IT CLUSTERS IN THE EUROPEAN UNION AND THE LOCATION SIGNIFICANCE

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Biographical Note

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Abstract

Industrial clusters became an attractive subject for research in the last decades starting with the clusters theory of Michael Porter. Empirical studies demonstrated that cluster building depends on local conditions and can enhance economic development at regional level. Romania reached the efficiency driven development stage in the period of pre-accession to the European Union and new industrial clusters emerged. The IT sector is a dynamic sector which attracted foreign investment, improved the use of resources and contributed to the increase of Romania’s exports in recent years. The paper presents an empirical analysis of IT clusters in the EU in order to identify Romania’s position in this field. The research focuses on the location of IT clustering in Romania and the potential to further develop functional cluster organization.

Keywords: cluster location, competitive advantage, industrial cluster, information technology, regional development.

JEL Classification: D21, L63, R12
1. Introduction

A widespread definition says that clusters are geographic concentrations of interconnected companies and institutions in a particular field. According to Michael Porter (1998) the role of locations has been long overlooked, despite the evidence that innovation and competitive success in many fields are geographically concentrated. The sophistication with which companies compete in a particular location depends very much on the local business environment and on the number and skills of the employees. Micro-foundations of clusters are labor market pooling, supplier specialization, knowledge spillovers, entrepreneurship, path dependence and lock-in, culture and local demand (Cortright, 2006, p.18). However there are many possible drivers for clustering and the identification of clusters in the territory is not as simple as it may look like. According to an extensive study, a collection of firms and institutions could be considered a cluster if they comply with a minimum set of conditions: 1) geographical concentration of firms, in particular industrial specialization; 2) number of SMEs has to be larger than the number of large size enterprises; 3) presence of inter-firm and institutional networks (Borrás and Dimitrios, 2008, p.9).

The concepts of embeddedness and connectivity point to the conditions necessary for clustering and its contribution to smart specialization. The smart specialization of regions depends also on their innovation capacity. A recent study identified territorial patterns of innovation and concluded that in areas with limited R&D activities, the elasticity of GDP to human capital is more than double that to R&D (Cappelo and Lenzi, 2013, p.305). Accordingly, since in less developed EU countries, like Romania, the R&D resources are comparatively low, the smart specialization and GDP increase are more sensitive to changes in human capital and to the capitalization of local experience and connectedness.

An important debate is about formal and informal institutions which became critical for the generation of clusters and for their contribution to regional development (Rodriguez-Pose, 2013). Informal institutions are more dependent on the context and on the geographical characteristics. The main problem is the quality of institutions than their density, as well as the possibility to use them in the regional development policies.

The paper aims at identifying the main information technology (IT) clusters in the European Union, focusing on Romania’s position in this industry. Since IT cluster building in Romania is still at the beginning, the research refers mainly to the identification of regional IT employment and entrepreneurship concentration, which enhance the potential emergence of IT clusters.

According to the European Cluster Observatory definition, the IT activities in this paper include the following NACE 2.0 industries: manufacturing of electronic components; manufacture of loaded electronic boards; manufacture of computers and peripheral equipment; publishing of
computer games; other software publishing; computer programming activities.

The research is based on the descriptive statistics of IT clusters in EU provided by the European Cluster Observatory and European Commission reports. The analysis of IT active enterprises in Romania relies on data from the National Institute of Statistics, as well as from the National Office of Trade Register.

In order to measure the dynamics of skill concentration at NUTS3 level, the employment specialization in IT is calculated by using the location quotient (LQ). This approach consists in comparing the share of employment in a sector \( k \) at NUTS3 level relative to average share of each sector in the national economy.

\[
LQ_k = \frac{x_{ki}}{x_i} \times \frac{X_k}{X}
\]

where:
- \( x_{ki} \) = employment in sector \( k \) in the county \( i \)
- \( x_i \) = total employment in the county \( i \)
- \( X_k \) = employment in the sector \( k \) in the national economy
- \( X \) = total employment in the national economy.

If the location quotient for a specific sector in a specific county is greater than 1.0 then that county is more specialized in that specific sector.

2. IT clusters in Europe

The European Union has demonstrated already a decade ago that strong clusters in EU15 countries, defined by the localization quotient, are significantly related to prosperity (European Commission, 2006). It is more likely that clusters prosper and survive where the general conditions support productivity and innovation.

The recovering of Europe from the economic crisis and the reindustrialization process needs new initiatives and approaches to new production structures. Emerging industries have been identified, as well as clouds and core cluster categories (European Cluster Panorama, 2014). The clusters for „information technology” and „analytical instruments” are among those which have a relative high number of related traded industries, that is industries which are serving markets beyond their own location. The identification of new linkages may indicate engines of emerging industries.

The orientation in the industrial policy in more developed EU countries affects also the Central and Eastern European (CEE) countries, which make efforts in the catching-up process. The CEE countries struggle for a higher technological level of the industry and for the competitiveness, considering the cluster policy integrated in the industrial policy (Török, Csuk et al, 2013).
The core of the more developed EU (Germany, UK, Italy, France) have a high concentration of IT employees. However, the high ranking of Poland, Romania and the Czech Republic is obvious. In 2011 they were in Top 10 considering both IT employment and number of IT enterprises (Table 1).

Table 1. Top 10 of EU countries according to the number of employees and number of enterprises in the IT sector, 2011

<table>
<thead>
<tr>
<th>Rank</th>
<th>Country</th>
<th>Number of employees</th>
<th>Rank</th>
<th>Country</th>
<th>Number of enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Germany</td>
<td>393578(^\text{a,e})</td>
<td>1</td>
<td>Poland</td>
<td>25534(^\text{a})</td>
</tr>
<tr>
<td>2</td>
<td>United Kingdom</td>
<td>250621(^\text{b,f})</td>
<td>2</td>
<td>Italy</td>
<td>23198(^\text{a})</td>
</tr>
<tr>
<td>3</td>
<td>Italy</td>
<td>189040(^\text{a})</td>
<td>3</td>
<td>Sweden</td>
<td>22581(^\text{a})</td>
</tr>
<tr>
<td>4</td>
<td>France</td>
<td>136678(^\text{a,e})</td>
<td>4</td>
<td>Netherlands</td>
<td>20750</td>
</tr>
<tr>
<td>5</td>
<td>Spain</td>
<td>101026(^\text{a,e})</td>
<td>5</td>
<td>Germany</td>
<td>19133(^\text{e})</td>
</tr>
<tr>
<td>6</td>
<td>Netherlands</td>
<td>70876(^\text{a})</td>
<td>6</td>
<td>Spain</td>
<td>14323</td>
</tr>
<tr>
<td>7</td>
<td>Poland</td>
<td>58809(^\text{a,e})</td>
<td>7</td>
<td>France</td>
<td>9099(^\text{d,e})</td>
</tr>
<tr>
<td>8</td>
<td>Sweden</td>
<td>53338(^\text{a,e})</td>
<td>8</td>
<td>Romania</td>
<td>5440(^\text{a})</td>
</tr>
<tr>
<td>9</td>
<td>Romania</td>
<td>46275(^\text{a})</td>
<td>9</td>
<td>Austria</td>
<td>4715(^\text{a})</td>
</tr>
<tr>
<td>10</td>
<td>Czech Republic</td>
<td>43845(^\text{a})</td>
<td>10</td>
<td>Czech Republic</td>
<td>4156</td>
</tr>
</tbody>
</table>

Notes: a - value for earlier year, b - consolidated value for a mix of years, e - value (partially) imputed by splitting a more aggregated industry, f - value translated from a different industry classification system


The top positions of the three CEE countries may be surprising. Beyond the available skilled workforce, a good reason for the IT development in CEE countries after the EU accession is the wage differential. According to the data from the European Cluster Observatory, there are huge discrepancies between the average wage in IT between countries (Figure 1). Romania was in 2011 on the last position from this point of view.

From the countries mentioned in the above top 10 hierarchy (Table 1), only Sweden (SE), Austria (AT) and Romania (RO) have reported data about wages. We could assume that employees in countries with high concentration of IT employees and enterprises are at high level. These discrepancies have slowly decreased in the recent years. It is remarkable that the wage level in Romania increased from 4.62 thou euro/year in 2008-2009 to 9.1 thou euro/year in 2010-2011, despite the economic crisis.

Empirical data about clusters are provided by the Global Cluster Initiative Survey (GCI, 2012). The analysis is based on data from 356 cluster organizations in 50 countries world-wide, primarily in OECD countries. The cluster initiatives started visibly in 2001, but these initiatives accelerated in the period 2007-2011. Most cluster initiatives, irrespective the sector, were initiated as private
sector initiatives (39% of the respondents), as well as a response to a public call/policy program (36% of the respondents). The number of industry clusters in Europe that stated that they belong to the IT sector is significantly higher than other clusters, while the scope of the cluster initiative refers mainly to the regional level (GCI, 2012). These data indicate an evolution compared to the situation observed a few years ago, when researchers could not support the view that the ICT industry is more clustered than other industries in a country like Germany (Maurseth and Frank, 2009).

Figure 1. Average wage in the IT sector in selected EU countries, 2011
(thousand euro/year)

![Figure 1. Average wage in the IT sector in selected EU countries, 2011](source: representation based on data from the European Cluster Observatory)

In 2011, EU top clusters specialized in IT according to regional concentration of IT employees at regional level are in Germany (Mittelfranken, Oberbayern, Karlsruhe), Sweden (Stockholm), Ireland and UK (Berks, Bucks and Oxon).

3. IT resources concentration in Romania

The digital industries, which cover key parts of the ICT economy (computer hardware, software, e-commerce and wireless services) are emerging industries in Europe, as well as in Romania. The Romanian exports of digital services (telecommunications, IT and information services) increased from 1.1 billion euro in 2008 to 2.2 billion euro in 2014. The share of these exports in 2014 was 14.7% of the total value of exported services and 3.2% of the total value of exported goods and services all together. Within the ICT group of services, the IT component is strongly increasing, with a rising positive external trade balance. This remarkable rise of exports proves that these industries are competitive on the international markets.
The regional concentration analysis of the IT activity in this paper relies on the location of enterprises and employees with IT profile. The top 10 counties (NUTS3 level) with IT enterprises include the capital city Bucharest and six counties which maintain in 2014 their positions they had in 2008 (Table 2). In 2014 this list includes new counties, Constanta and Ilfov, but the better ranking of Ilfov is rather due to the proximity to Bucharest.

Almost all active enterprises are SMEs and their number has significantly increased in the last six years. An important share of the SMEs consists in individual enterprises with zero employees, while the share of this category has increased a lot, reaching in many counties 50%. Certainly individuals are able to provide IT services as self-employed, but the tax evasion may also have contributed to this trend, especially during the crisis.

The economic activity is more successful in regions where skills and capabilities are available. And vice versa, the increasing concentration of firms with the same profile in a certain geographical area contributes to the consolidation of a strong labor market in a specific skill.

### Table 2. Top 10 counties with IT enterprises

<table>
<thead>
<tr>
<th>County (NUTS3)</th>
<th>2008</th>
<th>Of which:</th>
<th>2014</th>
<th>Of which:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total number of enterprises</td>
<td>SMEs (%)</td>
<td>SMEs with zero employees (%)</td>
<td>County (NUTS3)</td>
</tr>
<tr>
<td>Bucuresti</td>
<td>2340</td>
<td>99.7</td>
<td>37.5</td>
<td>Bucuresti</td>
</tr>
<tr>
<td>Cluj</td>
<td>513</td>
<td>99.4</td>
<td>29.1</td>
<td>Cluj</td>
</tr>
<tr>
<td>Timis</td>
<td>344</td>
<td>99.8</td>
<td>28.1</td>
<td>Timis</td>
</tr>
<tr>
<td>Brasov</td>
<td>273</td>
<td>98.0</td>
<td>36.6</td>
<td>Brasov</td>
</tr>
<tr>
<td>Iasi</td>
<td>259</td>
<td>99.6</td>
<td>26.0</td>
<td>Iasi</td>
</tr>
<tr>
<td>Bihor</td>
<td>153</td>
<td>98.4</td>
<td>23.2</td>
<td>Bihor</td>
</tr>
<tr>
<td>Dolj</td>
<td>150</td>
<td>99.1</td>
<td>41.3</td>
<td>Dolj</td>
</tr>
<tr>
<td>Prahova</td>
<td>142</td>
<td>100</td>
<td>39.4</td>
<td>Prahova</td>
</tr>
<tr>
<td>Sibiu</td>
<td>129</td>
<td>100</td>
<td>22.5</td>
<td>Ilfov</td>
</tr>
<tr>
<td>Mures</td>
<td>128</td>
<td>100</td>
<td>30.7</td>
<td>Constanta</td>
</tr>
</tbody>
</table>

Source: Own calculations by using data the National Office of Trade Register – Recom online

The regional concentration of IT employees is a relevant indicator for potential cluster building. Even if the ascending trend of this activity is visible in Romania, it is worth mentioning that the situation is not comparable with other European locations with high density of IT activities. In Romania, in 2014, the capital city recorded 19509 IT employees (32% increase compared to 2008), the highest concentration level in the country. However, other regions in Europe have a much higher employee concentration in elite IT clusters, i.e. Mittelfranken – 33814 persons, Oberbayern – 50338 persons, Stockholm 25000 persons, Berks – 30184 persons in 2011.
Table 3 shows the specialization of regions in IT activities, calculated by using the location quotient. It indicates the share of IT employees in the total employment in the county relative to the share of IT employees in total employment at national level. The results show that the counties with the location quotient greater than 1.00 are around large cities having internationally recognized universities. The concentration of IT employees in the Arges county is mainly connected to the automotive cluster, which became a competitiveness pole and which requires IT services. The most important change in this hierarchy is the rise of Cluj county, which became an attraction for multinational companies in recent years and began to create a competitive advantage of the region.

**Table 3. Counties in Romania specialized in IT, according to the number of employees, in 2008 and 2014**

<table>
<thead>
<tr>
<th>Counties</th>
<th>2008</th>
<th>Counties</th>
<th>2014*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timis</td>
<td>3.54</td>
<td>Cluj</td>
<td>3.29</td>
</tr>
<tr>
<td>Bucuresti</td>
<td>2.96</td>
<td>Timis</td>
<td>3.10</td>
</tr>
<tr>
<td>Cluj</td>
<td>2.20</td>
<td>Bucuresti</td>
<td>2.81</td>
</tr>
<tr>
<td>Sibiu</td>
<td>2.07</td>
<td>Sibiu</td>
<td>2.12</td>
</tr>
<tr>
<td>Brasov</td>
<td>1.80</td>
<td>Bihor</td>
<td>1.80</td>
</tr>
<tr>
<td>Bihor</td>
<td>1.65</td>
<td>Brasov</td>
<td>1.70</td>
</tr>
<tr>
<td>Arges</td>
<td>1.22</td>
<td>Ilfov</td>
<td>1.64</td>
</tr>
<tr>
<td>Iasi</td>
<td>1.05</td>
<td>Iasi</td>
<td>1.03</td>
</tr>
<tr>
<td>Ilfov</td>
<td>1.01</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*estimation

Source: Own estimations based on data from the National Office of Trade Register and the National Institute of Statistics

The situation is strongly connected to the fact that two of the metropolitan areas of secondary ranking, such as Timis and Cluj, had a higher economic growth rate before 2010, compared to Bucharest city, even if they are still far from its economic performance. Even if only Bucharest is a predominantly urban area in Romania, other large urban agglomerations belonging to intermediate areas confirm the presence of economic concentration (Bakk and Benedek, 2010, pp.137-141). Also R&D units (universities, research centers and research units of companies) are concentrated in these metropolitan areas or in counties at the geographical limit of large cities (Ilfov county).

### 4. IT cluster building in Romania

The pre-identification of potential clusters in the first decade of Romania’s transition to market economy was object of many consecutive studies (Guth and Cosnita, 2010). During this period there were geographical areas oriented mainly to specific industries, but no functional clusters. After 2004 several studies focused on the industrial potential clusters in sectors such as textile sector, software, automotive sector, wood processing, steel components and metal products.
etc. In accordance with the EU strategic development goals and initiatives, many studies refer also to innovative clusters in Romania (Dudian, 2011). The findings point to the fact that regional concentration of enterprises and employees created favourable conditions for clusters, but not necessarily functional informal clusters or cluster organizations as functional institutions.

Clusters became an important element of the National Reform Program 2011-2013 and of the smart specialization strategy, as well as of the export strategy 2014-2020. The inclusion of cluster building in governmental programs as an instrument of increasing competitiveness and development is a clear sign that this process needs support. The catching-up with already consolidated cluster system in more developed European countries cannot rely only on voluntary sporadic connections at regional level. The reluctance of various actors to cooperate on a mutual interest base originates both in the socialist period and in the transition period, when the partnership was not part of the local culture. The behavior in this direction has not much improved.

Romania is not on the list of so called “star clusters” in Europe with the IT industry, but the dynamics recorded in the last years induces high expectations in this field.

The European Cluster Observatory recorded in its database only three IT clusters.

- **Information and Communication Technologies (ICT) Club** - Region West Romania, cluster in general IT;
- **iTechSylvania by ARIES Transilvania Cluster**, region North-West, cluster in ICT, focused on developing human resources in the field of advanced technologies, promoting professional and commercial interests for its members from North-West region of Transylvania, in order to improve their competitiveness and authority in the global market;
- **Hemeius Information Technology Park**, region Center, sector ICT.

The IT cluster building process has further developed and new clusters occurred, which can be identified within the Romanian Cluster Association:

- **Cluj IT Cluster**
- **ICT – Regional Competitiveness Pole Oltenia Cluster**
- **Cluster for Innovation and Technology, Brasov**
- **POLARIS**, ITC competitiveness pole which operates in the North-West development region, being coordinated in Cluj-Napoca, while most members are located in Cluj.

These clusters have developed in regions (counties) with entrepreneurship propensity, proved by the large number of active SMEs, with skilled workforce and the proximity to R&D institutions which allow the tripartite cooperation.
5. Conclusion

The role of cluster building for economic development has been theoretically explained and put into practice by all European countries. The cluster policy is already part of the industrial policy development strategies at national and regional level.

Romania entered the top 10 EU countries with highest number of IT enterprises and employees. The structurated activities in IT concentration areas prove that location matters. In less developed EU regions the territorial patterns of clustering and innovation have high sensitivity to human capital accumulation, regarding both quality and geographical concentration. IT clusters in Romania are on their way to reach a stage when the location attraction for IT activities is not primarily about low salaries, but about quality of workforce and proper environment for business development.

The IT cluster building in Romania has followed the western model and established specifically structurated associations. These new organizations and structures that collect data and support ongoing processes of cluster development are formal structures. Further research should evaluate the effectiveness of networks between the cluster members.

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