Abstract

The traditional role of the universities involves education, basic research and science. In the last few decades, new functions have emerged such as knowledge and technology transfer to industry, commercialization of knowledge, and playing an active role in national and regional innovative systems. This holds particularly true for high-technology and knowledge-based sectors, where scientific input is of key importance in innovative processes. This paper proposes an analysis of the relationship between potential innovative clusters and the research activity of universities in Romania, and reveals the influence of universities on the development of innovative regional clusters.

1. Introduction

The development of a knowledge economy together with the growth in the recognition of the fact that universities can be drivers of regional development, have led to a increasing awareness of the role of universities as producers of knowledge and innovation. In many countries, some strategies have been developed to engage universities, more effectively, in development and innovation processes.

According to most cluster theories, businesses are at the core of competitive clusters, with universities and other institutions forming a critical support infrastructure for continued industrial innovation and productivity growth (Feser, 2009).

Theoretical arguments concerning localized knowledge flows suggest that knowledge production and innovative activities within a company will tend to be more efficient in agglomerations involving research universities and other companies which are engaged in R&D. According to Cooke et al. (2007), knowledge organisations such as universities and research institutes, as well as businesses involved in innovative activities are usually concentrated in a few specific regions or urban areas, and are not evenly spread across geographical space. However, the contribution of universities to regional development, in general, and to innovative regional cluster set-ups, in particular, is very difficult to measure.

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In this paper we identify a bridge between the research activity of Romanian universities and the innovative industries operating in the same geographical area. To our knowledge, no similar study exists with regard to the situation in Romania.

The goal of this paper is to fill this gap and to provide an overview of the relationship between research papers published in Romanian universities and cluster type agglomerations with a higher innovative potential.

To achieve this goal, the first step is to identify the location of cluster type agglomerations with regard to industries with a relatively high innovative potential. The second step follows and involves identifying the scientific results of universities operating in geographical proximity to the potential innovative cluster-type agglomerations which have been identified in step one, and to analyse the concordance between the degree of concentration of such innovative industries and the internationally recognised scientific results published in related research areas.

The structure of this paper is as follows. Section 2 sets out a theoretical framework aimed at understanding the contribution of universities to innovative regional cluster development. Second 3 discusses the regional clustering of innovative industries. In the fourth and fifth sections we tackle the research methodology, the data used and the research results. Finally, there is a brief statement with regard to the key conclusions.

2. The Contribution of Universities to Innovation

For innovative companies, the interaction with the scientific community is generally considered to be crucial. Innovative firms are often assumed to be highly dependent upon knowledge generated by nearby research universities. It is obvious that universities contribute to industrial innovation, not only by offering new kinds of technological development, but also through a variety of interactions.

The role of geographical proximity for tacit knowledge exchange has been frequently pointed out in the literature. The argument is that the exchange of innovation-relevant knowledge requires trust, a common language of understanding and is strongly aided by face-to-face interaction.

The available research suggests that regions with strong research universities have better opportunities to attract and support innovative firms, than regions without such universities. Agrawal and Cockburn (2002) use data about scientific publications and patents as indicators for the measurement of university and R&D industry performances, and have found strong links in terms of geographical concentrations at the level of metropolitan statistical areas in the USA.

3. Regional Innovative Clustering

A cluster is defined as a group of interconnected companies and associated institutions, located close together from a geographical point of view, working in a particular field and linked by common and complementary elements (Porter, 1990).

Clustering seems to be an easily observable phenomenon. However, according to Van Dijk (1999), the empirical evidence on clusters suggests that there are important differences in both the definition used by different researchers and the real-word manifestations of clustering. The theories about clusters, industrial districts and flexible specialisation all stress the importance of innovation.

It is a common observation that innovations tend to be agglomerated, to be clustered, in large urban regions. Amin and Nigel (1994) demonstrate that in the context of a globalizing economy, centres of geographical agglomeration are centres of innovation, because they offer to the wide collectivity, a well-consolidated network of contacts, knowledge, structure and institutions. Within the innovation systems approach, particular attention is paid to knowledge flows between various actors (Newlands, 2002).

4. Methodological Research and Data

Our main empirical task is to examine the relationship between the research activity developed in Romania’s universities and the innovative cluster environment. As such, we require to be able to measure concentrations of
innovative clusters, the strength of research activity of Romanian universities, as well as the relationship between academic results and the specialisation of innovative companies, in close proximity to university centres. We investigate the contributions of universities to innovative activity by analysing the relationship between knowledge-based industries (high-technology, medium-high-technology and knowledge-intensive services), as the most important exponents of innovation in one economy, and the internationally recognised results achieved by the universities from the same geographical area.

Since one purpose of this study is to identify the locations of innovative clusters, the first step in our research is to identify regions with strong innovative geographical specialisation as cluster type agglomerations. For this research paper, we are considering only knowledge-based industries, because these are the most appropriate potential beneficiaries of results gained from interaction with universities. We are using the classification provided by Eurostat, based on NACE Rev. 2 (Statistical Classification of Economic Activities in the European Community) and on a 2-digit level of aggregation of economic industries.

To achieve this goal, the most commonly used tool available is the coefficient of localisation which is based on the location quotient (Kim, 1995). The location quotient was first defined by Hoover (1936) and depicts the degree of specialisation of a region in a certain industry. The general formula for the location quotient is:

$$\text{Location quotient} = \frac{n_{A,R}}{n_{A,T}} \cdot \frac{N_R}{N_T}$$

where: $n_{A,R}$ is the number of employees in industry A in region R, $N_R$ is the total number of employees in the region R, $n_{A,T}$ is the total number of employees in industry A, at the national level, $N_T$ is the total number of employees at the national level. Based on this method, a region is considered to have a high degree of specialisation in one industry if the location quotient calculated for that region is greater than 1.25.

The second goal of the paper aims to identify the innovative potential of Romanian universities. In highly developed countries, patent-based methodology is used to evaluate the innovative capacity of companies, institutions and organizations. Patents and scientific publications are considered to be the ‘closest’ possible measures of technological and scientific activity (OECD, 1994).

However, in Romania the number of registered patents is very small and a half of them are registered by institutions associated with the communist regime, most of whom no longer exist in that form. To measure the innovative potential of Romanian universities, we used some internationally recognized results, namely the scientific papers published by university staff, in prestigious scientific journals.

Another purpose of this paper is to analyse the relationship between the research activity of universities and the innovative industries, in medium-high technology economic sectors, and in related fields of science, within the top university cities of Romania. The medium high industries are disaggregated into 32 economic sectors corresponding to the NACE 2-digit classification. On the other hand, we distinguish 17 fields of science, which covers all academic disciplines. For each pair of industrial sectors and fields of science, the correlation between the degree of industry specialisation and the number of scientific papers published in the same region is measured.

Data used to support the research is from two sources: data about all the companies operating in Romania in 2011, is used to identify innovative cluster type agglomerations. The location of each company, the number of employees, and the NACE classification, provide a description of the industrial field in which the company is operating and is used to describe each company. The data are processed and aggregated at the NUTS3 level (county), and at the 2 digits level for the NACE classification of economic activities.

The second data set underlying the analysis presented here is the Science Citation Index (SCI) and the Social Science Citation Index (SSCI), with scientific papers published by Romanian university staff, provided by Thomson Reuters. The database contains some internal biases such as language, because the majority of journals covered are published in English, and scientific disciplines, because the dominant disciplines are the life sciences. Despite its limitations, it is an important data source and serves as the basis for a number of analyses.

5. Results

The number of employees in companies from each county, operating in each industry, is used to quantify the importance of economic activities, and the geographical distribution of economic activities in space. The distribution
of economic activities over all the counties of Romania is presented in Figure 1. The distribution of ISI papers published between 2006 and 2010, in all areas of research, and in all Romania’s counties is shown in Figure 2.

Both economic and scientific activities are concentrated in a number of counties of Romania. The following counties are considered in our analysis: Bucharest, Cluj, Iasi, Timis, Dolj, Constanta, Bihor and Brasov. Based on this analysis, we find that strong university centres are also economic agglomerations. There are some cases that deviate from this trend, namely Dambovita, which is not in top in terms of economic activity. On the other hand, there are two counties, Prahova and Ilfov, with an important share of employment, but without strong universities (Prahova) and without any university (Ilfov). But they are in close geographic proximity to Bucharest, the most important economic and academic city of Romania, and benefit from its influence. The distribution of ISI research papers published in each university centre is presented in Figure 3.

According to the methodology described in the previous section, in the next stage of our research we analyse the specialisation of top academic counties (Bucharest, Cluj, Iasi, Timis, Dolj, Constanta, Bihor, and Brasov), in terms of the industries with a higher innovative potential, and the relationship with the ISI papers published in the related scientific fields. We created a list containing related academic research fields for knowledge-based industries, as presented in Table 1, and considered only the scientific papers published in the corresponding research field. To identify this relationship between the number of concentrated knowledge-based industries and the number of ISI papers, the Pearson correlation coefficient has been calculated. In Table 1, the Pearson correlation coefficient values, and the corresponding Sig values are presented. The results suggests a strong relationship between the academic research results and the number cluster type agglomerations in terms of high technology industries (NACE 21 and 26), in the technical knowledge-intensive services (NACE 58-63, 69-75 and 84-93) and with no influence for medium-high technology industries and for non-technical knowledge-intensive services such as water transport, air transport, financial and insurance activities, employment activities, security and investigation activities.

Table 1. The relationship between knowledge-based industries and research fields

| Industry Type                             | NACE Rev. 2 codes – 2-digit level | Related Research fields                                                                 | Pearson | Sig value |
|-------------------------------------------|----------------------------------|----------------------------------------------------------------------------------------|---------|-----------|
| High-technology                          | 21 21.21 Manufacture of basic pharmaceutical products and pharmaceutical preparations | Medicine and Pharmacy, Chemistry, Technical chemistry                                  | 0.834   | 0.00      |
|                                           | 26 26.26 Manufacture of computer, electronic and optical products | Mathematics, informatics, Electrical, electronic engineering and telecommunications, Automation, Robotics | 0.850   | 0.00      |
| Knowledge-intensive services (KIS)        | 58 to 63 58.58 Publishing activities, Motion picture, video and television programme production, sound recording and music publishing activities, Programming and broadcasting activities, Telecommunications, Computer programming, consultancy and related activities, Information service activities | Tools, imaging, multidisciplinary engineering, Mathematics, informatics, Electrical, electronic engineering and telecommunications, Automation, Robotics, Other social sciences | 0.859   | 0.00      |
|                                           | 69 to 75 69.69 Legal and accounting activities, Activities of head offices; management consultancy activities, Architectural and engineering activities; technical testing and analysis, Scientific research and development, Advertising and market research, Other professional, scientific and technical activities, Veterinary activities | Economics and business, Engineering, Materials engineering, Biology, botanics, zoology, Geography and environmental science, Sociology, political science, journalism, Forest Agricultural Sciences | 0.863   | 0.00      |
|                                           | 84 to 93 84.84 Public administration and defence, compulsory social security, Education, Human health and social work activities, Arts, entertainment and recreation | Philosophy, Educational science, Economics and business, Other social sciences           | 0.724   | 0.02      |


Conclusions

Based on the research results, we conclude that there is a strong relationship between cluster-type agglomerations and the research results from related scientific fields, published by the academic staff of universities located in the same region. This is especially true for high-tech industries and knowledge-intensive services and in technical fields, but less for economic and social human sciences, and is primarily reflected by pair-wise correlations between industry employment across locations and the number of ISI scientific papers published. We can conclude that the research activity in these fields could be an important issue for cluster-type agglomerations setting up in the same region.

Acknowledgements

This work was supported by the project “Performance and excellence in postdoctoral research in the Romanian economic science domain”, POSDRU contract No. 89/1.5/S/59184.

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