# ROMANIAN NUTS-2 REGIONS: EU CONVERGENCE AND THE ROLE OF FDI

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**Abstract:**

This paper shows the progress Romania's NUTS-2 regions achieved in reducing the gap to the average GDP per capita in the European Union and the role of FDI in this process. By using the elastic net methodology, the paper identifies the main factors driving foreign direct investment (FDI) in selected Central and Eastern European NUTS-2 regions. It finds that high GDP and GDP per capita in a region increase attractiveness for FDI. Large FDI stocks contribute, on the other hand, to rising regional GDP per capita. The paper identifies key fields that need support from policy makers in order to enhance FDI and foster convergence.

**Key words**: NUTS-2, growth, GDP, elastic net

**JEL classification codes**: O11, O18, H70

## 1. Introduction

The economic performance of a country is determined by the development of the regions it is composed of. Many middle-income and also some high-income countries show large economic and social disparities on the regional level. In the OECD countries as a whole, more than 40 % of economic growth originate in only 10 % of the regions. In this realm, Romania is no exception from the rule.

Since its accession to the European Union at the beginning of the year 2007, Romania passed through three major development phases: during the years 2007-2008, Romania experienced a boom mainly driven by private consumption fuelled by bank credit, while internal and external imbalances accentuated; during 2008-2010 Romania was affected by the financial and economic crisis, which lead to a severe GDP contraction; since 2011 Romania resumed its convergence process, however at a moderate pace compared to the pre-crisis period.

Despite challenging times, Romania made significant progress in reducing its income gap vis-à-vis the European Union (EU). Its average GDP per capita continued to converge towards the EU average. The catching-up process of Romania was associated with profound internal and external liberalisation and deepened integration in the EU production and technology networks.

In Romania, more than a quarter of its GDP is generated by the capital city, Bucharest, and the region surrounding it – Bucuresti-Ilfov. This region is characterized by a high population density, accounts for about 10 % of the Romanian population, and features an over-proportional share in the capital stock and educated workforce of the country. By contrast, other NUTS-2 regions, such as Sud-Vest Oltenia and Vest contribute by less than 10 % to the national GDP.

A closer look at the eight Romanian NUTS-2 regions reveals that regional performance was quite differentiated among them and the economic and social disparities still remain substantial. When GDP per capita is taken as a statistical approximation of economic development and productivity, Romanian NUTS-2 regions show a striking picture. In the best performing region, Bucuresti-Ilfov, GDP per capita is almost 4 times as high as in the poorest performing region, Nord-Est.

During the past 20 years foreign direct investment (FDI) has played an important role in Romania's economic restructuring and regional growth. However, FDI has contributed little so far to reduce regional disparities which have even increased. "*All in all it can be argued that there are no signs that FDI contributed to reducing the income and productivity gaps within the countries. FDI tend to cement the development gap between stronger and lagging regions*." (Koko and Gustavson, 2004).

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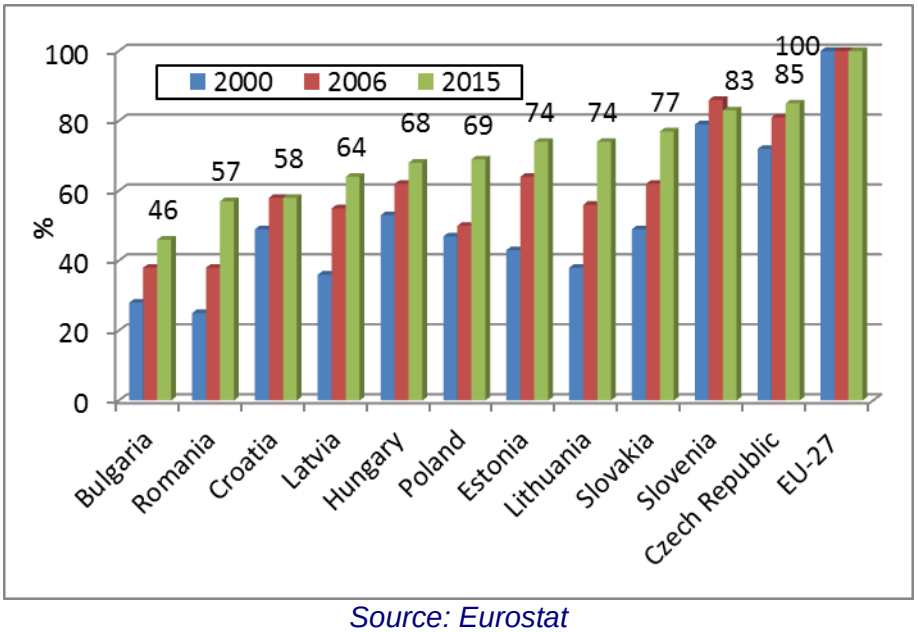
An empirical analysis of the growth-generating economic activity on the regional level requires the availability of relevant regional indicators. Compared to data on the national level, the availability of regional data is much more limited. This is also true for data regarding FDI. Moreover, national accounts data are published with sizable time lags which may amount to two to three years. For this article, we draw upon data provided by the European Commission's Statistical Office, Eurostat and data on FDI provided by the central banks and national statistical offices of the considered countries.

## 2. Convergence, regional disparities and FDI

Since its accession to the European Union Romania has undergone major economic and social change. In particular, structural change was the result of an adjustment to the new environment induced by the financial and economic crisis. The crisis changed Romania's growth model fundamentally. In the period preceding the crisis strong growth was primarily driven by private consumption and investment, fuelled by extensive crediting with money from abroad. In the aftermath of the crisis, economic growth became increasingly driven by exports and investment in infrastructure with co-financing from the European Union.

At the same time, Romania has made considerable progress in the convergence process. Between 2006 and 2015 GDP per capita, measured in purchasing power standards (PPS), advanced in Romania by 19 percentage points. Compared with the other ten new EU member states (NMS) in Central and Eastern Europe (CEE), Romania ranked together with Poland on the first place regarding its performance in convergence. Quite successful in reducing the gap to the EU-average were Lithuania with 18 percentage points, Slovakia with 15 percentage points, and Estonia with 10 percentage points. During the same period, GDP per capita in the most advanced countries among the NMS, Slovenia and the Czech Republic, showed a contraction of 3 percentage points in Slovenia and a rise of only 4 percentage points in the Czech Republic, respectively (Figure 1). Croatia registered in the same timeframe a stagnation. Also in Bulgaria, Latvia, and Hungary progress was only modest with values below 10 percentage points.

**Figure 1 - GDP per capita in PPS, EU-27 = 100**

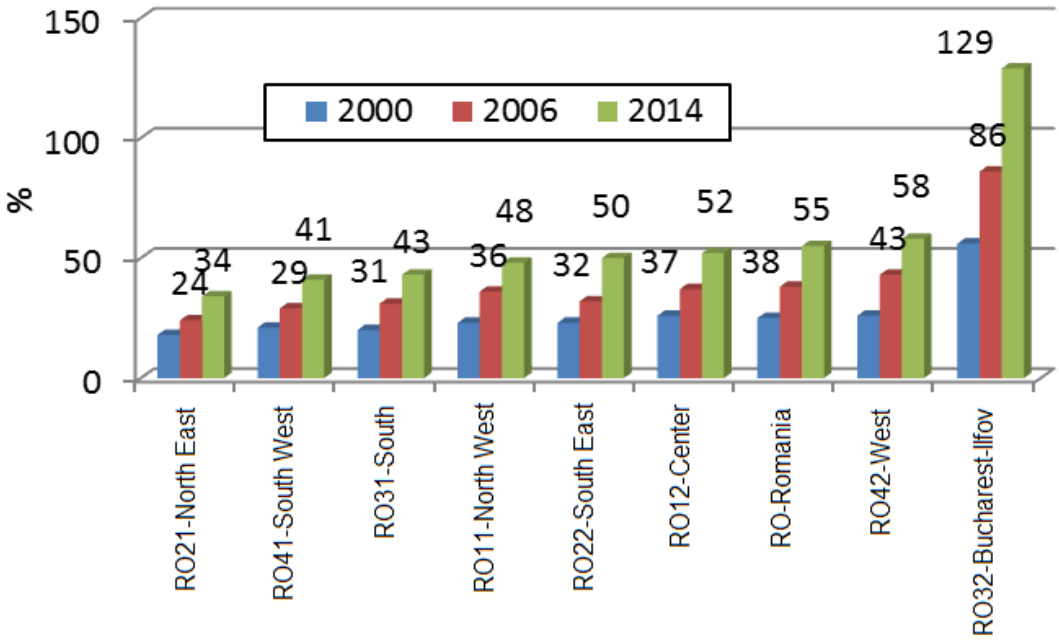



*Source: Eurostat*

Aggregated data at country level, however, hide deep regional disparities. By contrast, a regional analysis for Romania shows that the region Bucharest-Ilfov accounted for most of the progress in the convergence process. Between 2006 and 2014 GDP per capita in PPS advanced by 43 percentage points in this particular region. In the other Romanian NUTS-2 regions, except for the region Sud-Est, GDP per capita in PPS increased by values ranging between 12 and 17 percentage points (the Romanian average). The lowest value was registered by the region Nord-Est, at the Eastern border, with 10 percentage points, the most populous region in Romania and predominantly rural (Figure 2). Due to their peripheral position border regions usually display a lower GDP per capita compared to the country average (except for border regions that include the

capital city, like Bratislavskij region in Slovakia). Urban regions like Bucuresti-Ilfov, by contrast, show a high concentration of human and physical capital and thus tend to grow faster than the rural regions.

**Figure 2 - GDP per capita in PPS in Romanian NUTS-2 Regions, EU = 100**




*Source: Eurostat*

High GDP concentration and fast growth in urban centers is due to "agglomeration" advantages. Businesses may benefit from lower transport costs as they are closer to their markets, they may take advantage from learning from competitors, as they are closer to information sources and the availability of skilled and more productive workers is higher. Furthermore, the overall productivity of the regional economic system rises in such urban agglomerations due to more intensive use of infrastructure by a larger number of firms (OECD, 2007).

FDI has played a major role in the convergence process. According to *Vernon's product cycle theory* (Vernon, 1966) new products and technologies are primarily developed in the advanced countries. During the mature stage of a product its production is relocated towards countries where production costs are lower, such as Romania and the other NMS. Thus, these countries adopt the technologies created in the countries of the investors. Furthermore, the investors may import the goods produced in the countries of the adopters or export them to third countries. During 2006 until 2015 the stock of FDI almost doubled in Romania. The share of industrial production in FDI stock remained almost unchanged at about 45 %. In 2015 FDI companies in Romania contributed by about 70 % to Romanian exports and over 60 % to Romanian imports, thus propelling the cross-border division of labour.

The manufacturing of petrochemicals and chemicals, vehicles, electrical equipment, metallurgical goods, wood products and textiles attracted most FDI. Regionally, FDI is highly concentrated in Bucuresti-Ilfov with almost 60 % of the investment stock, a trend which is common to the most European capital cities. Regions like Centru and Vest follow with shares ranging between 8 and 9 % of the FDI stock, while the border region Nord-Est attracted only 2.6 % of the total Romanian FDI stock (Table 1). The place of these regions in national ranking regarding the FDI stock attracted till 2015 coincides with the place they occupy regarding the regional GDP per capita.

**Table 1**

**Stock of Foreign Direct Investment in Romania (million euro and %)**

| | 2006 | | 2015 | |
|---|---|---|---|---|
| **Romania**: | **34512** | **100.0** | **64433** | **100.0** |
| Bucureşti-Ilfov | 22205 | 64.3 | 38243 | 59.3 |
| Centru | 2559 | 7.4 | 5831 | 9.0 |
| Vest | 1948 | 5.6 | 5237 | 8.1 |
| Sud | 2228 | 6.5 | 4626 | 7.2 |
| Sud-Est | 2653 | 7.7 | 2869 | 4.5 |
| Nord-Vest | 1570 | 4.6 | 3793 | 5.9 |
| Sud-Vest | 938 | 2.7 | 2172 | 3.4 |
| Nord-Est | 411 | 1.2 | 1662 | 2.6 |

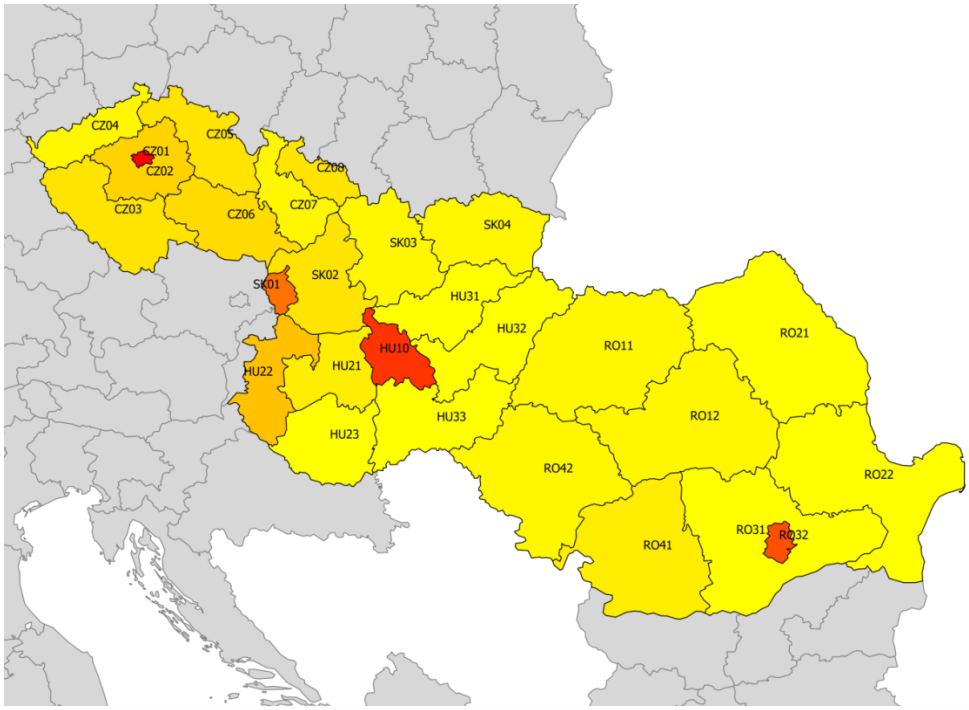
*Source: National Bank of Romania*

## 3. Main Drivers of Regional FDI: Methodology and Data

The economic attractiveness of a region can be best described by its ability to attract foreign direct investment (FDI). When using this concept, one has to differentiate between outward FDI (domestic companies invest in a foreign country) and inward FDI (foreign companies invest in the observed country) as well as between flows (the annual stream of investments) and stocks (the aggregated volume of all past investments minus depreciation and repatriation). The following analysis uses data on inward FDI stocks since flows are usually too volatile. Stocks are in fact a moving, weighted average of flows depreciating over time.

The analysis includes the NUTS-2 regions of the Czech Republic (CZ01 Praha, CZ02 Střední Cechy, CZ03 Jihozápad, CZ04 Severozápad, CZ05 Severovýchod, CZ06 Jihovýchod, CZ07 Střední Morava, CZ08 Moravskoslezsko), Slovakia (SK01 Bratislavský kraj, SK02 Západné Slovensko, SK03 Stredné Slovensko, SK04 Východné Slovensko), Hungary (HU10 Közép-Magyarország, HU21 Közép-Dunántúl, HU22 Nyugat-Dunántúl, HU23 Dél-Dunántúl, HU31 Észak-Magyarország, HU32 Észak-Alföld, HU33 Dél-Alföld), and the NUTS-2 Regions in Romania (RO11 - Nord-Vest, RO12 – Centru, RO21 - Nord-Est, RO22 - Sud-Est, RO31 - Sud – Muntenia, RO32 - Bucuresti – Ilfov, RO41 - Sud-Vest Oltenia, RO42 – Vest) as well as the FDI stock data of the year 2011. Since there are only 27 NUTS-2 regions (data points), the results should be interpreted as indicative. Figure 3 shows the distribution of FDI in the countries under consideration, a darker colour (e.g. RO32, HU 10, SK01, CZ01 etc.) indicates a better performance in attracting FDI.

**Figure 3 - Regional FDI**




*Source: National Statistical Offices and National Central Banks of individual countries.*

Due to the scarcity of regional data in some countries, the analysis uses eight different properties of a region (explanatory variables) (Table 2):

- Foreign direct investment, inward stocks;
- Population;
- Gross regional product (GDP/GRP);
- Gross regional product per capita, own calculations,
- Population aged 25-64 having tertiary education;
- Human resources in science, technology and innovation (persons being educated);
- National annual road freight transport;
- A dummy variable for regions containing the capital city.

**Table 2**

**Driving Factors of FDI**

| | FDI 2011 in mil. € | Population | GRP in mil. € | GRP 1000 € / capita | % of pop. tertiary edu-cation | % of pop. being educa ted as HRST | National ann. road freight transport | Region con-taining capital |
|---|---|---|---|---|---|---|---|---|
| cz01 Prague | 48,721 | 1,249,026 | 38,634 | 30.9 | 37.5 | 39.0 | 21,711 | 1 |
| cz02 Central Bohemia | 9,875 | 1,247,533 | 15,795 | 12.7 | 18.6 | 19.4 | 45,915 | 0 |
| cz03 Southwest | 6,332 | 1,209,506 | 14,978 | 12.4 | 17.0 | 18.3 | 42,899 | 0 |
| cz04 Northwest | 4,140 | 1,143,834 | 12,850 | 11.2 | 11.9 | 12.4 | 34,547 | 0 |
| cz05 Northeast | 6,171 | 1,509,758 | 17,647 | 11.7 | 15.0 | 16.2 | 40,507 | 0 |
| cz06 Southeast | 8,118 | 1,666,700 | 21,362 | 12.8 | 20.8 | 19.6 | 39,347 | 0 |
| cz07 Central Moravia | 3,136 | 1,233,083 | 14,023 | 11.4 | 15.9 | 16.9 | 32,117 | 0 |
| cz08 Moravskoslezsko | 6,707 | 1,247,373 | 14,985 | 12.0 | 16.2 | 18.0 | 31,481 | 0 |
| hu10 Central Hungary | 38,454 | 2,951,436 | 47,021 | 15.9 | 32.1 | 34.0 | 39,593 | 1 |
| hu21 Central Transdanubia | 4,578 | 1,098,654 | 9,243 | 8.4 | 18.0 | 19.6 | 25,100 | 0 |
| hu22 Western Transdanubia | 13,472 | 996,390 | 9,618 | 9.7 | 18.2 | 19.4 | 20,661 | 0 |
| hu23 Southern Transdanubia | 981 | 947,986 | 6,222 | 6.6 | 18.0 | 20.9 | 15,553 | 0 |
| hu31 Northern Hungary | 1,831 | 1,209,142 | 7,087 | 5.9 | 15.7 | 18.3 | 17,163 | 0 |
| hu32 Northern Great Plain | 2,551 | 1,492,502 | 9,126 | 6.1 | 17.2 | 20.3 | 17,745 | 0 |
| hu33 Southern Great Plain | 1,962 | 1,318,214 | 8,269 | 6.3 | 18.7 | 21.4 | 19,339 | 0 |
| ro11 North-West | 3,987 | 2,719,719 | 14,079 | 5.2 | 13.5 | 11.2 | 28,956 | 0 |
| ro12 Centru | 2,970 | 2,524,418 | 14,028 | 5.6 | 13.0 | 10.9 | 19,527 | 0 |
| ro21 North-East | 2,454 | 3,712,396 | 13,234 | 3.6 | 12.5 | 10.2 | 17,680 | 0 |
| ro22 South-East | 1,806 | 2,811,218 | 13,400 | 4.8 | 11.6 | 9.5 | 21,786 | 0 |
| ro31 South Muntenia | 1,627 | 3,267,270 | 15,716 | 4.8 | 11.2 | 9.1 | 28,009 | 0 |
| ro32 Bucharest-Ilfov | 34,021 | 2,261,698 | 31,144 | 13.8 | 31.4 | 26.6 | 16,970 | 1 |
| ro41 South-Vest Oltenia | 4,215 | 2,246,033 | 9,981 | 4.4 | 13.6 | 11.1 | 13,068 | 0 |
| ro42 West | 4,059 | 1,919,434 | 12,590 | 6.6 | 14.9 | 12.3 | 26,044 | 0 |
| sk01 Bratislava Region | 26,550 | 622,706 | 18,297 | 29.4 | 37.4 | 38.5 | 10,167 | 1 |
| sk02 Western Slovakia | 6,641 | 1,866,400 | 21,206 | 11.4 | 15.9 | 16.1 | 42,037 | 0 |
| sk03 Central Slovakia | 3,336 | 1,350,688 | 13,357 | 9.9 | 17.6 | 18.2 | 21,158 | 0 |
| sk04 Eastern Slovakia | 3,258 | 1,585,131 | 13,010 | 8.2 | 16.3 | 17.4 | 25,562 | 0 |

*Source: National Statistical Offices and National Central Banks of individual countries, Eurostat*

The elastic net has been used to estimate the effects of the seven explanatory variables on FDI. This rather new method calculates a linear regression with some interesting properties. First, it does not either include or exclude a variable (discrete choice problem) but allows for partial inclusions leading to a gradient problem. Thus it is, as the second remarkable property, possible to find the global optimum of explanatory variables for the model. Finding the global optimum in a

discrete choice OLS-model can be very problematic or even practically impossible when there are many explanatory variables. In contrast to ridge regression, some of the coefficients of the elastic net are almost always zero, which in fact excludes the respective variables from the model.The third quality is that correlated explanatory variables constitute much less of a problem than for OLS or Tibshirani's Lasso (Tibshirani, 1996, and Friedman, Hastie und Tibshirani (2009)). This last property is especially useful since some of the explanatory variables here show high correlation coefficients.

The calculation of the coefficient vector $\beta$ in Lasso is based on the equation:

$$(1)\quad \hat{\beta}^{lasso} = \arg\min_{\beta} \sum_{i=1}^{n} (y_i - \beta' x_i)^2 + \lambda \sum_{j=1}^{k} |\beta_j|$$

where the term to the left of "+" is calculated as the sum of the squared deviations.

To the right of this there is the "penalty" or "control" term. Under the condition $\lambda = 0$ there is the known OLS-estimate. For $\lambda > 0$ the sum of the absolute coefficients is also added to the squared deviations. The larger $\lambda$, the stronger this limitation. Variables with only small explanatory power are strongly restricted or no longer taken into the model. The parameter $\lambda$ is therefore also referred to as the "tuning parameter".

The model, with the exception of the dummy variable, was estimated in logs so that the resulting coefficients are rendered as elasticities, indicating the variation in percent of the explained variable when the explanatory variable is changed by one percent. If for example the coefficient of explanatory variable *x* is found to be 0.95, a 1% variation of *x* leads to a 0.95% change of FDI.

## 4. Results

The estimates are presented in Table 3. The model explains 84.2% of the overall variance of the FDI data. This can be considered a high value, suggesting that the model approximates the data well. The elastic net excludes population, education of human resources in science technology and innovation, as well as national road freight transport from the model.

**Table 3**

**Coefficients of explanatory variables, n=27, $R^2$=84.2%**

| | |
|---|---|
| *Population* | *0.0000* |
| **Gross regional product** | **0.8022** |
| **Gross regional product per capita** | **0.5250** |
| **Persons aged 25-64 with tertiary education** | **0.7932** |
| *HR in ST, education* | *0.0000* |
| *National road freight transport* | *0.0000* |
| Capital region (dummy) | 0.3141 |

*Source: own calculations*

The first included variable is **regional Gross domestic product (GDP)**. Its coefficient indicates that, keeping everything else constant, a region having 1 % more GDP than another one is expected to have 0.8022 % more FDI. Stated otherwise, regions attract FDI in a (slightly) lower proportion than their economic strengths suggest.

The coefficient of regional **GDP per capita** suggests that, keeping everything else constant, a region with 1% higher GDP per capita attracts 0.5250% more FDI.

The same holds for **persons aged 25-64 with tertiary education**. A 1 % increase in their number enhances the FDI expectation by 0.7932 %. This explanatory variable is highly correlated (r=0.96) to human resources in science technology and innovation which was excluded from the model by the elastic net. A simple OLS regression using both variables leads to one having a high positive, the other one an accordingly high negative coefficient, which nearly cancel out each other. The elastic net only includes one of them carrying the full information.

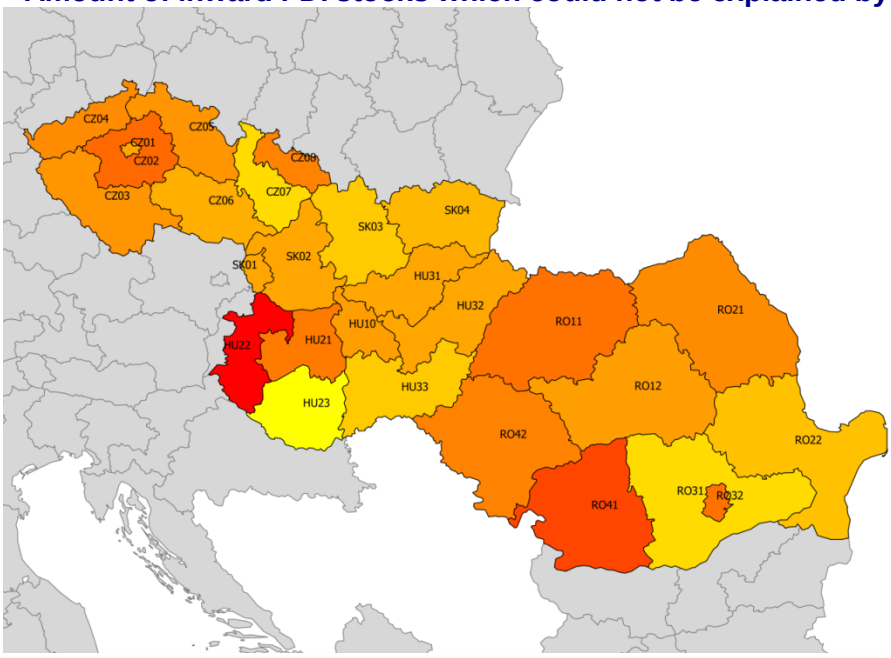
The last variable is the capital dummy. Only regions with the capital of their respective nation receive a 1, all other regions receive a 0. Since that variable is not logged, the coefficient has to be used as exponent in the power function to show the expected effect of a capital city on FDI:

$e^{0.3141}$=1.3690. Just for containing the capital, the region thus gets an additional 36.9% of FDI compared to an otherwise equal region. There may be a number of reasons for that result: foreign investors often perceive the capital as the politico-economic centre of a country. Premises in the capital city help keep distances short and thus transaction costs low when dealing with authorities, which are usually gathered there. Frequently headquarters are located in the capital while the production sites may be based somewhere else – with the production being "booked" for statistical reasons at the location of headquarters. Moreover, headquarter functions regularly require specific knowledge- and capital-intensive services, such as legal counselling or the services of network air carriers.

Interpreting the above results, one must bear the *ceteris paribus* critique in mind. By implication, it is often not possible to change just a single variable while keeping everything else constant. High population almost always goes hand in hand with high GDP (at least within one country), and the capital usually is the most populated place. For analytic purposes, however, this *ceteris paribus* analysis is highly valuable as it disentangles complex effects and distributes its impact to the individual explanatory variables.

Additional insights can be gained by subtracting model estimates from real FDI (i.e. analysing residuals). The resulting difference shows how much better a region performs than expected otherwise by the (explanatory variables in the) model. The highest value is that of HU22 Nyugat-Dunántúl (West Transdanubia), followed by RO41 Sud-Vest Oltenia. These regions attract roughly 3.5 times and twice as much FDI as estimated, respectively. Common to both regions is their high share of FDI in the machine building and especially in the automotive sector. Between 2000 and 2011 the share of HU22 Nyugat-Dunántúl in total Hungarian FDI stock rose from 11 % to 21 %, due to the settlement of large capital-intensive companies in the region. Figure 6 shows the amount of inward FDI stocks which could not be explained by the model. The extent of red color indicates the de facto attraction of FDI relative to the estimated one.

**Figure 4 - Amount of inward FDI stocks which could not be explained by the model**




*Source: own calculations*

## 5. Conclusions

The analysis shows that high GDP and high GDP per capita are factors enhancing the attractiveness of a region for foreign investors. These variables suggest a higher productivity and a higher purchasing power of the population in the region under scrutiny. In turn, FDI itself contributes to rising gross value added in a region, thus fostering this kind of self-enhancing dynamics. At the same time, these indicators can hardly be changed quickly.

Since its accession to the European Union, Romania made significant progress in rising its GDP per capita and convergence to the average GDP per capita in the EU. This progress took place simultaneously with changes in its economic structure, a re-industrialisation of the country, an

increasing degree of competitiveness of Romanian exports, and gain of market shares. These favourable dynamics are, however, characterised by a strong regional differentiation. Progress is highly concentrated in Bucuresti-Ilfov while the other regions show a more modest advancement.

Large markets, with higher purchasing power, such as Bucuresti-Ilfov, offer more opportunities to take advantage of scale economies than smaller markets. In order to reduce their delivery costs, companies with scale economies usually choose locations with a large local demand Krugman (1991). But also the availability of highly educated human resources contributes to the success of Bucuresti-Ilfov and makes it an attractive location of FDI.

While Romania is hosting, compared to the other EU countries, a high share of population with secondary education, this share is contracting. For specific qualifications and regions skilled workers are scarce or not available at all. Bridging the gap between the demand for and the supply of workforce represents a challenge for the Romanian policy makers in the future. The experience of Austria and Germany shows that the implementation of a dual apprenticeship system, which combines in-company and school training, can supply the economy with qualifications tailored to the labour market requirements and thus substantially reduce youth unemployment.

The financial and economic crisis has highlighted the vulnerability of the low-educated and low-qualified population which has been strongly affected by unemployment. Policy measures should concentrate on all education stages, starting with the primary school, where support measures are needed for poor and hardly integrated families in order to keep their children in the school system and culminate with life-long learning for the persons in the labour market.

Technological progress, research and development need a highly educated and qualified workforce. Taking into account Romania's low share of population with tertiary education, the lack of such workforce may posit a bottleneck for continued convergence in the future. Policy measures are needed to increase this share and to keep qualified workforce in the country. This aspect will become even more stringent due to demographic ageing and emergence of new growth patterns as a result of the implementation of industry 4.0.

Regions are striving to adapt to a constantly changing economic and social environment in order to increase their economic performance. Nation-wide factors and international business cycles have a crucial impact on regional economic performance but in parallel regional growth can be strongly influenced by region-specific factors. It is these factors policy makers should address on top of the nation-wide factors through tailor-made regional policies. The ability of a region to enhance labour participation rates, change its specialization patterns, foster educational attainment, and the generation and diffusion of innovation has a significant impact on regional performance. Regional factors can thus support or slow down economic growth.

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