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Contrasting innovation dynamics of professional-technological knowledge intensive business services in metropolitan areas

Mehmet Tahsin Şahin [1]
PhD (Geography), Assistant Professor of the Department of Geography,
[1] Akdeniz University, Antalya, Turkey,
e-mail: tahsinsahin@akdeniz.edu.tr, https://orcid.org/0000-0003-1012-6814;
Liudmyla Niemets [2]
DSc (Geography), Professor, Head of the Kostyantyn Niemets Department of Human Geography and Regional Studies,
[2] V. N. Karazin Kharkiv National University, Kharkiv, Ukraine,
e-mail: ludmila.nemets@karazin.ua, https://orcid.org/0000-0001-9943-384X;
Mutlu Yilmaz [3]
DSc (Geography), Professor of the Department of Geography,
[3] Ankara University, Ankara, Turkey,
e-mail: yilmazm@ankara.edu.tr, https://orcid.org/0000-0001-8914-1165;
Liudmyla Kliuchko [2]
PhD (Geography), Associate Professor, Kostyantyn Niemets Department of Human Geography and Regional Studies,
e-mail: ludmila.klychko@karazin.ua, https://orcid.org/0000-0001-6937-3364;
Çiğdem Varol [4]
DSc (Geography), Professor of the Department of Urban and Regional Planning,
[4] Gazi University, Ankara, Turkey,
e-mail: cvarol@gazi.edu.tr, https://orcid.org/0000-0002-2432-5745

ABSTRACT

Formulation of the problem. The study examines knowledge-intensive business services (KIBS) firms' capability to access, process, and transform information into innovation. KIBS are defined as facilitators, carriers of knowledge, and sources of innovation for other sectors. KIBS play an important role in the production, use, and transfer of knowledge to the manufacturing sector. KIBS activities do not demonstrate a uniform structure within themselves, so a dual classification as professional services (P-KIBS) and technological services (T-KIBS) based on functioning and input has been developed. KIBS activities are concentrated in large cities. Major cities or capitals have well-developed infrastructure, public administration centers, advanced social activities, and numerous research institutes and universities. All of them attract a highly skilled population. Regarding metropolitan city economic growth, KIBS stand out because of their high added value, high income, high innovation returns, and high financial capacity, and they contribute to development.

The purpose. The present study aims to reveal the innovative capacities and dynamics of P-KIBS and T-KIBS firms operating in the metropolitan area of Ankara, Turkey's capital city. To reach this aim, Turkey's capital city Ankara is analyzed by using the results of a questionnaire applied to 410 small and medium-sized (SMEs) KIBS firms, 146 of which are P-KIBS firms and other 264 are T-KIBS firms.

Methods. In the course of the research and preparation of the article, the authors used several scientific methods, both philosophical and general scientific, as well as specific scientific methods. In particular, the methods of analysis and synthesis, induction and hypothetical-deductive method, mathematical-statistical and spatial analysis, methods of grouping and classification, questionnaires and surveys, etc., were used.

The results. There are notable differences between the P-KIBS and T-KIBS firms, considering their spatial distribution patterns and the dynamics of their innovation processes. The spatial distribution patterns of the KIBS firms were revealed. While T-KIBS activities demonstrate a spatial clustering tendency independent of the CBD, the P-KIBS firms prefer to locate within the CBD or its vicinity. KIBS sectors generally prefer to be situated by high-income residents, new settlements, secure and prestigious areas close to large public institutions such as ministries and general directorates. It was revealed that the T-KIBS firms are most densely located in the CBD and newly developing business districts of Balgat and Söğütözü, and in the Technology Development Zones of Ankara. P-KIBS firms, on the other hand, are more widely spread in the Çankaya and Yenimahalle districts. It was found that advances in information and communication technologies have a varied impact on the location selection preferences of P-KIBS and T-KIBS enterprises. According to the research results, the factors influencing the clustering of P-KIBS companies and T-KIBS firms were identified and determined. There is a significant relationship between the innovative P-KIBS and T-KIBS firms and their collaboration with other institutions. As a result of the the study, it has been determined that there is a significant relationship between collaboration, R&D, intrafirm and extrafirm social relationships on the innovation of KIBS firms and also contrasting innovation dynamics related to different classes of KIBS in metropolitan areas.

Keywords: *Knowledge intensive business services (KIBS), innovation, collaboration, development, Professional KIBS, Technical KIBS.*

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1. Introduction

Since the 1960s, the economic structure has changed rapidly with the development of ICTs and it has become a necessity for countries to have a sustainable economy. The competitiveness and sustainable economy of a country or region are directly related to the openness to innovation and adaptation to technological development. Therefore, in recent years, studies on regional economic development have focused on innovation. One of the most important debates in developed economies is how innovation is produced. Among the agents actively involved in the innovation process are the knowledge intensive business services (KIBS), a sub-sectoral branch of the producer services [22, 24, 25, 26, 27, 31, 37, 47, 49, 51, 55].

During the 1980s, the focus of most research put the reason behind the fast-economic growth on KIBS and the integration of KIBS into local and regional economies is believed to be very important [59]. Therefore, there has been growing interest in the study of KIBS since the 1990s [3, 4, 5, 16, 18, 20, 38, 42, 45, 46, 56, 57, 59, 60]. One of the most significant reasons behind this interest is that KIBS sectors have the potential to process initial information and make it usable. Therefore, KIBS sectors are among the most important actors of innovation production.

The KIBS discourse first emerged with a study conducted by Miles et al. (1995). One of the most significant reasons behind the emergence of this concept is the transition to the knowledge era and the use of knowledge as the new raw material in production. Particularly in the early 1900s, the fact that the concept of "knowledge" began to be used more actively and discourses such as "knowledge economy" started to gain an increasing number of supporters reveals the importance of KIBS activities. However, while KIBS, which are regarded as sub-branches of manufacturing sectors within the service industry, cannot be fully defined even today, the sectors covered within its scope have differed based on the time and space. In the most general sense, KIBS are defined as "service sectors in which initial information is collected and converted to knowledge to be used to solve the problems and requests of customers, intermediate input is provided generally to businesses, organizations or public institutions, and the majority of employees is constituted by educated workforce" [52]. KIBS are also defined as facilitators, carriers of knowledge and sources of innovation for other sectors [24]. The sector was described as consisting of firms that specifically provide solutions to problems of other organizations, solutions which require knowledge and experience from external sources [34]. KIBS play an important role in the production, use and transfer of knowledge to the manufacturing sector. In this way, it serves as a bridge between knowledge and the production [13, 30]. In other words, KIBS functions as an intermediary between producers and users of knowledge [25, 62, 63].

KIBS activities do not demonstrate a uniform structure within themselves. Miles (2008) subjected KIBS to a dual classification based on operation and input. Miles (2008) classifies KIBS into two as professional services (P-KIBS) and technological services (T-KIBS). P-KIBS consists of services such as business and management services, legal activities and accountancy, marketing research, etc. T-KIBS, on the other hand, focuses on information and communication technologies and other technical activities (such as IT-related services, engineering, and R&D consultancy) [32, 31]. On the other hand, the current literature has further diversified this classification. Some researchers have suggested a third category: C-KIBS [33] or CIBS [29] to highlight creativity-based KIBS, where the critical forms of knowledge are those of a cultural or symbolic nature: advertising and design are examples of this group.

The dual classification (P-KIBS and T-KIBS) specified by Miles (2008) is utilized in the present study, based on the nature of the case study. The reason for using this classification as a starting point is because the creation and infrastructure of KIBSs in the conditions in Turkey are conducive to this dual separation [52]. While defining the sub-sectors of KIBS, standard industrial classifications (such as NAICS) is used. These sub-sectors are: the legal services industry, accounting and related service industries, architecture, engineering and related service industries, surveying and mapping service industry, design service industries, management, scientific and technical consultancy service industries, R&D service industries and marketing service industries [43]. According to the study of Şahin et al. (2018), P-KIBS activities involve; motion picture, video and television programming production, sound recording and music publishing activities coded 59 in NACE classification, legal and accounting activities coded 69, activities of head offices, management consultancy activities coded 70, advertising and market research coded 73, and other professional, scientific and technical activities coded 74. T-KIBS activities involve five sub-sectors: telecommunications activities coded 61, computer programming, consultancy and related activities coded 62, information service activities coded 63, architectural and engineering activities, technical testing and analysis coded 71, and scientific research and development activities coded 72.

Information and communication technology (ICT) advancements, as well as the rapid expansion and growth of linked service sectors, have exposed new information demands and sub-sectors in recent years. Furthermore, the demand for expert knowledge has increased as the social, political, and

commercial environment has changed. As a result of the ICT revolution, the concepts of "inevitable transformation" and "spaces of flow" gained prominence, as pointed out by Castells (1996). Although advances in ICT have been dubbed "the end of geography" [41] and "the death of proximity" [8] by certain researchers, economic activities utilizing KIBS have emerged or accumulated in specific areas. Uncertainty regarding where KIBS activities take place within a country, region, or city, redefining dispersal and clustering patterns, and recognizing cluster types and their capacity to foster innovation can all be considered as major flaws in development policies.

The metropolitan cities are viewed as an area that needs to be investigated since they are the areas where KIBS activities are located and agglomerated the most. In the last 30 years, rapid changes in the economic structure have altered the urbanization process and structure of metropolitan areas. Knowledge-intensive production clusters are fundamentally common in metropolitan regions. In his study, Wolfe (2009) argues that multidimensional demand and supply factors maintain innovation and growth, and that clustering produces a need for resources as well as a demand environment and competitiveness for innovative business dynamics. He claims that metropolitan cities are the most suitable framework for this innovative milieu [58].

Many innovative activities and complex structures can be found in metropolitan centers. They are tangible sites of interaction for many corporate and public institutions and actors, as well as venues where face-to-face communication takes place, which hosts many innovation actors and might disclose tacit knowledge. The dispersion of technology as well as the generation and transfer of knowledge take place more easily in these sectors. As a result, businesses can gain access to new services or products more quickly and simply, as well as gain a better understanding of the technology and processes that are used in the innovation process [21].

The majority of KIBS clusters now occur in the urban core [23]. The spatial behavior and innovation dynamics of KIBS in different structures in metropolitan centers are critical for policymakers and practitioners to understand. In terms of metropolitan economic growth, KIBS stand out from other services due to their high added value, high income, high innovation returns, and high financial capacity, all of which contribute to development.

The aim of the present study, conducted at the scale of the metropolitan city of Ankara, Turkey's capital, is to redefine the changing structure of urban economies through KIBS spatial patterns, distribution, density, and innovation, and to serve as a critical foundation for future metropolitan area planning and policies. In this context, the study reveals the contrasting innovative capacities and dynamics of two sub-classes of KIBS activities (P-KIBS and T-KIBS) operating in the metropolitan area of Ankara. In line with this purpose, the article first exhibits the spatial distribution of P-KIBS and T-KIBS activities in a regional context and then examines the innovational dynamics of P-KIBS and T-KIBS activities on a micro scale. Within this scope, in the first part, the connection between KIBS activities and innovation will be discussed and afterwards, the data collection methods and the analysis method used in the study will be explained. In the findings section, the spatial distributions of P-KIBS and T-KIBS firms within the Ankara metropolitan area will be analyzed and the contrasting innovative capacities and dynamics will be interpreted. Finally, in the conclusion and discussion section the findings will be discussed.

2. Theoretical background

As much as the way knowledge is produced is important, it is also important why it is produced and by whom. The most important of the agents that play an active role in the knowledge production process is KIBS, a sub-sectoral branch of producer services. KIBS are important elements of innovation systems and key carriers in the communication of knowledge [24, 32, 39]. The increased level of education has popularized the skilled and qualified workforce and universities have begun to support R&D activities, causing KIBS activities to play an important role in processes such as product development, testing and brand development [50].

Recent studies point out the connection between innovation and KIBS [15, 24, 25, 37, 39, 45, 53]. While there is a sufficient number of studies on the innovation forms of KIBS and its differences from the manufacturing industry [9, 12, 15, 19, 53], there are very few studies on the determinants and spatial patterns of innovation by KIBS [16].

Previously, innovation involved the improvement or development of processes or products in the industrial sector, particularly in the manufacturing industry [35]. Afterwards, especially with the development of KIBS, the concept of innovation in the service sector has attracted increasing interest in the last 10 years and became the driving force behind the economic development of metropolitan cities [61]. Within this scope, KIBS activities, which have started to gain an important position in urban economics, are among the primary factors shaping the economy, particularly in metropolitan cities. The faster development and sustainability of metropolitan economies have become directly related to the development capacity of the economic environment and the capacity of KIBS in the area [48, 56].

Although KIBS are important for the development of a region or in micro scale the firm, the biggest problem has been the measurement, conceptua-

lization and characterization of innovation within KIBS [44]. Up to date, there is no consensus in the literature regarding the measurement of innovation within KIBS. Although many previous studies used methods similar to the measurement of industrial innovation to measure service innovation, service innovation and industrial innovation are very different from each other [7]. This is due to the difficulties in data collection and the inability to interpret the data as they remain abstract. In the literature, a number of methods have been attempted to measure innovation in the service sector.

Despite the improvements in the analytical survey for innovation measurements in recent years, the geographical extent in national and regional innovation studies has remained limited [16]. The relationship between innovation and geography is important in terms of determining the innovative capacities of regions, the dynamics of the region in the production of knowledge and the spatial patterns of firms producing innovation [40].

One of the dynamics in the production of innovation is the network relations structure, which is among the most important tools in the production, transfer and development of knowledge. Network relations can develop formally and informally within KIBS activities. The dynamic structure of network relations has a positive effect on the formation of innovation. In this context, it is important to consider the relationship between KIBS activities and collaboration structures.

The establishment of the flow of information between actors play an important role in the production and transfer of knowledge and the development of innovation processes. In the study conducted by Uyarra (2010), the importance of the flow of information and interactive learning in special location conditions was related with the multi-level, multi-actor governance interaction within the dynamics of the regional innovation systems [54]. In addition to the investment conditions and policies in the region, the process of uncovering the tacit knowledge that is embedded in the region during the innovation process should also be regarded as a factor that affects innovation. KIBS activities play a significant role in uncovering this embedded knowledge and establishing a bridge with the firm. In the study of Cooke and Leydesdorff (2006), the contribution of KIBS as the auxiliary of mutual knowledge production with local actors was emphasized regarding the regional innovation systems. It was emphasized that KIBS constituted a significant part of the knowledge infrastructure of the region and that this knowledge infrastructure served as a motivator of innovation and development. Additionally, Asheim and Gertler (2005) mentioned the role played by regional innovation systems in the production and circulation of new knowledge, and argued that the extent of the relationship between the national institutional framework and regional innovation systems was important in terms of local innovative capacity [2].

In a study conducted by Andersson & Karlsson (2005), using the parameters of employees' modes of departure from home and arrival to work, travel times, means of transportation and connection type, it was emphasized that the market, information and face-to-face communication leading to the innovation of the spatial boundaries in the use of knowledge that are produced in the innovation process of a firm can differ significantly based on proximity and accessibility. As a result, the researchers proposed that accessibility, with its functional notion and embodied form, can take the place of proximity. They also noted that considering business interaction density and market density, temporal proximity is more significant compared to geographic proximity, and that there is a strong correlation between regional innovation system performance and regional accessibility [1].

Similarly, in the studies conducted by Britton and Echeverri (2004) and Carroll and Brennan (1999), it was emphasized that innovation systems reduced spatial limitations related with the distance, that distance was not a weakness anymore particularly in relations that required high levels of interaction [6, 17]. Notwithstanding, Asheim and Gertler (2005) argued that locational preferences had a strong influence on innovation and innovation was directly related to its adoption in areas where it was presented with geographical clusters and the resources, services and expert inputs required for the innovation process were concentrated [2].

When the general output of these studies in the literature is evaluated, the contribution of KIBS activities to the national, regional or urban economy is quite clear. However, the structural transformations in the economy that have taken place in recent years such as the rapid development of ICTs and the resulting new spatial patterns at the urban scale reveal the necessity of micro-analyses in the studies on the subject. Considering context dependent characteristics of the regions, the need of in-depth analyses emerges due to the local atmosphere, network structure, and the production and dissemination of knowledge in areas where this transformation takes place.

3. Case Study and Methodology

According to a report published by the European Cluster Observatory, KIBS activities are concentrated in large cities. Many other studies corroborated this finding, demonstrating that metropolitan regions, particularly capital cities, are hotspots for KIBS [14]. Furthermore, major cities or capitals have well-developed infrastructure, public administration centers, advanced social activities, and numerous research institutes and universities, all of which attract a highly

skilled population [16]. The capital city of Turkey, Ankara was selected as the case study due to the assumption that KIBS activities are mainly concentrated in the metropolitan cities. Additionally, according to the location quotient (LQ) analysis in NUTS-2 level of Turkey, it is revealed that KIBS activities are concentrated the most in Ankara, following Istanbul. Within this framework, Ankara, which is one of the largest metropolitan cities in Turkey, is worth researching due to its economic, social and cultural aspects, as well (Figure 1).

The present study's population consists of 7603 KIBS enterprises registered with the ATO in the Çankaya district. The district of Çankaya was chosen since it houses 69.93 percent of all KIBS companies in the city of Ankara, and specific KIBS sectors are exclusively found in the Çankaya district. The choice of this district will aid in representing the metropolitan city of Ankara and making generalizable inferences for metropolitan regions from the findings acquired at the end of the field study. In this context, a questionnaire was applied to 372 companies out of 7603 located in Çankaya, and out of a total of 10.872 registered to ATO in Ankara, in accordance with a confidence interval of 95%, in order to understand the innovation dynamics of KIBS activities in metropolitan areas and to generalize the results. Because subsectors with less than ten samples were identified using proportional stratified sampling, the study was organized by selecting at least 12 samples from each sector to ensure adequate representation and a healthy analysis. Additionally, in the event of inadequate information or errors in the questionnaire applications, two or three additional surveys were sought from each sub-sector, bringing the total number of questionnaires used to 410 (*Table 1*).

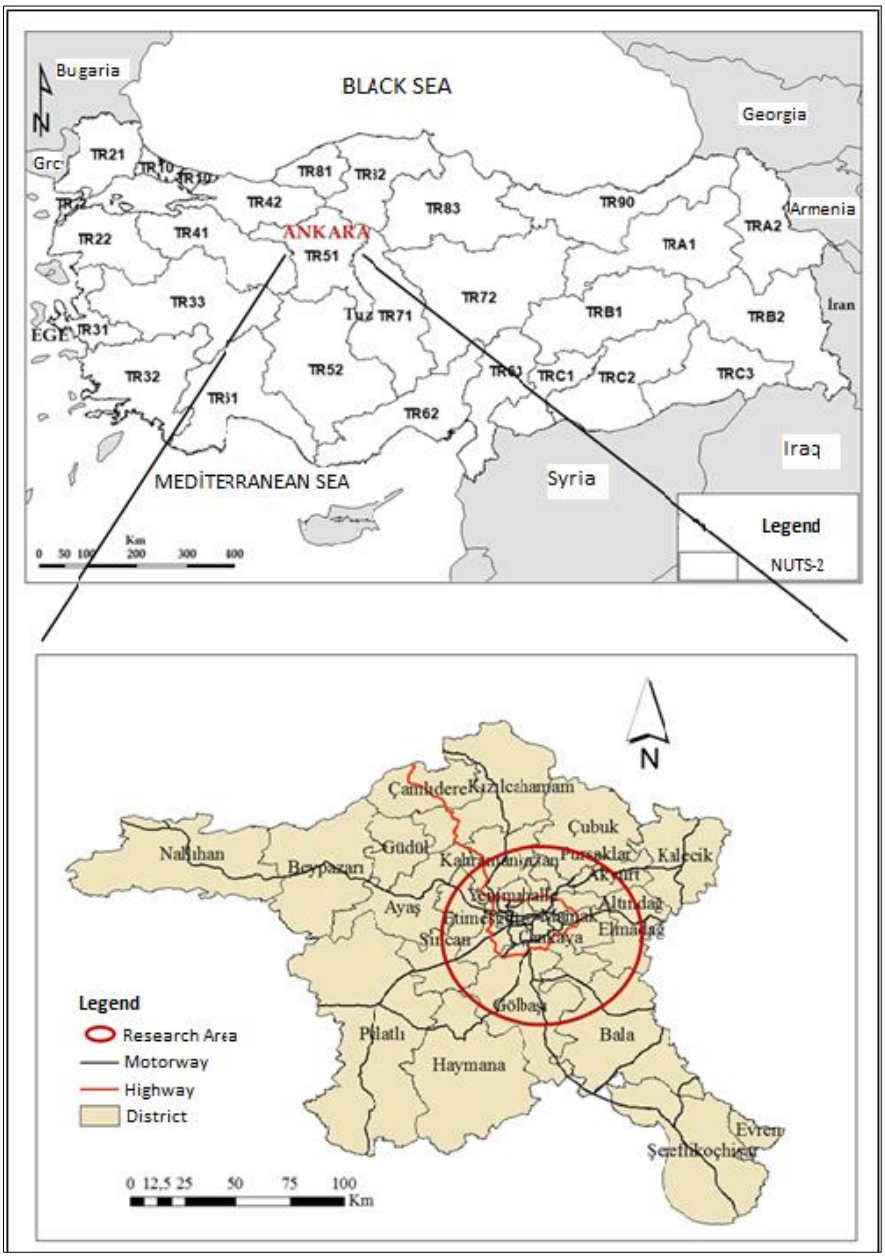

Fig. 1. Map of the Study Field

Certain sectors agglomerate in order to reduce costs, benefit from the atmosphere of knowledge that occurs in a particular area and facilitate the production and dissemination of knowledge. This structure creates a state of clustering of firms in that area. Two main hypotheses were emphasized in the present study. The first hypothesis was developed on the idea that P-KIBS and T-KIBS activities form different gathering dynamics, considering that the same activity branches of KIBS will form a cluster and benefit from positive externalities:

H1: *In the Ankara metropolitan area, the locational preferences of T-KIBS and P-KIBS activities differ in terms of core and periphery.*

Since P-KIBS and T-KIBS firms have different concepts, their ways of collaboration, access to knowledge, production of knowledge and customer relations will also be different. In this context, the second hypothesis was developed as follows:

H2: *The network relations, sources of knowledge, access to knowledge and customer relations of P-KIBS and T-KIBS differ significantly.*

Within the scope of the second hypothesis, six sub-hypotheses were developed to test the relationship between innovation and certain variables of collaboration, social networks, age of the firm, number of employees in KIBS activities.

Sub-H_1: There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and their collaboration activities.

Sub-H_2: There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and their intrafirm social networks.

Sub-H_3: There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and their extra firm social networks in the own-sector.

Sub-H_4: There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and their extra firm social networks in different-sectors.

Sub-H_5: There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and the age of the firms.

Sub-H_6: There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and the number of employees in the firms.

In the first step, the spatial distributions of KIBS activities were analyzed on the scale of the Ankara metropolitan area. The address data of a total of 10.872 two-digit NACE code level KIBS (P-KIBS and T-KIBS) firms with two classes were accessed through Ankara Chamber of Commerce (ATO). In order to examine the spatial clustering of the KIBS firms, spatial distribution maps were generated using Geographic Information Systems (GIS). Each point represented a firm on the map. Based on the firm addresses, it was determined which of the sub-sectors in KIBS activities were clustered in the city center and which in the periphery, and the spatial distribution patterns of the KIBS firms was revealed. The second step was based on measuring the innovation dynamics of the KIBS firms. A survey was applied to a total of 410 firms, 146 of which were P-KIBS firms and 264 were T-KIBS firms. The two classes had a total of five sub-sectors each. For the survey to produce more meaningful results, a sample distribution was made proportionally based on the number of sub-sector firms (*Table 1*).

The data obtained as a result of the survey were subjected to descriptive analysis in the SPSS program over frequency (f) and percentage (%) values. At the end of the descriptive analysis, the differences of the variables between the P-KIBS and T-KIBS classes

Table 1

Distribution of the Sampling Surveys in Ankara by KIBS Sectors

Sector (NACE codes)	KIBS Activities	Number of firms	Sample	Percentage
59 P-KIBS	Motion picture, video and television programmer production, sound recording and music publishing activities	195	13	3.17
69 P-KIBS	Legal and Accounting Activities	231	13	3.17
70 P-KIBS	Activities of head offices; management consultancy activities	1086	53	12.9
73 P-KIBS	Advertising and market research	504	28	6.83
74 P-KIBS	Other professional, scientific and technical activities	647	39	9.51
61 T-KIBS	Telecommunications	172	13	3.17
62 T-KIBS	Computer programming, consultancy and related activities	1323	68	16.59
63 T-KIBS	Information service activities	85	13	3.17
71 T-KIBS	Architectural and engineering activities; technical testing and analysis	3195	158	38.54
72 T-KIBS	Scientific research and development	165	12	2.93
Total		**7603**	**410**	**100**

[a] Classification adapted from Şahin et al. (2018)

were evaluated. The scores given to each item by the participants on a Likert-type scale were added up and averaged. At the end of the analysis, the differences between P-KIBS and T-KIBS activities were evaluated for each item.

The Chi-Square Test of Independence (x2), one of the non-parametric methods, was used in the analyses. The observed (Gij) and expected frequency (Bij) in the cells containing two variables (first variable j; second variable observed frequency at i level; Gij) were compared, and it was evaluated whether there was a difference between the observed value and the expected value through cross-tabulation between the variables prior to the chi-square test of independence, which investigates the relationship between variables.

4. Findings

When the distribution of the KIBS firms in Ankara is examined, it is observed that out of the total 25 districts, 99% of the firms are distributed in the central districts of Çankaya, Yenimahalle, Etimesgut, Altındağ, Keçiören, Gölbaşı, Sincan and Mamak (Table 2). Based on this distribution, the Çankaya District, where approximately 70% of the existing KIBS firms locate, was selected as the study field.

Table 2

Distribution of the P-KIBS and T-KIBS Firms in Ankara by Districts

District	P-KIBS Number of Firms	%	T-KIBS Number of Firms	%	Total Frequency
Çankaya	**2663**	**35.03**	**4940**	**64.97**	**7603**
Yenimahalle	431	30.61	977	69.39	1408
Etimesgut	124	27.56	326	72.44	450
Altındağ	182	47.77	199	52.23	381
Keçiören	92	30.87	206	69.13	298
Gölbaşı	36	12.29	257	87.71	293
Sincan	45	27.11	121	72.89	166
Mamak	28	17.07	136	82.93	164
TOTAL	3613	33.23	7259	66.77	10872

Source: ATO, 2017

According to the spatial analyses performed, it is observed that the ring road that surrounds the city of Ankara contains almost 99% of the KIBS firms. Inside the Road, KIBS firms are agglomerated in the areas of the central business district (CBD) of the city, Kızılay, the vicinity of the Ministries located in the south extension of the CBD, and the vicinity of the Beysukent-Koru and Balgat-Söğütözü, which are newly developing business districts. It is observed that the other agglomeration zones are the Technopolis's of the major universities in the city and Organized Industrial Zones located in the south and northwest (*Figure 2*).

From the spatial analyses, it is also observed that the T-KIBS firms constitute 66% of the total number of KIBS firms. Figure 3 shows that the T-KIBS firms are most densely located in the CBD and newly developing business districts of Balgat and Söğütözü, and in the Technology Development Zones of Ankara. P-KIBS firms, on the other hand, are more widely spread in the Çankaya and Yenimahalle districts. According to the 2017 records of ATO, 84% of the P-KIBS firms in Ankara are located in these two districts. P-KIBS firms constitute approximately 30% of the KIBS firms located in the Çankaya district.

The survey was applied to the KIBS firms located within the Çankaya district. The survey was applied to a total of 410 firms, 146 of which are P-KIBS firms and 264 are T-KIBS firms. In the analyses of the survey, first, the general characteristics of the P-KIBS and T-KIBS firms and then their creation of knowledge and innovation will be analyzed.

The employees in KIBS firms are divided into 5 classes based on their qualifications. Among these 5 classes, the highest share belongs to the engineers with 42.2% in total but it differs due to T-KIBS and P-KIBS firms. While in the T-KIBS firms, the highest share belongs to the engineers with 45.9%, in the P-KIBS firms, the highest share belongs to administrative staff with 37.3% (*Table 3*). The KIBS employees with a Bachelor's degree hold the highest share with 69.1% while the lowest share belongs to the employees with Master's or Ph.D. degrees with 7.7%. The P-KIBS and T-KIBS firms reflect this general structure. In terms of the firm age, it is observed that there has been an increase in the number of firms established after the year 2000 in general.

The P-KIBS firms aged 1-5 hold a share of 34.2% while this rate is 31.8% in the T-KIBS firms. When the employment structures of the KIBS firms are examined, it is observed that the highest share is held by the firms with 2-9 employees with 67.3%. In the P-KIBS firms, the group that demonstrates the highest accumulation is 2-9 employees with 68.5%, followed by 0-1 employee with 15.8%. In the T-KIBS

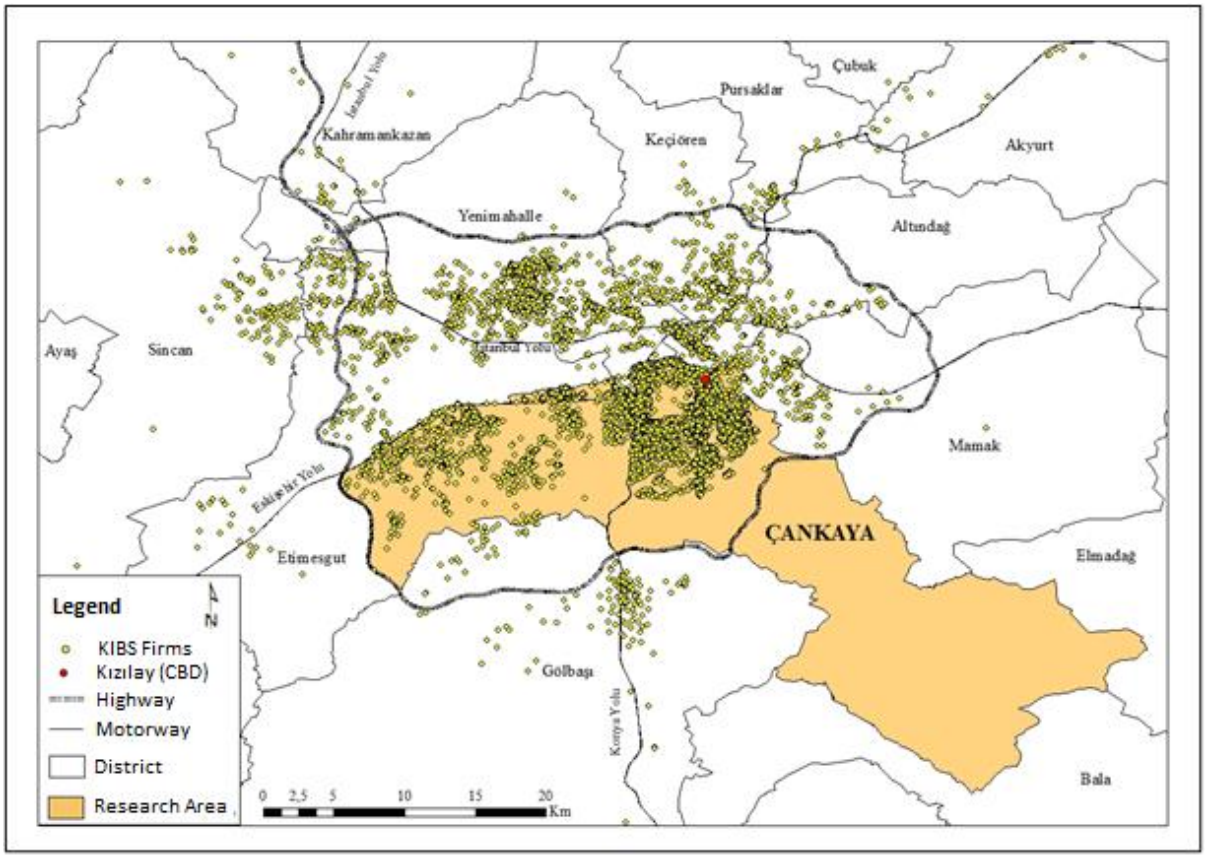

Fig. 2. Distribution of the KIBS Firms in Ankara

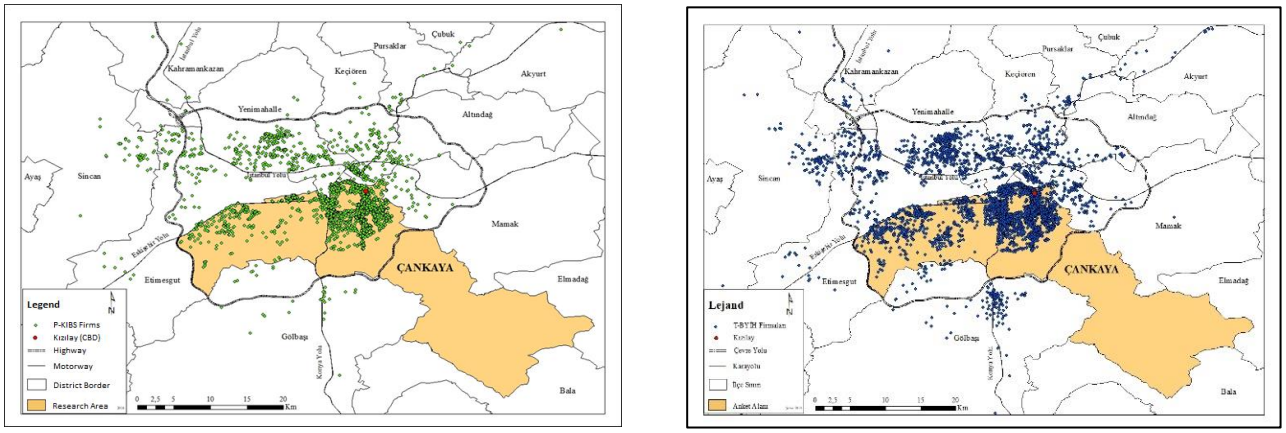

Fig. 3. Distribution of P-KIBS and T-KIBS Firms in Ankara

firms, the first group is 2-9 employees with 66.7%, followed by 10-49 employees with 25.8% (*Table 3*).

Considering that the most important output of the KIBS sector is knowledge, as the processed information, the ways in which firms obtain information is of importance. While the most effective method of tracking information for the P-KIBS firms was determined as the item "online" with a mean importance of 4.37. The least effective methods, can be listed as "to follow international fairs" with a mean importance of 2.51, "to follow domestic fairs" with 2.71 and "to follow organizations such as scientific and commercial NGOs" with 2.90, respectively. Like the P-KIBS firms, the most effective method of tracking information according to the T-KIBS was determined as "online" with a mean importance of 4.45, followed by "collaboration/follow-up with the own sector" with a mean importance of 3.91. It is observed that the least effective method used by T-KIBS firms to track information is "to follow international fairs" with a mean importance of 2.72 and "to follow domestic fairs" with a mean importance of 2.97. The general structure of KIBS activities does not demonstrate differentiated results (*Table 4*).

One of the most important dynamics in the production and transfer of knowledge by KIBS for other sectors is the R&D department and its expenditures [36, 10, 37, 47]. Table 5 shows that 24.88% of the

overall KIBS firms do not allocate shares for R&D over the annual turnover, while 21.46% of the firms allocate a share of between 1-5%, and 17.8% of the firms allocate a share of between 6-10%. Different than the P-KIBS firms, it is observed that T-KIBS firms allocate more shares for R&D (*Table 5*).

Regarding the innovation capacity of the KIBS firms, the non-parametric chi-square test was used and sub-hypotheses were tested.

Sub-H1: *There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and their collaboration activities.*

Table 3

General Characteristics of the P-KIBS and T-KIBS Firms

General characteristics	P-KIBS	T-KIBS	KIBS	General characteristics	P-KIBS	T-KIBS	KIBS
Quality of Employees	%	%	%	**Age of the Firm**	%	%	%
Owner	15.5	13.6	14.2	1-5 Age	**34.2**	31.8	**32.7**
Engineer	34.2	**45.9**	**42.2**	6-10 Age	24.7	26.5	25.9
Technical staff	10.2	15.4	13.7	11-25 Age	26	**32.2**	30
Administrative staff	**37.3**	20.2	25.7	26+ Age	15.1	9.5	11.5
Partner (Shareholder)	2.8	4.9	4.2				
Total	**100**	**100**	**100**	**Total**	**100**	**100**	**100**
Education status	%	%	%	**Employment**	%	%	%
High school	10.5	9.6	10.5	0-1 Employee	15.8	5.3	9
Associate of Science	14.2	12.6	12.6	2-9 Employees	**68.5**	**66.7**	**67.3**
Bachelor's Degree	**69.8**	**69.8**	**69.1**	10-49 Employees	14.4	25.8	21.7
Master and Ph.D. Degree	5.5	8.1	7.7	50-249 Employees	1.4	2.3	2
Total	**100**	**100**	**100**	**Total**	**100**	**100**	**100**

Table 4

The Methods Used by the P-KIBS and T-KIBS Firms to Track Information

	Methods of Tracking New Information	Not important at all	Not very important	Important	Rather important	Very important	Mean	SD
		1	2	3	4	5		
P-KIBS	To follow domestic fairs	25.3	24.0	15.1	26.0	9.6	2.71	1.350
	To follow international fairs	30.1	29.5	12.3	15.8	12.3	2.51	1.386
	Online	2.7	2.1	3.4	39.0	**52.7**	4.37	0.871
	To follow publications and catalogs related to your products or services	10.3	16.4	4.8	42.5	26.0	3.58	1.312
	To follow organizations such as Scientific and Commercial NGOs	23.3	20.5	13.7	28.1	14.4	2.90	1.413
	Collaboration/follow-up with the own sector	10.3	10.3	11.0	49.3	19.2	3.57	1.209
T-KIBS	To follow domestic fairs	15.5	22.3	21.2	31.4	9.5	2.97	1.242
	To follow international fairs	22.0	24.6	21.2	24.2	8.0	2.72	1.269
	Online	.8	2.7	4.5	34.8	**57.2**	4.45	0.769
	To follow publications and catalogs related to your products or services	4.9	11.0	12.9	44.7	26.5	3.77	1.108
	To follow organizations such as Scientific and Commercial NGOs	15.9	20.8	20.1	30.7	12.5	3.03	1.287
	Collaboration/follow-up with the own sector	4.2	4.9	14.8	47.7	28.4	3.91	1.000
We asked firms to indicate on a five-point scale (1 = not important, 5 = most important)								

Table 5

R&D Expenditure Share of the P-KIBS and T-KIBS Firms

R & D expenditure share over the annual turnover for 2016 (%)	P-KIBS		T-KIBS		KIBS	
	Number of companies	%	Number of companies	%	Number of companies	%
No Expenditure	45	**30.82**	57	**21.59**	102	**24.88**
1-5	32	21.92	56	21.21	88	21.46
6-10	25	17.12	48	18.18	73	17.8
11-20	22	15.07	43	16.29	65	15.85
21-50	18	12.33	33	12.5	51	12.44
51-80	3	2.05	17	6.44	20	4.88
81-100	1	0.68	10	3.79	11	2.68
Total	146	100	264	100	410	100
Source: calculated by the authors						

As shown in Table 6, the chi-square value was calculated separately for P-KIBS and T-KIBS activities. According to this analysis, the chi-square value of the P-KIBS activities was calculated as 6.771 and the doubled p-value (Asymp. Sig. (2-sided)) was obtained as 0.009. This shows that there is a significant relationship between the innovative P-KIBS firms and their collaboration with other institutions. The chi-square value of the T-KIBS activities was calculated as 30.204 and the doubled p-value (Asymp. Sig. (2-sided)) was obtained as 0.000. This shows that there is also a significant relationship between the innovative T-KIBS firms and their collaboration with other institutions (*Table 6*).

Table 6

The Chi-Square Tests of the KIBS, P-KIBS, and T-KIBS Regarding the Innovation-Collaboration Activities

Class	Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
P-KIBS	Pearson Chi-Square	6.771[c]	1	0.009
	Continuity Correction[b]	5.796	1	0.016
	N of Valid Cases	146		
T-KIBS	Pearson Chi-Square	30.204[d]	1	0.0000
	Continuity Correction[b]	28.833	1	0.0000
	N of Valid Cases	264		
KIBS	Pearson Chi-Square	40.525[a]	1	0.0000
	Continuity Correction[b]	39.218	1	0.0000
	N of Valid Cases	410		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 70.24. b. Computed only for a 2x2 table c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 14.32. d. 0 cells (.0%) have expected count less than 5. The minimum expected count is 47.78.				
Source: calculated by the authors				

Sub-H_2: *There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and their intrafirm social networks.*

As seen in Table 7, although there is not a significant relationship for the P-KIBS activities, there is a significant relationship between the variables of the innovative T-KIBS firms and their intrafirm social activities with a confidence level of 95%.

The alternative hypothesis regarding the measurement of the relationship between the innovation capacity of the KIBS firms and extrafirm social activities was formed as follows:

Sub-H_3: *There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and their extrafirm social networks in the own-sector.*

As seen in Table 8, since the P-KIBS activities' *degree of freedom* is 5 and also there are *expected values* lower than 5 in 3 cells (this value represents an error rate of 25%), the chi-square (x^2) value cannot be

Table 7

The Chi-Square Tests of the KIBS, P-KIBS, and T-KIBS Regarding the Innovation-Intrafirm Social Networks

Class	Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
P-KIBS	Pearson Chi-Square	7.378[b]	5	0.194
	N of Valid Cases	146		
T-KIBS	Pearson Chi-Square	14.770[c]	5	0.0110
	N of Valid Cases	264		
KIBS	Pearson Chi-Square	18.982[a]	5	0.0020
	N of Valid Cases	410		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.83.				
b. 3 cells (25 %) have expected count less than 5. The minimum expected count is 1.30.				
c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.03.				
Source: calculated by the authors				

calculated. The chi-square value of the T-KIBS activities was calculated as 17.826 and the doubled p-value (*Asymp. Sig. (2-sided))* was obtained as 0.003. In this case, it can be said at a confidence level of 95% that in T-KIBS firms, there is a significant relationship between the variables of the innovative firms and their extrafirm social activities within the own sector.

Table 8

The Chi-Square Tests of the KIBS, P-KIBS, and T-KIBS Regarding the Innovation-Extrafirm Social Networks within the Own Sector

Class	Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
P-KIBS	Pearson Chi-Square	4.241[b]	5	.515
	N of Valid Cases	146		
T-KIBS	Pearson Chi-Square	17.826[c]	5	.003
	N of Valid Cases	264		
KIBS	Pearson Chi-Square	19.709[a]	5	.001
	N of Valid Cases	410		
a. 2 cells (16.7%) have expected count less than 5. The minimum expected count is 1.40.				
b. 3 cells (25 %) have expected count less than 5. The minimum expected count is 0.26.				
c. 2 cells (16.7%) have expected count less than 5. The minimum expected count is 1.20.				
Source: calculated by the authors				

Sub-H_4: *There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and their extrafirm social networks in different-sectors.*

Regarding the sub-H_4, the chi-square value shows that there is again no significance for the P-KIBS considering the innovation capacity and their extrafirm social networks in different-sectors. However, the chi-square value of the T-KIBS activities was calculated as 11.754 and the doubled p-value (*Asymp. Sig. (2-sided))* was obtained as 0.038 which shows that at a confidence level of 95% in T-KIBS firms, there is a significant relationship between the innovation capacity of the firms and their extrafirm social activities with different sectors (*Table 9*).

Sub-H_5: *There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and the age of the firms.*

The chi-square values show that there is no significant relationship between the variables of the firms that implement innovation and the age of the firms both in P-KIBS and T-KIBS firms (*Table 10*).

Sub-H_6: *There is a significant relationship between the innovation capacity of P-KIBS and T-KIBS firms and the number of employees in the firms.*

According to the chi-square value for the overall KIBS activities was calculated as 20.119. The doubled p-value (*Asymp. Sig. (2-sided))* was obtained as 0.000. This shows that the alternative hypothesis (H_1) is accepted for the total KIBS activities. Similarly, for T-KIBS firms at a confidence level of 95%, there is also a significant relationship between the innovative firms and their number of employees. However, for P-KIBS, this (*Table 11*).

5. Discussion and Conclusion

KIBS are defined as activities that create high added value and play an important role in the production of new knowledge and thus innovation. This study indicates that there are notable differences between the P-KIBS and T-KIBS firms considering their spatial distribution patterns and the dynamics of their innovation processes. While T-KIBS activities

Table 9

The Chi-Square Tests of the KIBS, P-KIBS, and T-KIBS Regarding the Innovation-Extrafirm (Different Sector) Social Networks

Class	Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
P-KIBS	Pearson Chi-Square	8.880[b]	5	.114
	N of Valid Cases	146		
T-KIBS	Pearson Chi-Square	11.754[c]	5	.038
	N of Valid Cases	264		
KIBS	Pearson Chi-Square	12.771[a]	5	.026
	N of Valid Cases	410		
a. 1 cells (8.30%) have expected count less than 5. The minimum expected count is 2.81.				
b. 4 cells (33.3%) have expected count less than 5. The minimum expected count is 0.26.				
c. 2 cells (16.7%) have expected count less than 5. The minimum expected count is 2.81.				
Source: calculated by the authors				

Table 10

The Chi-Square Tests of the KIBS, P-KIBS, and T-KIBS Regarding the Innovation-Age of the Firm

Class	Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
P-KIBS	Pearson Chi-Square	2.306[b]	3	.511
	N of Valid Cases	146		
T-KIBS	Pearson Chi-Square	4.731[c]	3	.193
	N of Valid Cases	264		
KIBS	Pearson Chi-Square	3.128[a]	3	.372
	N of Valid Cases	410		
a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 16.51.				
b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.73.				
c. 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.04.				
Source: calculated by the authors				

Table 11

The Chi-Square Tests of the KIBS, P-KIBS, and T-KIBS Regarding the Innovation-Employment

Class	Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
P-KIBS	Pearson Chi-Square	5.231[b]	3	.156
	N of Valid Cases	146		
T-KIBS	Pearson Chi-Square	16.683[c]	3	.001
	N of Valid Cases	264		
KIBS	Pearson Chi-Square	20.119[a]	3	.000
	N of Valid Cases	410		
a. 1 cells (12.5%) have expected count less than 5. The minimum expected count is 2.81.				
b. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 0.52.				
c. 2 cells (25.0%) have expected count less than 5. The minimum expected count is 2.41.				
Source: calculated by the authors				

demonstrate a spatial clustering tendency independent of the CBD, the P-KIBS firms prefer to locate within the CBD or its vicinity. In general, KIBS sectors prefer to locate by high-income residents, new settlements, and secure and prestigious areas close to large public institutions such as ministries and general directorates.

When looking at the clustering areas of P-KIBS enterprises, it is observed that the population is dense, with a high-income group and areas that are easily accessible. These areas indicate CBD. According to Alonso's bid rent theory, KIBS activities will be concentrated in CBD areas. This assumption holds true for P-KIBS activities but not for T-KIBS activities. This structure, which emerged in the West following the 1990s, began to emerge in Turkey around 2005 and is still evolving. In this regard, one of the most notable findings of the present study is that advances in information and communication technologies have a varied impact on the location selection preferences of P-KIBS and T-KIBS enterprises.

P-KIBS companies' clustering regions are determined by criteria such as population density and income level, whereas T-KIBS companies' clustering areas are determined by characteristics such as information security, prestige, and proximity to a compe-

tent workforce. T-KIBS firms are found outside CBD areas, whereas P-KIBS firms are concentrated within CBD areas.

In order to understand the innovation forms of KIBS activities, it is necessary to discuss the subject under several headings. The innovation process takes place linearly in balance but not depend on any one factor. One of the important dynamics underlying the innovative capacity of firms is the presence of an independent R&D department within the firm and investments made in R&D. Within this scope, when P- and T-KIBS sectors are compared, certain differences are encountered. P-KIBS sectors consist of firms that draw on a symbolic and synthetic knowledge base, and use explicit and implicit knowledge constituted by a synthesis of relatively symbolic and cultural types of knowledge in the production of services. Since they are built on this type of knowledge, P-KIBS firms do not require the presence of an R&D department within their internal structure. In the field study carried out, it was determined that only 8.9% of the P-KIBS firms had an R&D department and the innovation they create is mostly organizational innovation defined as the use of a new organizational structure in business practices, planning processes, training structures and internal or external relations of the firm. Therefore, the presence of an R&D department is not a requirement for P-KIBS firms. A reflection of this is that the annual R&D investments made by the P-KIBS sectors have a very low share within their total investment.

Considering that T-KIBS activities consist of sectors with an analytical knowledge base, it is normal that these sectors have a more technical and mechanical structure compared to P-KIBS sectors. Thus, the share allocated to R&D expenditures by the T-KIBS sectors is larger compared to the P-KIBS activities. The difference between two types of KIBS sectors affects the distribution of the number of engineers working in the firms, as well. The rate of engineers employed by P-KIBS firms is lower than that of T-KIBS firms.

T-KIBS sectors have higher percentages compared to P-KIBS sectors in terms of their R&D unit, employment and expenditure. When the effects of this structure on innovative capacity are examined, positive reflections of this situation are observed in T-KIBS sectors. T-KIBS sectors are clearly more innovative compared to P-KIBS sectors. In addition to this, there are differences between the type of innovation implemented by the two sectors. It is observed that organizational innovation is the most common type of innovation in P-KIBS sectors as these sectors have a synthetic knowledge structure, do not engage in R&D activities and mainly provide services in the fields of planning and implementation. On the other hand, product and process innovation are more dominant in T-KIBS sectors since they have a more technical and mechanical structure, involve intensive R&D activity, and provide analytical knowledge to their clients. In this context, the innovative capacity of P-KIBS and T-KIBS sectors and the type of innovation they implement are determined by the knowledge base they draw on, their R&D activities and the way in which they present services.

Another important dynamic of the innovation process is the established networks of KIBS firms with other institutions or firms. Certain state policies have also been developed to improve the collaboration network between firms and institutions. The purpose behind the arrangement of these policies is to monitor the incentives to be provided within a certain system and to strengthen the collaboration network between firms/institutions. In this context, the presence of collaboration networks in which firms affect each other with their innovative capacities is important in terms of KIBS sectors. As a result of the analysis based on the field study about the collaboration structure among the P-KIBS and T-KIBS sectors, differences were found between the two sectors. While only 30% of the P-KIBS firms cooperate with another institutions/firms, this rate is quite high in the T-KIBS firms. It was found that the P-KIBS firms mainly cooperated with R&D centers. This finding can be interpreted as the complementary activity for their low level of technical personnel. Therefore, they outsource in the provision of analytical or technical services. Therefore, P-KIBS sectors do not require different types of sectors in their collaboration network or own structure as service delivery involves a universal structure that requires routine information. This situation is different for T-KIBS sectors. T-KIBS firms cooperate more intensely with public institutions. This means that T-KIBS firms carry out project-based service delivery with a tendering procedure or service delivery in the form of collaboration with public or semi-public institutions. On the other hand, the results of the field survey shows that although there is a significant relationship between innovation and collaboration in the P-KIBS sector, this relationship is at a low level. There is a significant relationship between collaboration and innovation for the T-KIBS sector, as well. However, unlike the P-KIBS sector, this relationship is at a high level.

Considering the discussions in the literature that the most important dynamics for KIBS activities are innovation and knowledge production, it is inevitable for them to collaborate with universities. However, it is notable that in Ankara, universities are the institutions with which the KIBS firms collaborate the least. This situation verifies that the government policy emphasizing the collaboration between universities and the industry is still not fully established. It also shows that firm owners still have difficulties in building

business relationships with universities. KIBS firms give more importance to intrafirm dynamics in the knowledge production phase. The fact that the innovation capacities of KIBS activities remain below 40% indicates that intrafirm dynamics can be limited in producing new knowledge.

The ways in which KIBS firms obtain the localized/implicit knowledge and their capacity to process them affect or shape their forms of innovation. In this context, for discussing the relationship between implicit knowledge and innovation, the frequency of social activities carried out by the KIBS firms were analyzed. When the relationship between innovation and intrafirm social networks was examined, no significant relationship was found in the P-KIBS sector while a medium-level and significant relationship was determined between innovation and intrafirm social networks in the T-KIBS sector. These results are in parallel with the relationship between innovation and extrafirm social networks within the own sector or with different sectors. In other words, while the frequency of social activities in the P-KIBS sector supports the type of knowledge it uses, it does not reveal the relationship with innovation. Similarly, in the T-KIBS sector, the frequency of social network activities supports the type of knowledge it uses. However, unlike the P-KIBS sector, it has a significant relationship with innovation.

The methods used by the KIBS sectors to track knowledge provide insights into their competitiveness and innovative capacity. P- and T-KIBS sectors track new knowledge from internet. In this context, in terms of intrafirm sustainability, competitiveness and innovation development capacity, they do not have formal institutional structures to track knowledge. For the T-KIBS sectors, besides the internet, which is the easiest medium to access information, the second most common method as an important source of information is to follow the firms in their own sector. This reveals one of the main reasons why T-KIBS firms prefer to locate in Technology Development Zones (TDZ) along with the firms in their own sector.

On the other hand, the intrafirm knowledge production and the customers were regarded as the source of information in both classes of sectors. Customer relations of the P-KIBS and T-KIBS sectors are of importance within the framework of competitive advantages, planning, strategy and marketing innovation. Among the KIBS firms that implement innovation, the strategy/marketing innovation type has the lowest share in both the P-KIBS and T-KIBS firms. The inability of both sectors to produce innovation in terms of marketing techniques is among the most important reasons why they communicate with their customers through traditional methods. The non-institutional structure of the KIBS firms in Ankara is evident in their customer relations, as well. Both subsectors of KIBS activities establish customer relations through acquaintances or long-term relationships. According to the results of the field application, fairs/meetings and marketing hold the lowest averages.

In conclusion, strategies such as the development of R&D clusters in metropolitan cities whose economies are primarily based on ICT and information activities should be prioritized. KIBS firms, despite their lack of scientific understanding, must collaborate with universities in order to innovate [28]. The present study found that protocols should be created and this network should be strengthened with the help of governmental policies in order to promote cooperation between universities in metropolitan areas and KIBS firms. It is vital to promote and/or encourage studies to develop relations amongst KIBS enterprises in order to provide an information network between companies in metropolitan cities. Finally, initiatives should be undertaken to institutionalize KIBS enterprises at the SME level, and they should be managed more professi-onally.

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Контрастна інноваційна динаміка професійно-технологічних наукомістких бізнес-послуг у міських районах

Мехмет Тахсин Шахін [1]
PhD (географія), доцент кафедри географії
[1] Університет Акдениз, Анталія, Туреччина;
Людмила Нємець [2]
д. геогр. н., професор, завідувач кафедри соціально-економічної географії і регіонознавства імені Костянтина Нємця,
[2] Харківський національний університет імені В.Н. Каразіна, Харків, Україна;
Мутлу Йілмаз [3]
д. геогр. н., професор кафедри географії,
[3] Університет Анкари, Анкара, Туреччина;
Людмила Ключко [2]
к. геогр. н., доцент кафедри соціально-економічної географії і регіонознавства імені Костянтина Нємця;
Сігдем Варол [4]
д. геогр. н., професор кафедри міського та регіонального планування,
[4] Університет Гази, Анкара, Туреччина

Це дослідження спрямоване на виявлення інноваційного потенціалу та динаміки розвитку компаній P-KIBS і T-KIBS фірм, що працюють у столичному районі Анкари, столиці Туреччини. Для досягнення цієї мети було проаналізовано столицю Туреччини Анкару на основі результатів анкетування 410 малих та середніх підприємств, 146 з яких належать до P-KIBS, а інші 264 фірми T-KIBS. У процесі дослідження та підготовки статті авторами було використано низку наукових методів як філософських і загальнонаукових, так і конкретно-наукових. Зокрема, використовувалися методи аналізу та синтезу, індукції та гіпотетично-дедуктивний метод, математико-статистичний та просторовий аналіз, методи групування та класифікації, а також анкетування та опитування та ін. Існують помітні відмінності між компаніями P-KIBS і T-KIBS, враховуючи їх моделі просторового розподілу та динаміку їх інноваційних процесів. Виявлено закономірності просторового розподілу фірм KIBS. Хоча діяльність T-KIBS демонструє тенденцію просторової кластеризації незалежно від CBD, фірми P-KIBS віддають перевагу розміщенню в межах CBD або поблизу нього. Загалом сектори KIBS надають перевагу розташуванню серед мешканців із високим рівнем доходу, у нових поселеннях, а також у безпечних і престижних районах, близьких до великих державних установ, таких як міністерства та генеральні дирекції. Було виявлено, що фірми T-KIBS найбільш щільно розташовані в центральному діловому районі та нових ділових районах Балгат і Согутезу, а також у зонах технологічного розвитку Анкари. Фірми P-KIBS, з іншого боку, більш поширені в районах Чанкая та Єнімахалле. Було виявлено що розвиток інформаційно-комунікаційних технологій має різний вплив на вибір місця розташування підприємств P-KIBS і T-KIBS. За результатами дослідження виявлено та визначено фактори, що впливають на кластеризацію компаній P-KIBS та фірм T-KIBS. Існує значний зв'язок між інноваційними підприємствами P-KIBS і фірмами T-KIBS та їхньою співпрацею з іншими установами. У результаті дослідження було встановлено, що існує значний зв'язок між співпрацею, дослідженнями та розробками, внутрішньофірмовими та позафірмовими соціальними зв'язками щодо інновацій фірм KIBS, а також контрастна динаміка інновацій, пов'язана з різними класами KIBS у містах.

Ключові слова*: наукомісткі бізнес-послуги (KIBS), інновації, співпраця, розвиток, професійні KIBS, технічні KIBS.*

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