	-0.232	0.351	-0,254	1.000

Public expenditure in R&D impacts negatively on the produced number of patent applications and utility models at respectively -27.08 and -0.052 which means that inputs in R&D emanating from the private and public expenditure are not efficient with relation to the R&D outputs. In other meanings, and according to our model negatively the produced number of patent applications and utility models. This fact however, does not fulfill our second assumption telling that increasing inputs (Labor and expenditure) efficiently increase output of R&D in the form of patent application and utility models. At the same time, this decreasing return to scale to R&D spending of firms is in line with previous studies supported by empirical research. Ref. [25] explains that the decision making coordination and resource allocation process in large firms are more inefficient in small firms. Thus, each additional spending of R&D yields less in the way of creative outputs. Reference [26] denotes that as firm age, they tend to be more conservative as the influence of the group of founding entrepreneurs is diminished and replaced by professional managers, ultimately make it difficult for truly inventive ideas to merge. Reference [27] finds out a decline of innovative productivity with respect to R&D. References [25], [28] demonstrate that productivity in innovation tends to decline with firm size. Reference [29] finds evidence that increasing levels of R&D spending was counterproductive in terms of innovation outputs in the pharmaceutical industry.

In the other side, the correlation matrix shows in both models a negative relation between the inflow of FDI and both government labor and expenditure which can be explained by the fact that the inflow of FDI crowds out the government expenditure in both patent applications and utility models which is in line with many previous studies such as [30] who find that the effect of R&D expenditure funded by the government is negative and this is due to the crowding out effect of public sector investment in R&D. Reference [31] finds out that excessive involvement of government economic activity may hinder the beneficial effects of FDI.

VI. CONCLUSION

OLS multiple regression was applied using the microdata of the Czech statistical office and the Czech national bank to examine the influence of FDI inflow and the absorptive capacity of the fourteen regions of the Czech Republic for the period 2005-2012. Our results state that coefficient of FDI inflows is always positive for both models so that the empirical evidence supports that FDI generates spillover effects on the domestic regional innovation capability of the Czech Republic. As advised by the literature, the spillover effects occur through the absorptive capacity such as the skilled labor turnovers and the R&D expenditure in both entrepreneurial and public sector. In this context, our two models suggest a positive impact of labor in private sector and even significant in both models for the public sector which highlights the important role played by universities, scientific institutes and NGO ́s.

However, a decreasing return to scale of R&D expenditure was detected in our two models more expressive in the entrepreneurial sector. That suggests an inefficiency in allocating means for innovation purposes and a time lag between the time were financial means were invested and the innovation output consisting on patent applications and utility models.

On the other hand, the correlation matrix of both patents application and utility models show a negative relation between two independent variables; FDI inflows and R&D government expenditure that fosters the assumption that the government expenditure in R&D crowds out the FDI inflow and hinder the beneficial effects of the latter.

The results obtained in this current study attract our attention about two main facts. First, channels conducting to decreasing returns to scale in R&D entrepreneurial expenditure and second, channels conducting to crowd out the government expenditure in the same sector. Thus channels will be deeply analyzed in further analysis.

ACKNOWLEDGMENT

We gratefully acknowledge the help provided by constructive comments of the anonymous referees. This work was supported by a grant provided by the scientific research project of the Czech Sciences Foundation Grant No: 14-02836S.

REFERENCES

[1] J. Stejskal and K. Maťátková, "Descriptive analysis of the regional innovation system-novel method for public administration authorities," *Transylvanian Review of Administrative Sciences*, no. 39, pp. 91-10, 2013.

[2] Czech Investment Agency. [Online]. Available: www.czechinvest.cz

[3] L. Branstetter, "Is foreign direct investment a channel of knowledge spillover? Evidence from Japan ́s FDI in the United

states," *Journal of International Economics*, vol. 68, pp. 325-344, 2000.
[4] X. Fu, "Foreign direct investment and managerial knowledge spillovers through the diffusion of management practices," *Journal of Management Studies*, vol. 49, no. 5, pp. 970-999, July 2012.
[5] R. Smeets, "Collecting the pieces of knowledge spillovers puzzle," *World Bank Research Observer*, vol. 23, no. 2, pp. 107-138, March 2008.
[6] T. Müller and M. Schnitzer, "Technology transfer and spillovers in international joint venture," *Journal of International Economics*, vol. 68, no. 2, pp. 456-468, March 2006.
[7] R. Smeets and A. D. Vaal, "An integrated framework of knowledge spillovers from FDI," *Nice Working Paper*, pp. 06-103, October 2006.
[8] M. Blomstrom and F. Sjoholm, "Technology transfer and spillovers: Does local participation with multinational matter?" *European Economic Review*, vol. 43, no. 4-6, pp. 915-923, April 1999.
[9] S. Dimelis and H. Louri, "Foreign direct investment and technology spillovers: Which firms really benefit?" *Review of World Economics*, vol. 140, no. 2, pp. 230-253, June 2004.
[10] N. Driffield and J. H. Love, "Linking FDI motivation and host economy productivity effects: Conceptual and empirical analysis," *Journal of International Business Studies*, vol. 38, no. 3, pp. 460-473. May 2007.
[11] S. Beugelsdijk, R. Smeets, and R. Zwinkels, "The impact of horizontal and vertical FDI on host´s country economig growth," *International Business Review*, vol. 17, no. 4, pp. 452-472.
[12] A. Protsenko, "Vertical and horizontal foreign direct investment in transition countries," Ph.D. dissertation, dept. Economics, Munich Univ., Munich, Germany, 2004.
[13] Cohen and D. A. Levinthal, "A new perspective on learning and innovation," *Administrative Science Quarterly*, vol. 35, no. 1, pp. 128-152, March 1990.
[14] M. Blomstrom and J. Y. Wang, "Froeign direct investment and technological transfer," *European Economic Review*, vol. 36, pp. 137-155, July 1992.
[15] A. N. Ruiz, "Does foreign direct investment generate technological spillovers in the host country? Evidence from patent citations," in *Proc. CESifo Economic Studies Conference on Productivity and Growth*, Munich, June 2007.
[16] G. Blalock and D. H. Simon, "Do all firms benefit from downstream FDI? the moderating effect of local suppliers´ capability in productive gains," *Journal of International Business studies*, vol. 49, no. 6, pp. 1095-1112, September 2009.
[17] K. Marci, "How does FDI inflow affect productivity of domestic firms? The role of horizontal and vertical spillovers, absorptive capacity and competition," *National Bank of Poland Working Paper*, vol. 42, March 2007.
[18] W. Keller and S. R. Yeaple, "Multinational entreprises, International trade, and productivity growth: Firm level evidence from the United States," *The Review of Ecionomics and Statistics*, vol. 91, no. 9, pp. 821-831, November 2009.
[19] G. Blalock and P. J. Gertler, "How firm capabilities affect who benefits from foreign technology," *Journal of Development Economics*, vol. 90, no. 2, pp. 192-199, November 2009.
[20] K. E. Meyer and E. Sinani, "When and where does foreign direct investment generate positive spillovers? A meta-analysis," *Journal of International Business Studies*, vol. 40, no. 7, pp. 1075-1094, January 2009.
[21] OECD, *Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development*, ed. 6, 2002.
[22] J. Stejskal and P. Hajek, "Competitive advantage analysis: A novel method for industrial clusters identification," *Journal of Business Economics and Management*, vol. 2, pp. 344-365, 2012.
[23] J. Stejskal and K. Maťátková, "Assessment of shift share analysis suitable for identification of industrial cluster establishing in regions," *Ekonomicky Casopis*, vol. 60, no. 9, pp. 935-948, 2012.
[24] M. Srholec and P. Žížalová. Mapping the geography of R&D: What can we learn for regional innovation policy in the Czech Republic and beyond. *European planning studies*. [Online]. Available: http://dx.doi.org/10.1080/09654313.2013.806435
[25] Z. J. Acs and D. B Audretsch, "Innovation in large and small firms: An empirical analysis," *American Economic Review*, vol. 78, no. 4, pp. 678-690, November 1990.
[26] W. Adams and J. Brock, *The Bigness Complex*, Standford: Standford University Press, 2004.
[27] N. S. Langowitz and S. B. Graves, "Innovation productivity in pharmaceutical firms," *Research Technology Management*, vol. 35, no. 2, pp. 39-52, 1992.
[28] W. M. Cohen and S. Klepper, "Firm size and the nature of innovation within industries: The case of process and product R&D," *Review of Economics and Statistics*, vol. 78, no. 2, pp. 232-243, May 1996.
[29] E. Boreinsztein, J. D. Gregorio, and J. W. Lee, "How does foreign direct investment affect economic growth?" *Journal of International Economics*, vol. 45, pp. 115-135, 1998.
[30] S. Rasekhi, S, Anousheh, H. Ranjbar, and M. Moghimi, "Regional spillover R&D investment: A geographically weighted regression approach," *African Journal of Business Management*, vol. 7, no. 33, pp. 3212-3219, September 2013.
[31] M. Iftikhar, M. Khan, I. H. Padda, N. Akram, and A. Haidar, "Public spending, foreign direct investment, and economic growth," *International Research Journal of Finance and Economics*, no. 61, 2011.

Abdelwalid Rouag was born on 10th July 1979 in Algiers, Algeria. He is currently a PhD student at the University of Pardubice, Czech Republic. He received his first Bachelor degree in "International relations" from the University of Algiers, Algeria, 2000. He then obtained a post graduation degree in "Diplomacy" from the same university in 2002. He obtained his second bachelor degree in "Public Economics and Administration" from the University of Pardubice, Pardubice, Czech Republic in 2011. He then finished his master degree in "Economics of the Public Sector" at the same university in 2013. At present, he is finishing PhD studies in "Regional and Public Economics" at the same university where he also teaches Economics and Public Economics. He works presently in project team concerning the modeling of knowledge spillover effects in the context of regional and local development. Ing. Rouag has different research interests including innovation and development, transformation of the public sector and economic reforms of the resource rich countries.

Jan Stejskal is Assoc. Prof. in public and regional economics, Ph.D. obtained at University of Pardubice, Faculty of Economics and Administration in Pardubice, Czech Republic. His domain is connection of the public economy in the regional scope and view. In the papers he describes and analyses specially the regional policy, tool of the local and regional economic development, public policies after care of the investors, systems of support in national economy in EU countries.

