Transfer of Knowledge and Innovation in Peripheral Regions: The Case of Podlaskie Voivodeship

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Abstract:
The territorial dimension is one of the aspects by means of which various economic relations should be analyzed. The logic of regional systems concerns the integration of enterprises and regional institutions with their environments, which in turn provide them with necessary production factors such as: labour, entrepreneurship, material and non-material infrastructure, social culture, and institutions.

The purpose of this paper is to analyze the role of territories (regional economic systems) in the process of creating and using knowledge and its impact on the economic efficiency of the companies which function within their boundaries. The research comprises the traditional branches of Podlaskie's industry and the enterprises operating in the framework of regional economic systems (clusters).

The analysis is conducted by means of an econometric model gauging the influence of territory on the degree of knowledge utilization and innovation levels in enterprises from regional economic systems.

The results show that in the case of those regions which are based on traditional branches, being part of aregional economic system has a positive impact on the levels of innovation and knowledge transfer.

Regional cooperation increases the involvement of business entities in innovation activities, which translates into higher competitiveness of firms. Moreover, the awareness of the necessity of cooperation and use of innovation capital tends to grow.

Keywords: innovation, region, cluster, cooperation of enterprises

1. Introduction

Economic development is frequently seen as a process driven by regional or local factors. The territory becomes a category capable of creating or offering conditions for generating knowledge and innovation, and of diffusing them. This, in turn, determines the competitive advantage of the companies located within regional economic systems.

The dynamic changes of modern regional systems make it necessary to create such institutional conditions (economic policies) that would help to take better advantage of the growing role of the market and to diminish the direct impact of governments on economic processes. This process occurs with varying intensity, shaping the innovation systems, modifying them, and creating new conditions for their functioning. The companies which belong to regional economic systems can derive benefits from the presence of other entities, but this should happen under the conditions of limited interventionism, which, to a greater or lesser extent, favours some entrepreneurs at the expense of others. The very 'proximity' of particular entities is a sufficient argument for their functioning.

The structure of regional economic systems is a consequence of the ongoing innovation processes in the company's operating within a shared territory, as regards R&D, implementation, and diffusion. Innovation processes have a bearing on technological competitiveness by associating the changes in domestic and international market shares with their technological potentials. This primarily concerns the companies from technologically developed sectors, but some benefits for traditional sectors can also be observed. Activity in regional economic systems can facilitate and broaden access to technologies and potentially enhance innovativeness.

The purpose of this paper is to analyze the extent in which regional economic systems influence the levels of innovativeness and competitiveness of traditional industry companies from peripheral regions.

2. Methodology

The paper uses empirical data on enterprises from four clusters operating in Podlaskie Voivodeship and specialising in the following industries: food processing, metal working, lingerie manufacturing, and construction. These are branches with low or average levels of

technology, based on the criterion of R&Dexpenditure. Sixty-seven companies were chosen for the study, out of about 80 active in the years 2010-2013.

The data come from Bank Danych LokalnychGUS (Local Data Bankof the Central Statistical Office of Poland), Community Innovation Survey (CIS), local research publications, and direct information.

The analysis uses the econometric model founded on Marshall's district theory and further elaborated on in the work of Black S., Lynch L.M. [2001], Caroli E., Van Reenen J. [2001], Cainelli G., and De Liso N. [2003].

2.1. Territory as Factor of Knowledge Creation and Transfer

A territory assumes the nature of a genuine 'creative power' which strengthens the capabilities of individual companies. The territorial dimension is a kind of required reading which explains the ways of understanding and acting on economic complexity [Rullani, Beccattini, 1993, p.28]. The logic of regional systems concerns the ways in which enterprises bond with their environment. A regional milieu provides resources that substantially complement the production capacities of companies, i.e. labour, entrepreneurship, infrastructure, culture, or institutional liaisons.

In a regional economy, there develops tacit knowledge, born of the experience and skills of workers, which is later transferred onto the level of the domestic and global economies and provides the basis for codified knowledge. The transfer of formal tacit knowledge happens by means of specific, systematized processes (formal language). Therefore, tacit knowledge, which is naturally difficult to formalize, becomes a kind of technical and scientific matrix that allows for the application of experience and skills in the global economy.

A territory is, on the one hand, a place where tacit knowledge becomes socialized and internationalized and, on the other hand, a system of networks comprising scientific research and the practical applications of technological solutions. Tacit knowledge is created and diffused across a given territory through social processes, i.e. experience, observation, imitation, or practice [I. Pietrzyk, 2004; G. Gorzelak, 2005].

In order for it to arise, be transferred or applied, every type of knowledge must be based on experience. Irrespective of the ways in which it is codified, knowledge has no independent life, separate from the processes which have generated it, but functions exclusively in association with the system and the mode of its codification. The mode of codification denotes the entirety of relations, integration, language, semantics, and artifacts stemming from the processes of production, consumption, and exchange of knowledge. This allows for interpersonal communication, attracting other entities, memorizing and recording of consolidated procedures, as well as advancement and propagation of knowledge.

The resultant social interactions are matrices which represent patterns of specific attitudes or abilities [March, 1998, p.74]. At the same time, they are a foundation and an effect of social changes from which knowledge arises and develops. They are an introduction to broader cognition as they define the manner and content of communication. What should result from all of this is procedural knowledge which will be used by entities operating beyond a given territory. In this way tacit knowledge becomes formalized and renders itself to wider utilization.

A territory is a structure which evolves owing to knowledge, signals from the market, or the effects exerted by various types of local and regional institutions. Large enterprises treat knowledge and innovation as a hierarchical process, revolving around knowledge creation centres.A company, being a system of principles (not always formal ones) devised in the past and aiming at streamlining entrepreneurial processes, creates innovations, which themselves are sequential, based on the application of abstract knowledge. This is why regional economic systems should possess opportunities for the cumulative application of knowledge and innovation, and for the development of the complex cycle of knowledge transformation.

Territories have always played a key role in entrepreneurial reorganization, which derives benefits from social division of knowledge. As a result, companies can continually improve organizational, technological, and market solutions, in the longer period of time leading to knowledge transfer and innovation diffusion [Grandinetti, 1998, p.89].

In regional economic systems the spatial proximity of small and medium-sized enterprises gives rise to the creation of specialized areas characterized by highly developed interactions. Provided that, additionally, there exist close social and institutional interconnections, the process of cluster creation can ensue. If, moreover, there exist mutual trust relationships as well as informal and tacit knowledge flows, the so-called innovation environment comes into being.

Knowledge generated in an innovation environment spreads through: the relations among clients and recipients, producers and users, the links among enterprises, the flows of employees, and the creation of new companies [Salmi, Blomqvist, Ahola, Kylahejko, 2001, p.20].

2.2. Geographical Dimension of Innovation

Expenditure on research and development and the potential of human capital are the primary sources of innovative activity. This relationship can be formally recorded as:

$$I = \beta RD \times HC,$$

where: RD means the level or R&D expenditure and HC - the money spent on the creation of human capital.

Innovation results from R&D expenditure and its skillful exploitation by human capital. This simple model, however, ignores the influence of location or territory on the type of relationship taking place among the entities.

Proximity boosts the ability of companies to exchange ideas and helps them gain the requisite knowledge [Feldman, 1994, p.21]. Thus, when we take local environment into account, the attitude to knowledge and innovation changes. A company that is deprived of an environment and of the relationships with other enterprises is incapable of taking full advantage of the available knowledge; companies and their local milieus form a system of relationships which make it possible to considerably increase the innovative or technological capacities of the local firms [Dosi, Freeman, Nelson, Silverberg, Soete, 1988, pp.47-49]. This model can be modified and recorded as follows [Jaffe, 2003, p.9]:

$$I = \beta I_{R\&D} \cdot \beta_1 \times U_B \cdot \beta_2 (U_B \cdot G) \cdot \delta,$$

where $I_{R\&D}$ denotes private expenditure on R&D, U_B - research conducted by universities and research units, G – the geographical distance between university research centres, research units and private R&D units.

This model departs from seeing an enterprise as a point of reference in research into innovation and focuses on enterprises and their environment: research centres, universities, as well as other companies. It can be assumed that a geographical unit - a region or a local system - becomes a research unit. Therefore, appropriate location can have an impact on the economic results of an enterprise.
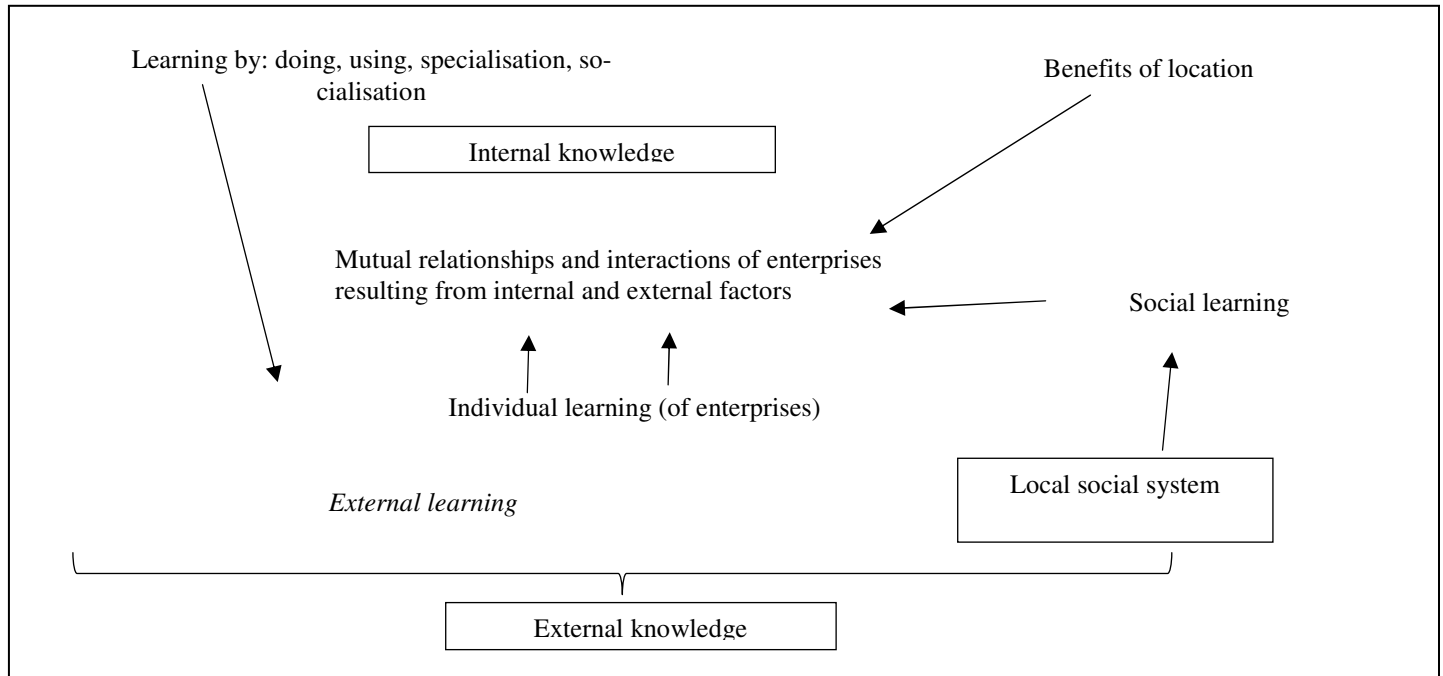

Figure 1: Learning and knowledge flows in local economic systems
Source: own work based on[Albino, Shiuma, 1999, p.8].

The mechanism of obtaining knowledge by enterprises within the framework of local economic systems can be divided into two parts: 1) learning by individual companies, and 2) learning through relationships with other enterprises. Individual learning can take place along one of the following four paths: learning by doing, learning by using, learning by specialization, or learning by socialization [Nonaka, Takeuchi, 1995, p.71].

While the first two paths seem to be fairly obvious, the third and the fourth require explanation. Learning by specialization involves the implementation of just one phase of production or producing just one type of product, which leads to more efficient specialization of particular entities [Jovanovic, Nyarko, 1996, p.1306]. Learning by socialization, on the other hand, means obtaining knowledge as a result of exchange of information with other local entities [Curtis, Pendakur, 2006, pp.2-5]. Geographical closeness increases the frequency of mutual contacts among enterprises, which in turn encourages new forms of cooperation (see Figure 1) [Duffy, Ochs, 2006, p.21].

Social learning enables small companies to jointly take advantage of knowledge and attracts transnational firms, which usually seek common resources created by groups of enterprises, and not capital owned by individual companies.

This can be noticed when, e.g. after a take-over, the new owner gains access to the shared pool of knowledge and local know-how. Suchutilization of an "industrial atmosphere" allows those who have just entered the market to attain specialized tacit knowledge (see Figure 2) [Lorenzon, Mahnke, 202, pp.5-9].
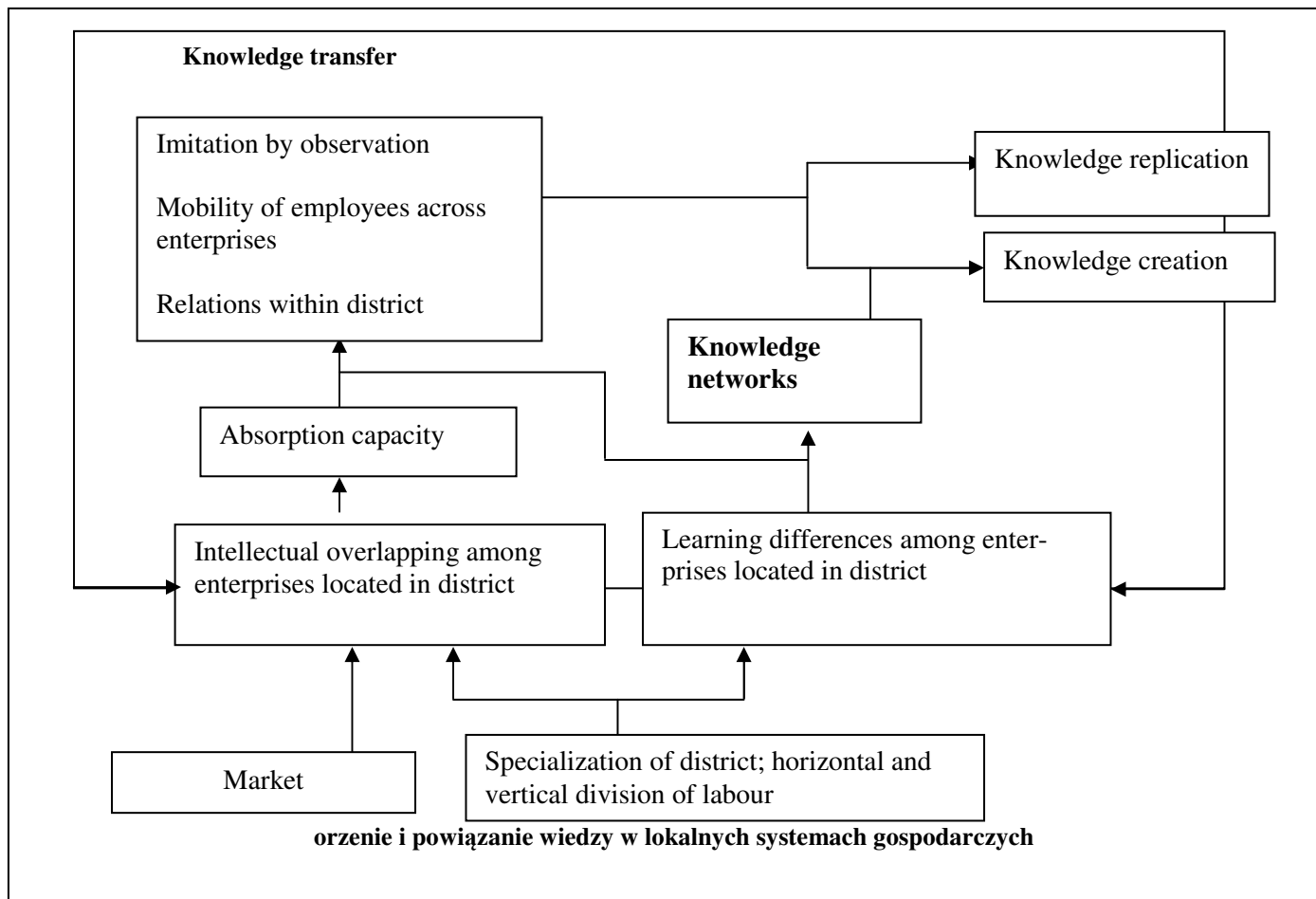
Knowledge transfer

Imitation by observation

Mobility of employees across enterprises

Relations within district

Knowledge replication

Knowledge creation

Knowledge networks

Absorption capacity

Intellectual overlapping among enterprises located in district

Learning differences among enterprises located in district

Market

Specialization of district; horizontal and vertical division of labour

orzenie i powiązanie wiedzy w lokalnych systemach gospodarczych

Figure 2: Knowledge creation and knowledge networks in local economic systems
Source: own work based on[Grandinetti, Tabacco, 2003, p.17].

The positive effect of 'cooperation atmosphere' aids regional and local learning by means of the mutual influence of enterprises. Regional systems profit from the external environment, adapting new, innovative solutions. Moreover, companies derive benefits from the relations with the more broadly understood external milieus: social, political, and economic.

The way in which new knowledge is utilized also depends on the characteristics of an enterprise:itsability to learn and to absorb knowledge. Knowledge itself, meanwhile, spreads within regional systems with the help of employees, through the relationships among entities, and through imitation. Learning differences depend on the specialization of the local system and the division of labour that exists within it.

2.2. Knowledge and Innovation Flows in Regional Systems Based on Traditional Industries. The Case of Podlaskie Voivodeship

Enterprises located within regional economic systems are more likely to innovate and utilize knowledge. This is true about both high-tech companies and those which specialize in traditional branches. Considering the innovative propensity of firms operating within clusters or industrial districts, a distinct advantage of companies which cooperate in regional systems can be noticed. This applies to all the technological levels of economic activity.

Innovating companies located in clusters or industrial districts achieve better results, both in terms of financial efficiency and productivity. The labour efficiency of small cluster firms is higher by about 7.5%. These differences are even more pronounced in the case of medium-sized and large companies, where they can exceed 10%. Clustered innovating enterprises attain far better financial results: e.g. the difference in ROI amounts to nearly 4 percentage points. Similar results have been obtained for ROE, which is higher by almost 3.5 pp in small cluster companies as opposed to those outside clusters; in the case of larger enterprises, this difference is about 2%.

Being part of a regional economic system boosts the innovative capacities of firms. This applies to the capability to create innovation (which is rare in traditional industries), as well as to the processes of imitation or technology transfer, which dominate in the regional economic system of Podlaskie Voivodeship.

The economic results of the spatial agglomeration of enterprises and of innovation processes can be presented by means of an appropriate model. This analysis concerns 67 companies operating within clusters located in Podlaskie Voivodeship in the years 2010-2013 [Cainelli, De Liso, Monducci, Perani, 2001].

The formula of the model is [Cainelli, De Liso, Monducci, Perani, 2001]:

$$LnY_{i,t} = lnA_{i,t} + \lambda_0 lnL_{i,t} + \lambda_1 lnK_{i,t} + \theta_i + \varepsilon_{i,t} \qquad [1].$$

The function takes the form of the Cobb-Douglas production function, where Y denotes value added of company, A - technological level of company; L - number of employees; K - capital resources; θ - unobservable characteristics of company; ε -statistical error. Next, the derivative of the equation was calculated in order to eliminate unobservable fixed effects:

$$\Delta_3 lnY_{i,t} = \Delta_3 lnA_{i,t} + \delta_0 \Delta_3 lnL_{i,t} + \delta_1 \Delta_3 lnK_{i,t} + \Delta_3 \varepsilon_{i,t} \qquad [2],$$

where: Δ_3 – long-term operator, in which t reflects year 2013 and t-3 - year 2010.

When creating innovative solutions, companies use two kinds of factors: internal and external ones (benefits of functioning within regional economic systems). The rate of technological change will be:

$$\Delta_3 lnY_{i,t} = \delta_0 \cdot INN_{i,j,t-3} + \delta_1 \cdot DIS_i \qquad [3],$$

where INN denotes a variable of 0 to 1 reflecting j of technological change implemented by I of companies during the period of t-3; while DIS means the benefits which companies derive from being part of local systems.

Finally, using the equations [2] and [3], an interdependence based on the Cobb-Douglas function can be expressed as follows:

$$\Delta_3 lnY_{i,t} = \delta_0 \cdot INN_{i,j,t-3} + \delta_1 \cdot DIS_i + \lambda_0 \cdot \Delta_3 lnL_{i,t} + \lambda_1 \cdot \Delta_3 lnK_{i,t} + \Delta_3 \varepsilon_{i,t} \qquad [4].$$

The thus constructed model contains two elements worth noting. First, in accordance with the microeconomic theory, enterprises simultaneously make decisions regarding the size of production as well as its optimality. This can cause certain difficulties with data estimation [Z. Griliches, J. Mairesse, 1995]. Second, it is sometimes impossible to precisely calculate a company's net capital (taxes, amortization), which might also pose a minor problem.

3. Results

The data collected in Podlaskie Voivodeship can be used to present a number of interdependencies and links between the companies which function in the regional economic systems of the district (here: clusters) as well as outside of them, expressed by levels of productivity (see: Table 1).

Variable	1	2	3	4
Operating in cluster	0.024** [0.011]	….	0.024** [0.011]	…
Implementing innovation(2010-13)	….	0.021** [0.010]	0.021** [0.010]	….
Cluster effect + innovation	…	….	….	0.030** [0.011]
No. of observations	67	67	67	67

Table 1: Long-term differentiation of companies in local economic systems
*Statistical errors in [], ** statistical significance: 10%*
Source: own work.

Table 1 presents selected factors influencing the productivity of an enterprise. The estimation methods consisted in introducing the following variables: belonging to a cluster, innovation implementation, both these variables, and their cumulative effect.

The first three columns show that being part of a cluster and innovative activity (as well as both of these simultaneously) have a positive impact on the productivity of an enterprise, as compared to those which operate outside the cluster.

The combined effect of belonging to a cluster and implementing innovation is the strongest of all the results obtained in the model. This indicates that functioning in a cluster broadens the innovative potential and also improves productivity dynamics.

The data suggests that in regions based on traditional industries (sectors), being part of a regional economic system is an effective method of boosting the levels of innovation and productivity of firms. This is possible thanks to the interdependence effect, mutual interaction, as well as gaining new knowledge (skills), which lay the foundations for development.

In regional economic systems based on traditional industries (Podlaskie Voivodeship) small and medium enterprises typically have high shares in production and sales volumes. This results from the strong tradition of small business ownership: family craft enterprises (agricultural farms) passed from one generation to the next, as well as from the economic policy of the state, which since the 1990s has aimed at the fragmentation of business activity.

It was also in the 1990s when dislocation of the activity of small and medium-sized firms began, gradually shifting towards cooperation with large concerns, and when concentration of some types of activity (e.g. milk processing industry) started. Primarily, this concerned cooperating firms, which could locate the entire production process in one place. Thanks to that, some enterprises enjoy high levels of specialization, not only in the Polish market, but the international one as well. This kind of specialization helped to increase the competitive advantage of some companies and to ensure a higher competitive position of selected sectors. What is more, sectoral specialization has evidently been developing, allowing for greater efficiency and better competitive conditions.

The structure of the regional economic systems of Podlaskie seems to be hierarchical. Companies are gathered around one leader (or several enterprises, so-called coordinators) who is a client of local firms.

The leader is usually a large or an international enterprise which has its own research centre. Small companies gathered around the leader specialize in one or a few stages of the production process. Using the economy of scale, they become providers for numerous

buyers, achieving a substantial lowering of unit costs. Such a situation can be observed in the agricultural and food processing sector of Podlaskie Voivodeship, which is dominated by two leaders shaping the manufacturing and trade processes in the entire branch.

In spite of their small size, the companies operating in regional economic systems are more inclined than others to seek various forms of product delocalization or internationalization. This is because the branches of production in which them operate constitute the traditional area of regional specialization and it is in those directions that the firms develop their manufacturing capabilities.

The regional economic system of Podlaskie is also characterized by its own processes of creating and transferring knowledge with the intermediation of informal institutions. In a given territory there exist professional associations, chambers of commerce, agencies, and experts providing services to support knowledge creation and diffusion, and thus innovation. Greater propensity for innovation is a consequence of the networking structure, thanks to which, as Marshall put it, 'secrets of the trade are in the air'.

Moreover, an important part is played by local institutions which strengthen the bonds among entities and which have at their disposal financial means and tools to support regional development. The entire range of connections within a regional economic system makes up a kind of Regional Case, reflecting the peculiar type of local development founded on traditional industries (the agricultural and food processing sector, the mechanical engineering industry, and the timber industry).

4. Conclusion

Podlaskie Voivodeship, where traditional industries prevail and which is characterized by a low level of innovation, requires more dynamic cooperation between the R&D sector, enterprises and institutions. So far, relatively low involvement in cooperation for innovative activity has been observed. The main problems include lack of capital and insufficient flexibility of R&D units and institutions as regards market needs, both in terms of knowledge creation and transferring knowledge outside.

Among the positive phenomena aimed at overcoming these weaknesses is the establishment of clusters which cooperate in the field of technology transfer: mainly the so-called 'inward technology transfer', i.e. purchasing new technological solutions. It should be noted that it is low and medium low-tech companies (from traditional industries) that are the most active in the area of technology transfer. The technological level of Podlaskie's enterprises is not, however, much enhanced by their activity in terms of the so-called 'outward technology transfer', i.e. selling new technological solutions.

Taking into account their innovativeness, involvement in R&D, technology transfer, and cooperation for innovative solutions, it can be noticed that the companies located in Podlaskie Voivodeship resign from technologies which come from outside the region, preferring instead to develop new technological solutions in the local laboratories. The leaders of the regional economic system implement their own R&D projects, transferring their results to the cooperating enterprises (the cluster effect).

In clustered companies, the value of new and modernized product sales exceeds 20% of the entire sales revenue. This means that the production of Podlaskie's companies is, to a greater extent, 'renewed', which is crucial for their competitiveness. Cooperation within a regional economic system, therefore, is beneficial for productivity and market position.

Owing to cooperation within clusters, the entrepreneurs in Podlaskie have clearly broadened their awareness of the necessity of greater engagement in innovative activity. In a way, this is reflected in the high dynamics of employment in the R&D sector (which, however, is partly due to higher employment rates at the region's universities), the value of research equipment, and the expenditure on innovation.

The companies of Podlaskie Voivodeship are more likely to become involved in cooperation with domestic customers, providers, and other firms than those in the other parts of Poland. This is also an effect of greater awareness of the need to collaborate and to seek innovation capital.

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