UNDERSTANDING THE REGIONAL DETERMINANTS OF THE FDI IN ROMANIA: EVIDENCE FROM A PANEL DATA MODEL

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Abstract*:*

This paper is aiming to explore the underlying factors that drive the FDI behaviour in Romania, focusing on the development regions. We use a panel data analysis in an attempt to harvest the advantages of both cross-sectional and time series data. The time span under consideration is 2001-2008, allowing us to capture the characteristics of a relatively long period of constant economic growth. The empirical results indicate the fixed effects model as more appropriate than the random effects model, suggesting regional heterogeneity and the existence of specific characteristics of the regions that have the potential to influence the FDI decisions.

Keywords*: foreign direct investment, panel data model, region, Romania.*

JEL Classification*:* J21, J64

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1. Introduction

The inflows of foreign direct investment (FDI) have been widely recognised as an important factor of growth, especially for the developing economies. Besides the productive potential brought about by the additional capital investment in the economy, the inflows of foreign investment are expected to provide newer and improved technology, thus increasing the growth prospects of the receiving economy.

The beneficial impact of FDI was especially important for the transition economies in Central and Eastern Europe, in need for additional capital investment, as well as access to foreign technology and management techniques in order to modernise and improve their economies and narrow the development gaps (Benacek et al, 2000). The countries in Central and Eastern Europe have been recipients of important foreign capital inflows, driven by the lower factor prices and skilled labour force that compensated for transportation costs and loss of accessibility (Constantin et al, 2012). The FDI flows were particularly high in the capital city regions of CEE countries, leading to increasing interregional disparities.

FDI has shown substantial growth rates Romania as well, reaching up a high of 9.3 bn euro in 2008, but decreasing sharply afterwards: 3.49 bn in 2009, 2.22 bn in 2010 and only 1.9 bn euro in 2011. At regional level the FDI picture is marked by high interregional disparities, showing a major imbalance between Bucharest-Ilfov and the other regions, as well as an important gap between the East and West of Romania (Figure 1).

Ranking the regions based on their ability to attract foreign investors, Danciu et al (2011) confirmed the strong domination of the Bucharest-Ilfov region, placed on the first position, followed at a long distance by the West and North East regions. The heterogeneous development areas, the economic decline recorded by small and medium size towns, and the severe negative impact of economic restructuring upon mono-industrial areas determine even bigger disparities inside the regions.

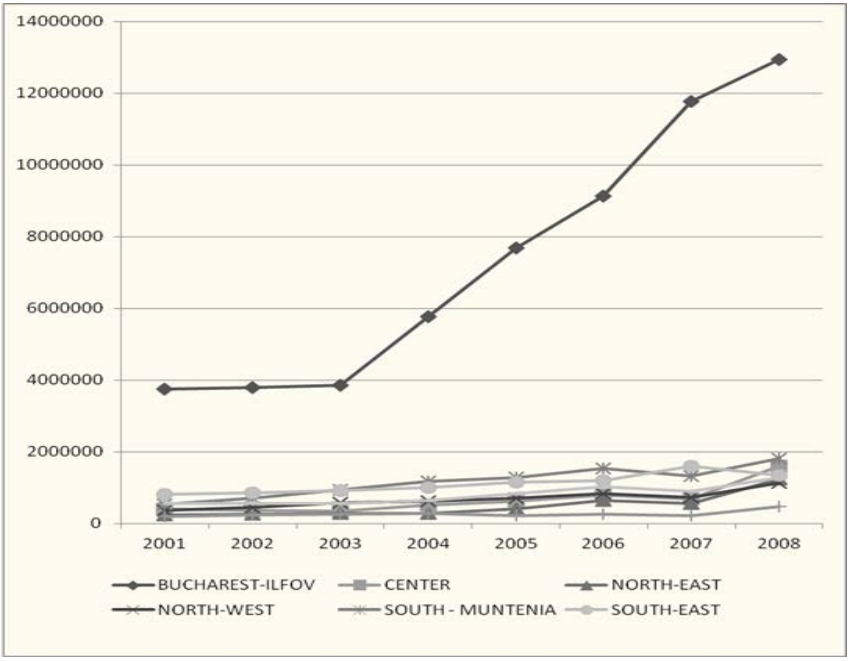

Figure 1. Evolution of the regional FDI stocks, 2001-2008
Source: processed by authors, based on Romanian National Trade Register Office data

Given the significance of investment flows for the regional development, identifying the forces that attract the foreign direct investment is a matter of high interest for the policy makers. Certain regional factors may determine which regions receive higher levels of investment, while other regions in the same country receive lower investments. Therefore we address two interrelated research questions: what are the underlying factors that drive the regional FDI behaviour in Romania? and how significant are the individual characteristics of the regions for the FDI activity? Considering the importance of investments for the economic development, such questions are key in shaping the economic policies of the regions, both in periods of economic growth and during recessions.

In this context, our paper seeks to explore the underlying factors that drive FDI behaviour in Romania, focusing on the development regions. We aimed particularly to point out the impact of private and public RD & I

expenditure and the influence of low-tech or high-tech technological specialization on FDI inflows and stocks. We use a panel data analysis in an attempt to harvest the advantages of both cross-sectional and time series data by bringing together the 8 development regions of Romania over 2001-2008. The time span under consideration is a period of constant economic growth, allowing us to capture the characteristics of a relatively long period of growth.

2. Potential factors of influence on the FDI

The topic of the importance of FDI on receiving countries was largely addressed in the economic literature, the determinants of FDI getting a substantial share of it. Although the researchers are far from reaching consensus, the theoretical and empirical analysis revealed an extensive range of likely determinants of FDI, including exogenous macroeconomic factors such as exchange rates (or expectations about future exchange rate movements), taxes and tariffs, market size, country risk, trade protection and trade flows, the quality of institutions that influence the well-functioning of markets (corruption included), knowledge-capital factors such as skilled labor, research and development factors (R&D expenditure and performance, patents) public goods (for instance, infrastructure), microeconomic factors such as firm's financing options, etc. (Blonigen**,** 2005), as well as non-economic variables like geographic distance or cultural differences (Reschenhofer et al, 2012). Only a part of these likely determinants of FDI is relevant if the discussion on the location and magnitude of investment flows is focused within a certain country, being placed at regional level.

A large body of literature on primary determinants of regional FDI location indicate workforce skills and costs as a significant factor of influence. Cross-wage elasticities of labour demand seem to be positive only for regions with similar skills (competition), while regions with different skills display negative cross-wage elasticities (complementarity) as documented by Riker and Brainard (1997).

Benacek et al found that lower factor cost in the CEECs compared to Spain and Portugal was less important than market size and growth potential. Nevertheless, labour costs relative to other transition economies are significant for the FDI, suggesting that the investor first decides to locate in Central and Eastern Europe, then chooses a location within the region (Benacek et al, 2000).

Gross capital formation and regional GDP per capita are other significant factors for the foreign investment decision (Reschenhofer et al, 2012). As the market size of a region is indicative of the local demand, it may determine the amount of FDI attracted in that region (Chakrabarti, 2003). Many empirical studies are using GDP per capita as a measure of the market size, other popular proxy being population (Bagchi-sen and Wheeler, 1989).

The existence of agglomeration economies (positive externalities and economies of scale associated with spatial concentration of activities and related production facilities) represent a potential attraction factor to both domestic and foreign investments (Driffield and Munday, 2000). The total number of industrial enterprises in a region, as well as its population density, may be used as proxies of agglomeration economies (He, 2002).

As expected profitability is dependent on the existence of a good infrastructure, this is another factor to be considered in the investment decision (Blonigen, 2005; Bagchi-sen and Wheeler, 1989).

The knowledge-seeking foreign investment is particularly interested in regional research and development (R&D) intensity and R&D-related factors of a region (Jensen, 2004). The number of patent applications, as a proxy for the technology development, was also found to be a positive factor for FDI decisions (e.g., Lansbury et al, 1996).

Empirical evidence suggests that investment incentives such as preferential tax rates, social security relief, special tax deductible items and exemptions from tariff payments may have high impact in attracting FDI inflows (Benacek et al, 2000).

The empirical studies on the determinants of foreign investment in transition economies found that the FDI were driven to CEECs by a combination of low wages and skilled workforce. The foreign investment in transition economies was also influenced by macroeconomic stability, the economic reforms, the privatization and trade liberalization (Garibaldi et al., 2001), while research intensity seems to influence the pattern of inward investment (Lansbury et al., 1996).

3. Model specification

We selected the candidate variables based on significant factors which had been identified in the literature (see previous section) and on available data. Many empirical studies gave preference to the FDI stock, rather than the

FDI inflows, as dependent variable of the model, as it seems to have a more stable relationship with the independent variables (Reschenhofer et al, 2012). We have choosed to employ both variables, not only as dependent variables, but as influence factors for each other, based on their strong correlation. Empirical studies suggest that the investment attractiveness of a region increases with the accumulation of FDI flows which are signalling business opportunities and macroeconomic stability (Markusen, 1990).

The independent variables of the model are economic indicators strongly correlated to the foreign investment variable, able to explain the regional and temporal variation of FDI inflows and stocks (Table 1).

GDP/capita captures the regional development level and can be used as a proxy for market size (e.g., Chakrabarti 2001; Taylor 2000). In addition to GDP/capita, a high population density, indication for agglomeration economies, may increase incentives for FDI inflows.

Since labour costs are an important component of the total production costs, hence influencing the location decision, we included regional wages as well. A potentially major factor in the FDI decision is the knowledge economy, captured by variables such as government spending for research and development, business expenditures for research and development, and total number of patent applications by a region. Such factors can be particularly important for the firms activating in high and medium high-tech sectors. We also included in the model the three variables expressing the technological specialization of the region via employed population structure, namely employment in industrial activities with high to medium-high technological intensity, low to medium low-tech intensity and employment in the knowledge-intensive services.

Gross fixed capital formation by regions reflects domestic investment (Krkoska, 2001), and the density of public roads is a proxy for agglomeration economies. We also included in the model the lagged FDI to control for unobservables.

Name	**Variable Description**	**Unit**	**Data source**
FDI	Foreign direct investment stock in the region	Euro	Romanian National Trade Register Office

FDI_I	Foreign direct investment inflow to the region	Euro	Romanian National Trade Register Office
GDP	GDP per capita is gross domestic product (the sum of gross value added by all resident producers in the region plus any product taxes and minus any subsidies not included in the value of the products) divided by midyear population of the region	Euro/ inhabitant	Eurostat
Wage	Monthly net earnings are calculated from gross earnings (remuneration in cash paid by the employer) by deducting the employee's social security contributions and income taxes, and adding family allowances in the case of households with children.	constant 2001 RON	Territorial Statistics, National Institute of Statistics
BERD	Total intramural R&D expenditure of Business enterprise sector by region	Percentage of GDP	Eurostat
GOV ERD	Total intramural R&D expenditure of Government sector by region	Percentage of GDP	Eurostat
POHT	Employment in ***high-technology*** manufacturing industries: Manufacture of pharmaceuticals, medicinal chemicals and botanical products; Manufacture of office machinery and computers; Manufacture of radio, television and communication equipment; Manufacture of medical, precision and optical instruments; Manufacture of aircraft and spacecraft and employment in ***medium-high-***	Thousand employees	Eurostat

	technology manufacturing industries*:* Manufacture of chemicals and chemical product; Manufacture of machinery and equipment; Manufacture of electrical machinery and apparatus; Manufacture of motor vehicles, trailers and semi-trailers; Manufacture of other transport equipment, Building and repairing of ships and boats; Manufacture of aircraft and spacecraft.		
POLT	Employment in ***low-technology*** manufacturing industries: Manufacture of food products, beverages and tobacco; textiles and textile products; leather and leather products; wood and wood products; pulp, paper and paper products, publishing and printing and employment in ***medium low-technology*** manufacturing industries: Manufacture of coke, refined petroleum products and nuclear fuel; Manufacture of rubber and plastic products; basic metals and fabricated metal products; other non-metallic mineral products; Building and repairing of ships and boats.	Thousand employees	Eurostat
POSI	Employment in ***knowledge-intensive services*** at the regional level: Air and Water transport; Post and telecommunications; Financial intermediation; Real estate, renting and business activities**;** Education; Health and social work; Recreational, cultural and sporting activities.	Thousand employees	Eurostat
PATENT	Patent applications to the EPO at the regional level	Number of patent applications per million of inhabitants	Eurostat

CAPITAL	Annual gross fixed capital formation (additions to the fixed assets of the region plus net changes in the level of inventories)	mn euro	Eurostat
EMPL_RATE	The employment rate at the regional level represents the employed persons as a percentage of the population of the region	%	Eurostat
Dens_road	Public roads density at the regional level	km/square km	Territorial Statistics, National Institute of Statistics
Dens_pop	Population density is the ratio between average (mid-year) regional population and the area of the region	inhabitants /square km	Territorial Statistics, National Institute of Statistics

The literature on the determinants of FDI location uses either cross-sectional or time series data, each option entailing both advantages and drawbacks. Time series data allow for changes in long-run determinants of FDI to be taken into account, for instance the variations in government economic intervention and specific economic policies that affect investment activities, while cross-sectional data capture the influence that individual characteristics of the regions may have on FDI decisions. We are aiming at empirically analysing which are the significant regional factors that determine the FDI patterns in the Romanian development regions, while controlling for underlying time changes. Therefore we need to examine both cross-sectional or time series data in the framework of a panel data model. Beside the advantages resulting from the possibility to capture both the spatial and the temporal variability, the panel data model also provides econometric benefits, such as increased variability, more information, less colinearitaty, more degrees of freedom, therefore is more efficient than separate territorial or temporal analysis[4].

[4] Badi H. Baltagi, *Econometric Analysis of Panel Data*, John Wiley and Sons, 1995.

Based on the previous selection of variables (Table 1) the general model specification is:

$$FDI_{it} = \beta_1 + \beta_2\, GDP_{it} + \beta_3 Wage_{it} + \beta_4\, POHT_{it} + \beta_5\, POLT_{it} + \beta_6\, POSI_{it} +$$
$$+ \beta_7\, Patent_{it} + \beta_8\, Capital_{it} + \beta_9\, EMPL\_RATE_{it} + \beta_{10}\, Dens\_pop_{it} + \beta_{11}\, Dens\_road_{it} + \beta_{12}\, BERD_{it} +$$
$$+ \beta_{13}\, GOVERD_{it} + \beta_{14}\, FDI\_I_{it} + e_{it}, \quad (1)$$

where: i = 1,..., 8 (regions) and t = 2001,..., 2008.

4. Empirical Results

The preliminary statistical analysis of model variables shows that in Romania the FDI inflows and stocks are highly correlated to R&D indicators (BERD, GOVERD, and patents), the employment in knowledge-intensive services, the capital, GDP/capita, population and public road density and wages. Employment rate and the population engaged in industrial high-tech and medium-high activities and the number of employees in industrial activities of low and medium-low technology correlate weakly with the FDI variables. The data also point to the lack of complementarity between advanced and low technologies: the population engaged in industrial high-tech and medium-high activities does not correlate with the number of employees in industrial activities of low and medium-low technology, neither with the employment in knowledge-intensive services. So in Romania seems to prevail regional technological specialization rather than an equal coexistence of sectors with different technological intensity.

The general model specified in (1) was estimated using EViews 7. The results are illustrated in Table 2. Model 1 (pooled data) confirms most of the FDI determinants highlighted in the literature.

Table 2. Results from FDI stocks modelling

	Dependent variable (Y): FDI stocks					
	Model 1		**Model 2**		**Model 3**	
Applied on →	**Pooled data**		**Panel model Fixed effects on cross-sections**		**Panel model Random effects on cross-sections**	
Determinants (X)	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**	**Coefficient**	**Std. Error**
CAPITAL	204.2148***	58.00672				
FDI_I	1.1478***	0.199681	1.0014***	0.159512	0.8469***	0.087978
GDP	379.9954***	102.0764	1039.326***	104.9351	468.642***	103.4697
POHT	2551.772	2396.342				
POLT	-4519.166***	1245.579	-13480.77**	4093.865	-4999.878*	2705.776
POSI	82774.54***	10463.74	117326.7***	26750.74		
WAGE	-5166.107***	1606.694	-12226.83***	1827.577	19581.03***	3922.394
BERD	2190247.***	656113.8				
DENS_POP	1149.355***	233.4620				
C	862278.5	652756.3	4725160.***	1102492.	-7750014.0***	1651609.
Adjusted R-squared	0.959233		0.973905		0.9929	
Durbin-Watson stat	0.960407		0.982760		1.2650	
F-statistic	212.7662***		196.9372***		465.6052***	

*** probability less than 1%; ** less than 5%; * less than 10%

Firstly, FDI stocks are positively related to both domestic and foreign new capital inflows. The regions that reached a critical investments mass are able to further attract more investments, benefiting from agglomeration economies. In addition, higher market size (measured by GDP/capita) and agglomeration (population density) seem to attract bigger new investments as well.

Secondly, the technological level of production significantly influences foreign investments: FDI are higher in the regions where a larger part of the population is employed in knowledge-intensive services, while employment in low-technology and medium low-technology manufacturing industries exerts a negative impact on the foreign investment magnitude. Moreover, the level of R&D expenditure of business enterprise sector seems to have a positive influence on the amount of FDI attracted in the region. The employment in high-technology and medium high-technology manufacturing industries has the expected positive sign, but the coefficient is not statistically significant. As expected, the labour cost negatively correlates with FDI, as

investors seek lower production cost in order to be competitive on the global market. Finally, densely populated regions attract more foreign investments, driven by the larger regional markets.

The panel data allow for a deeper exploration of the regional factors by using two additional specifications: the fixed-effects model and the random-effects model. The *fixed-effects model* may reveal the causes of changes within an entity (e.g. region). Each region has its own individual characteristics that potentially affect the dependent variable: for instance the specific business environment and the economic policy of a particular region may influence the FDI inflows in that region. The fixed-effects model assumes that time-invariant characteristics are unique to each region and should not be correlated with other characteristics. Since every region is different, the error term and the constant of a certain region (capturing its characteristics) should not be correlated with the others. If the opposite holds true then the fixed-effects model is inappropriate[5] and the random-effects model should be used instead, allowing to capture that relationship.

The *random-effects model* assumes a random variation across regions; this variation is not correlated with the predictor or independent variables in the model (Green, 2008, p.183), therefore this model is appropriate whenever differences among regions may affect the dependent variable. The random effects model allows for the use of time invariant variables.

The results from the fixed-effects model and the random-effects model are presented in Table 2. Although the results are partially in accordance to the initial model, the number of significant factors of influence is lower, especially for the random effects model.

Finally we ran an overall test of significance Hausman test to decide whether fixed or random effects model is better. The results from Hausman test (prob.= 0,0205) indicated that we should accept the fixed effects model as more appropriate, therefore there is regional heterogeneity and the specific characteristics of the regions have the potential to influence the FDI variable.

[5] "One side effect of the features of fixed-effects models is that they cannot be used to investigate time-invariant causes of the dependent variables. Technically, time-invariant characteristics of the individuals are perfectly collinear with the person dummies. Substantively, fixed-effects models are designed to study the causes of changes within a person . A time-invariant characteristic cannot cause such a change, because it is constant for each person." Kohler, U. and F. Kreuter, *Data Analysis Using Stata*, Second Edition., Stata Press, 2009, p.245

In addition to the analysis of the FDI stocks' determinants, we investigated the regional factors of influence for the FDI annual inflows. The results (Table 3) confirm same of the main factors of influence suggested by the previous model, which is not a surprise, considering the strong correlation between FDI stocks and inflows. There are however a few differences.

Table 3. Results from FDI inflows modelling (pooled data)

Determinants / Statistic	Coefficient	Std. Error	Prob.
FDI	0.249283	0.037413	0.0000
PATENT	145110.9	46873.65	0.0030
DENS_ROADS	27220.92	15308.96	0.0805
POSI	22473.89	5823.578	0.0003
DENS_POP	-1668.280	710.8817	0.0237
GOVERD	6764340.	3115073.	0.0356
PATENT	193936.1	88978.11	0.0349
BERD	2957116.	1138935.	0.0129
C	-938916.4	499083.7	0.0649
Adjusted R-squared	0.724067		
Durbin-Watson stat	2.165670		
F-statistic	42.32913		0.00000

Total intramural R&D spending of government sector in the region enters in the model as a significant positive factor of influence, alongside the number of patent applications per million of inhabitants, suggesting that new FDI inflows are more dependent on the knowledge production than the accumulated stocks of foreign investments. The variables wage, capital and GDP exit the model, while the population density, although significant, has an unexpected negative sign, suggesting that after reaching a certain critical point, agglomeration economies may no longer be attractive and the investors choose to explore new (possibly less competitive) areas.

5. Conclusions

This paper explored the underlying factors that had driven the FDI behaviour of the Romanian regions over 2001-2008 period. The time span

under consideration allowed us to capture the characteristics of a relatively long period of constant economic growth. We found regional determinants of FDI largely in accordance to the existing empirical literature. The FDI stocks are positively related to both domestic and foreign new capital inflows, to market size (GDP/capita) and agglomeration (population density). The technological level of production significantly influences foreign investments: FDI are higher in the regions where a larger part of the population is employed in knowledge-intensive services, while employment in low-technology and medium low-technology manufacturing industries has a negative impact on the foreign investment magnitude. In addition, the level of R&D expenditure of business enterprise sector seems to have a positive influence on the amount of FDI attracted in the region. As expected, the labour cost negatively correlates with FDI, as investors seek lower production costs, while densely populated regions attract more foreign investments, driven by the larger regional markets.

As the ongoing developments in the current political and economic environment are bringing new challenges, further research will be needed to assess the characteristics of regional FDI behaviour during and subsequent to the economic crisis.

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