NATIONAL RESEARCH UNIVERSITY
HIGHER SCHOOL OF ECONOMICS

Nikolay Chichkanov

THE IMPACT OF COPRODUCING SERVICES WITH CLIENTS ON KNOWLEDGE-INTENSIVE BUSINESS SERVICES' INNOVATIVENESS

BASIC RESEARCH PROGRAM
WORKING PAPERS

SERIES: SCIENCE, TECHNOLOGY AND INNOVATION

WP BRP 100/STI/2019

Nikolay Chichkanov[1]

THE IMPACT OF COPRODUCING SERVICES WITH CLIENTS ON KNOWLEDGE-INTENSIVE BUSINESS SERVICES' INNOVATIVENESS [2]

Despite the growing interest to the field of coproduction from the service-dominant logic literature, this concept is still being emerging and most of the existing papers do not provide any empirical evidence. The aim of the study is to investigate whether those KIBS firms that involve their customers in coproduction of services are more innovative. This paper explores the relationships between a set of innovation drivers and implementation of innovations in KIBS based on a sample of 441 firms operating in Russia. The results show that coproduction of services increases the possibility of both technological and non-technological innovations in KIBS to be implemented. This finding suggests that in addition to the service offerings quality improvement, coproduction of KIBS also acts as an innovation driver, which requires an attention from innovation managers.

Keywords: KIBS, coproduction, client involvement, innovation, innovation drivers

JEL Codes: O30, O31

[1] Research Fellow, Unit for Intellectual Services Market Research, Institute for Statistical Studies and Economics of Knowledge (ISSEK), National Research University Higher School of Economics. E-mail: nchichkanov@hse.ru

[2] The work was prepared within the framework of the Basic Research Program at the National Research University Higher School of Economics (HSE) and supported within the framework of a subsidy by the Russian Academic Excellence Project '5-100'. The author acknowledge the support from RESER Association under RESER Founders' PhD Award. The author also would like to thank Ian Miles (HSE), Veronika Belousova (HSE), and the participants of IFKAD-2019 Conference in Matera and 29th RESER Conference in Ceuta for valuable comments and suggestions as well as Managing Editor Dirk Meissner for helpful comments that improved this working paper.

Introduction

With the growth of technological complexity of most industries business customers has also significantly increased their demand for specific professional knowledge-intensive services (Heirati et al., 2016). It leads to a rapid development of knowledge-intensive business services (KIBS) – a set of industries that provide intermediate inputs for business processes of other companies by applying professional knowledge, expertise and experience (Miles, 2005). As a result, KIBS contribution in terms of value added and employment is still growing in developed economies like EU and the USA (Miles et al., 2018) and emerging ones like China, India or Russia (Chichkanov et al., 2019b). In addition, KIBS tend to be one of the most innovative sectors, compared to other services and most of manufacturing industries (Miles et al., 2019).

KIBS's production often occurs simultaneously with consumption and requires strong customer interactions. Generally, due to the heterogeneity, perishability and intangibility of KIBS solutions their standardization, storage and moving are quite challengeable (Bettiol et al., 2015). Very often KIBS even could not be identified or created before they are purchased, which means that the customer does not only receive a product as in a case of manufactured goods, but also take part in the production of KIBS (Paallysaho, 2008). This feature of KIBS is fully in line with service-dominant logic (SDL) which emerged in the early 2000s as the framework aiming at explaining the phenomenon of new digitalization-driven service marketing which is based on the customer-oriented business models and joint value creation while competitive advantages are achieved through the development of unique customer experiences (Greer & Lei, 2012; Kuula et al., 2018).

Proposed by Vargo & Lusch (2004), SDL highlights the crucial role of interactions and relationships and in contrast to industrial marketing and purchasing (IMP) argues that the value is customer-centric as the customer is those who always defines this value during the consumption or usage of the service (Aarikka-Stenroos & Jaakkola, 2010). In that case, customers should be considered as value creators rather than passive recipients of the solutions adjusted by companies to their needs. Value creation occurs not only during the usage of different products and services, but also during reciprocal interactions between customers and suppliers (Gronroos & Ravald, 2011). From a provider's perspectives this process refers to the joint production of value propositions or service offerings and the customer is considered to be a coproducer (Gronroos, 2011). Customers become coproducers if they are engaged in the production of a service at any stage(s) of the production process preceding service consumption, including idea generation and design stages, production of related goods, service delivery, etc.

During this process service providers integrate to their production processes some inputs provided by customers including intellectual (knowledge and expertise) and labor resources aiming at developing more optimal / effective / better quality / service solution (Aarikka-Stenroos & Jaakkola, 2012; Leclerq et al., 2016)

According to Cui & Wu (2016), there are two main streams of the literature in this field related to service marketing and innovation respectively. Despite the fact that coproduction is a promising area for innovation studies being in line with the concept of open innovations (e.g. Chesbrough, 2012), most of empirical studies are focused on customer outcomes like loyalty or satisfaction, while the impact of coproduction on innovations is still being under-researched (Cui & Wu, 2016; Cabigiosu & Campagnolo, 2019). Moreover, a lion share of empirical papers related to this area is based on the data come from B2C markets or public services (Doroshenko & Vinogradov, 2014). For instance, a few years ago Mustak et al. (2013) found that only 9 of 163 reviewed papers deal explicitly with B2B markets. In a more recent paper Mustak (2019) argued that this gap still exists.

In addition, SDL is still an emerging concept and although the number of studies in this field increasing, most of these studies are conceptual in their nature and only suggest some hypotheses to be validated, but do not provide any empirical evidence (Zaborek & Masur, 2019). Most of the existing empirical papers are based on the restricted number of case studies (Skaržauskaitė, 2013). The lack of evidence makes the whole concept quite abstract (Marcos-Cuevas et al., 2016; Fuentes et al. 2019). In turn, it leads to the lack of understanding how this concept is related to the real business projects and restrain the application of the implications suggested in the literature to the everyday practices of KIBS managers (Corsaro, 2019).

This paper tries to fill both of these gaps. Although it does not differentiate between different stages of coproduction or different types of clients, it makes an important step in developing the framework for a wider view of coproduction as an innovation driver by providing an empirical exploration of the following research question: *how coproduction of services with customers influences the KIBS firms' innovativeness?* This analysis is also one of the first attempts to provide empirical evidence from an emerging market which may also contribute to the development of KIBS, innovation and SDL research areas, as most of concepts and theories in these fields 'are influenced by their environments, which are mostly developed markets' (Anning-Dorson, 2018, p. 269).

The relationship between coproduction and implementation of innovation in KIBS is explored based on the data from HSE ISSEK project "Monitoring of Knowledge-Intensive Business Services in Russia". Despite the fact that under this project the level of KIBS

coproduction was measured on a regular basis, previous studies did not consider this factor as an innovation driver for KIBS. Earlier Russian KIBS studies explored coproduction effects only from a demand-side. For instance, Doroshenko et al. (2013) argued that coproduction is a knowledge transmission mechanism that effects KIBS customers' innovativeness. Later, Doroshenko & Vinogradov (2014) found that coproduction of KIBS influences KIBS customers' absorptive capacity. In turn, more recent studies devoted exactly to KIBS' innovation drivers (e.g. Chichkanov et al., 2019a) did not explore whether coproduction causes any effects on KIBS innovativeness. In contrast, this paper examines coproduction of KIBS from a supply-side in terms of the impact it causes on the implementation of innovation in KIBS providers. In addition, as appropriate coproduction measurement is quite challengeable (Skarzauskaite, 2013) different measures for baseline model and for robustness check are used. The former is related to the intensity of the coproduction of services in general, while the latter focuses specifically on the frequency of knowledge coproduction during KIBS-customer relationships.

The paper is structured as follows. Section 2 introduces coproduction as an innovation driver in KIBS and briefly presents other important innovation drivers. Section 3 is devoted to the methodology and the data used for the empirical analysis, following by Section 4 which discusses the empirical findings. The final section concludes and provides directions for future research.

Coproduction and innovation in KIBS

The concept of KIBS emerged in the mid-1990s and since then these industries have been acknowledged as one of the main actors in regional and national innovation systems (Muller & Zenker, 2001; Doloreux & Gomex, 2017). Although KIBS sector is highly heterogeneous one the main similarity of KIBS firms is their ability to support knowledge flows and to ensure knowledge reengineering and transferring of best practices among the whole economy just by providing their knowledge-intensive services (Weber & Schaper-Rinkel, 2017). KIBS are often considered as carriers, sources and facilitators of innovations and it was empirically found that KIBS purchasing causes a positive impact on innovation activities of manufacturing enterprises in both developed countries (Shearmur & Doloreux, 2013; Ciriaci et al., 2015) and emerging ones (Zhou et al., 2015). Recently, Shearmur & Doloreux (2019) developed a framework which conceptualizes KIBS as not only knowledge or innovation intermediaries, but simultaneously also as innovators themselves. It is in line with earlier empirical studies that found KIBS to be highly innovative. Compared to manufacturing and other service industries, KIBS are characterized by at least the same (Hipp et al., 2015) or by even a higher level of innovation

activities (Gotsch et al., 2011). In general, in term of the innovativeness level KIBS seem to outperform the other service industries and most of traditional manufacturing ones except some R&D-intensive sectors.

For KIBS knowledge about their customers or knowledge obtained during interaction with their customers becomes an extremely important asset (Landry et al., 2012). As the nature of KIBS is problem solving, they are oriented towards the supporting of business processes of their customers rather than developing products and services themselves. (Baltova & Baltov, 2017). It means that KIBS' competitive advantage is strongly connected to their opportunity to develop those service offerings or value propositions that are tailored to the current needs of their customers (Heikka et al., 2018). At the same time, most of the information required for the effective problem solving by KIBS retains by the customer (Mustak, 2019). Thereby, the process of problem solving in KIBS requires information about the particular client rather than about the "typical customer" (den Hertog, 2000) and could be obtained only in a collaborative manner.

KIBS also significantly rely on professional knowledge and expertise which leads to the existence of the high information asymmetry between KIBS producers and their customers (Kukk et al., 2014). It means that KIBS providers at the start of the project have a lot of professional knowledge in the field of their specification, but don't have specific information and understanding of the problems, needs and goals of the particular client (Mustak, 2019). In turn, clients in most cases know their problems and needs, but don't exactly understand which particular solutions they need. This information asymmetry significantly affects the process of value creation in KIBS from both provider and customer perspectives (Aarikka-Stenroos & Jaakkola, 2012). The former faces difficulties in communicating value propositions and managing their implementation and usage by the customers in a way that ensures the highest value-in-use to be realized. The latter, finds it difficult to evaluate KIBS solution and understand all the potential value it contains. In KIBS there is typically quite high level of uncertainty about the final solution and expected outcome as well as quite unrealistic customer expectations (Kukk et al., 2014).

To cope with these problems both KIBS provider and client should ensure the information exchange among both sides. In other words, KIBS solutions need to be co-clarified to a large extend (Aarikka-Stenroos & Jaakkola, 2010). Aarikka-Stenroos & Jaakkola (2012) argued that in that case customers act as co-diagnosers as they provide crucial information inputs that are necessary for KIBS providers to start the whole project. These information inputs may include as quite technical information like budget or schedule, as important data on customer's needs, preferences and business context that helps to specify the problem in order to develop

more suitable solution. Miles (2012) presented a model of the typical KIBS-client relationship which starts from the initial problem presentation by the client following by the reaction of the KIBS provider to this problem formulation. Diaz-Mendz & Saren (2019) also agreed that the process of coproduction is initialized by the customer who provides the required information for the service provider.

Marcos-Cuevas et al. (2016) suggested that those practices that include wide knowledge sharing related to the future KIBS offering could be classified as linking ones. The main goal of linking practices is to mobilize the connection between two parties. Three core examples of linking practices are co-diagnosis, co-ideation and co-evaluation. Co-diagnosis refers to the collecting and organizing knowledge which will be used by both KIBS provider and its' customer. Co-ideation is related to the collaborative generation of ideas, while co-evaluation refers to their joint assessment and selection. In contrast, Kukk et al. (2014) empirically found that the latter practice is not so widespread as most clients do not want to participate in idea evaluation and expect KIBS provider to chose the optimal solution and provide the reasoning for this choice.

If the information on the required service is scarce or does not cover all the necessary areas, it may cause significant changes in the specification of the KIBS solution during the implementation stage which in turn increases the risk of additional charges, delays and conflicts (Santos & Spring, 2015). In that case, all these practices discussed above are focused to involve the customer in the development of KIBS as an information source (Cui & Wu, 2016). The particular tools used for such practices tend to ensure information sharing. According to Fuentes et al. (2019), such tools like provider's briefings and demonstrations or user's workshops may be very useful for this purpose. These networking activities help both parties to meet in the informal settings and are very helpful for increasing the level of coproduction in future projects (Corsaro, 2019). Kukk et al. (2014) studied KIBS clients and found that the most expected forms of interaction during the initial project stage are face-to-face meetings, interviews and client visits.

However, choosing among different possible alternatives also contributes to the development of the KIBS specification (Santos & Spring, 2015). According to Marcos-Cuevas et al. (2016), the process of KIBS solution materializing, i.e. joint development and production of the offering (especially its material representation if any) includes three main operational coproduction practices: co-design, co-testing and co-launching. Co-design refers to the development of knowledge and concepts. In turn, the development of offering prototypes, their improvement and discussion is related to co-testing. The third practice, co-launching is

represented by joint information management and its diffusion. This practice may also be called ‘co-development’.

Similarly, Fuentes et al. (2019) distinguish co-designing and co-developing as two coproduction practices may occur during designing and configuring the value proposition. Co-designing refers not only to the service experience developing during the project, but also to the identification of the necessity for additional services to be provided after the project execution. Co-developing helps to create both tangible and intangible parts of the service in a way that ensures the high level of its’ functional value. Functional value refers to different functional improvements in service production and delivery for KIBS providers (higher efficiency and productivity by higher service quality) and identical improvements of services produced for customers (usability, speed of production and customization to specific needs) (Mustak, 2019). In addition, Fuentes et al. (2019) also identified problems co-solving as the collaborative decisions about those difficulties appearing during the project.

Aarikka-Stenroos & Jaakkola (2012) highlighted that although KIBS solutions are often supplier dominated in terms of their formulation, clients may not just ‘delegate almost everything’, but help KIBS providers to ‘find the right plan’ by supporting their decision making by additional information like industry insights or future plans related to the purchased KIBS solution. In addition, clients becomes co-producers or co-developers when they proactively provide information inputs like the appearance of new practices and requirements in their industry or offer their resources to be integrated with the resources of KIBS producer.

At the final stages of the project KIBS-client relationships may also include co-transitioning, i.e. the process that ensures that the solution would be correctly transferred operation and the value outcomes would be realized (Fuentes et al., 2019). The main reason for such interaction is that very often KIBS clients do not have enough expertise to fully access the quality of the service purchased (Diaz-Mendz & Saren, 2019). For instance, with the appearance of the opportunity to outsource these non-core activities to KIBS producers, clients firms may lose their expertise in this area. However, the value of KIBS is determined by the way they are used, adapted and implemented by the customer, rather than by the service offering itself (Aarikka-Stenroos & Jaakkola, 2010). The lack of absorptive capacity in a client firm may significantly reduce the value of KIBS (Doroshenko & Vinogradov, 2014).

To cope with this problem KIBS-customer interactions usually include such mechanisms like customer education and training. Some KIBS producers highlighted that teaching their customers especially inexperienced ones about the project and the service is crucial to develop the value for them (Aarikka-Stenroos & Jaakkola, 2012). Moreover, KIBS providers are not only

providers in the ordinary meaning, but also consultants who should teach clients how to use the service purchased to maximize the value this service may bring to the clients' businesses (Corsaro, 2019).

Coproduction could be also considered as closely connected to the customization, another feature of KIBS which is usually highlighted as one of the most important ones that distinguish KIBS from other services (Kukk & Leppiman, 2016). In general, Bettiol et al. (2015) argued that a long stream of research sees coproduction as crucial antecedent required for customization of services. For instance, Den Hertog (2000) highlighted that customization of such KIBS like consultancy is based to a higher extend on the tacit knowledge which makes these services to emerge as an outcome of the customer participation in the production process of KIBS firm. Intensive customer collaboration ensures the desired level of service customization and act as the key mechanism of increasing efficiency of these services (Heirati et al., 2016).

Heikka et al. (2018) define a competitive advantage in KIBS as their ability to offer a wide range of value propositions for a heterogeneous customer segments. Due to the high level of abstractness KIBS are providers have to develop specific configurations of their knowledge and expertise that fit the particular client's requirements in a best way. One of the ways to do so is to use service modularity. For example, Bettiol et al. (2015) found combinatory KIBS (those who develop both standardized and customized solutions) to be more successful in terms of revenue than industrialized (provide mainly standardized solutions) or bespoke (enterprises with a highly customized output) KIBS. Coproduction is beneficial for the development of new innovative products as it helps for service suppliers to select the most important service attributes (or modules) and to exclude those service features (or modules) that are not suitable (Prior et al., 2019). In addition, coproduction helps KIBS firms to increase the probability of success by decreasing the level of uncertainty, supporting the differentiation from existing solutions, reducing the time required for the development of the innovative solutions and the related costs and finally by generating more value and profits (Jouny-Rivier & Ngobo, 2016). Miles (2008) analyzed a set of surveys and found innovative KIBS to be much more depended on the information they receive from their customers than innovative enterprises from manufacturing or other service industries.

Masielo et al. (2014) argued that in recent years the interest of both academics and practitioners to the various aspects of customer participation in innovation process via coproduction has increased significantly. Some authors (e.g. Leclerq et al. 2016) even suggested considering open innovation as a form of coproduction. In general, customers may be important for innovation in KIBS for three reasons. Firstly, customers are typically used as sources of

innovations by contributing their industry insights and experiences as well as providing some specific knowledge developed during their in-house activities. Secondly, customers may be the drivers of innovation just by asking for serving some specific needs. By doing this customers force KIBS producers to develop new innovative solution and help to conceptualize them. Finally, KIBS customers may also be involved into the generation of new ideas, provide their resources and by doing so act as co-developers of innovations.

The situation of engaging customers to act as co-developers refers mostly to the application of such traditional tools for receiving customer information like surveys, interviews and focus groups (Johanson et al., 2019). In contrast, modern approaches focus on the customer involvement as coproducers in the early stages of the production of new services because it allows understanding their latent needs could not be identified via traditional methods. It is especially relevant for KIBS where it is also quite challengeable to differentiate the current service production and the development of future services due to their intangible and heterogeneous nature (Kuusisto, 2008). Den Hertog (2010) argued, that for the service firms like KIBS customer feedback received via interactions 'can shape innovations …just as much as service firm can influence customers' innovation' (p. 205).

Thus, intensive coproduction.i.e. customer participation in the production process of KIBS should also be considered as an important innovation driver for KIBS providers which leads to the following research hypothesis:

Research hypothesis: KIBS firms whose activities are characterized by higher levels of coproduction are more innovative than their counterparts with lower levels of coproduction.

Research Model & Data

The research model includes five innovation drivers (human capital, advertising expenditures, an access to a wide knowledge base, level of customization and coproduction). The first four drivers are measured in line with Chichkanov et al. (2019a), who found these factors to be related to the innovativeness of Russian KIBS. Human capital is measured as a share of expenditures on recruitment and training in total expenditures and those companies investing more in their human capital are expected to be more innovative. As most business processes in KIBS are those of the human nature based on the tacit professional knowledge and expertise, these firms usually spend more on human resource training and development than manufacturing enterprises (Gotsch et al., 2011; Schrike et al., 2012). Moreover, it was empirically shown that those companies that employ more qualified workforce are also better prepared to solving different issues related to innovation barriers (D'Este et al., 2014). One way to ensure the fit between the level of the company human capital and innovation needs may be to spend more on recruiting to identify those potential employees who could bring more value to the company. Another possible way may be to spend more on business trainings and other educational activities for current employees to maintain their professional skills and competencies being in line with the professional landscape.

Dependent on the context (type of services, type of clients, etc.) during their relationships with clients KIBS may either coproduce new knowledge or just transfer knowledge they previously absorbed. In contrast, so called A-networks, i.e. any other KIBS connections with competitors, research universities, etc. (Grandinetti, 2018) always provide KIBS an access to the new external knowledge that may be acquired, assimilated, transformed and applied. However, for the exchange of tacit knowledge between KIBS and their partners or competitors some level of the cultural and social proximity should exist (Muller & Zenker, 2001). These types of proximity are usually enhanced by the spatial proximity or co-location. Although the development of modern technologies allows remote communications, KIBS firms still tend to concentrate in large urban agglomerations (Deza & Lopez, 2014). In that case, the existence of branches in other regions provides for KIBS an opportunity to establish more A-networks with different organizations and by doing so to have an access to more external knowledge. In turn, this diversified knowledge sources may enhance the innovativeness of KIBS by ensuring the availability of required knowledge inputs (Chichkanov et al., 2019b).

In line with a "Schmooklerian" view of demand-driven innovation, the lack of demand significantly reduces the innovation activity (D'Este et al., 2012). The lack of demand is one of

the biggest challenges for KIBS, especially at immature emerging markets (Lingyun et al., 2011) like Russian one. However, in developed countries KIBS also usually invest a lot in marketing and advertising to promote their innovative solutions (Asikainen, 2015). Moreover, advertising and marketing are often considered by services enterprises as effective tools for protecting their innovations (Djellal & Gallouj, 2001). In that case, KIBS with higher amount of advertising expenditures are hypothesized to be more innovative.

Service solutions developed by KIBS are usually considered as highly customized and this feature is described as one of the main sources of KIBS' competitive advantage (Campagnolo & Cabigiosu, 2015). In turn, KIBS innovations are also typically employee and customer based, which means that these innovations often are not developed as a result of specific activities aiming at developing such innovations, but come from activities related to the serving of customers needs and could be recognized as innovations only after their provision (Paallysaho, 2008). In contrast, Cabigiosu & Campagnolo (2019) argued, that not only customization, but also standardization may be beneficial for KIBS innovations. More customized solutions are usually better suited to customer needs, but more standardized solutions are transferable from one customer to another. Thus, the relationship between customization and innovation in KIBS is expected to be non-linear with medium level of customization being more beneficial for innovation than both low and high levels respectively. As customization and standardization are two sides of the one coin in this paper a categorical variable related to the share of standardized services is used and the squared term of this variable is included to check the non-linearity.

The measure of coproduction intensity is in line with Doroshenko et al. (2013) and reflects the average level of customer engagement in KIBS production process based on the 10-grade scale where 1 refers to the lowest customer engagement (restricted by the terms of reference from the official contract) and 10 refers to the highest customer participation (collaborative activities during the whole process of KIBS development preceding its consumption including customer needs identification, delivery and implementation of the solution). Two alternative coproduction measures reflecting its frequency are used for the robustness check. They are dummy variables for those KIBS companies who reported that they apply the knowledge learned from or developed during the interaction with the one customer to the service development for other customers often or sometimes respectively. Descriptions for all used variables as well as their descriptive statistics are presented in Appendix A. The final research model is as follows:

$$\log\left(\frac{P_i}{(1-P_i)}\right) = \alpha + (\beta_1 \dots \beta_4) * Innovation\ Drivers + \gamma_1 * Coproduction +$$

$$(\lambda_1 \dots \lambda_5) * Controls + \varepsilon_i \quad (1)$$

where $\log(\frac{P_i}{(1-P_i)})$ is the logarithm of the ratio of the probability that KIBS enterprise implements an innovation to the probability, that it does not; Innovation Drivers is a set of innovation drivers; Coproduction is a coproduction measure; Controls is a set of control variables, α is a constant; β, γ, λ are regression coefficients; ε is an error term.

In addition, a set of standard and well-known control variables like location, industry, size and age in included (Anning-Dorson, 2018). Large firms are usually considered as those who have more resources to invest in innovation activities compared to small firms. The same point is also true for older firms. In turn, small and young firms may be less prone to decreases of innovation activity emerged from exceptional organizational routines and procedures.

This paper follows Gonzalez-Blanco et al. (2019) and treats both product and process innovations as a single group of technological ones as 'services are simultaneously both products and processes' (Kuusisto, 2008, p. 34). In addition, marketing and organizational innovations are also considered as a single group of "soft" or non-technological ones.

This paper uses the data from the database of the HSE ISSEK project "Monitoring of Knowledge-Intensive Business Services in Russia". This dataset includes 656 companies from 10 KIBS industries covering professional (P-KIBS), technological (T-KIBS) and creative (C-KIBS) KIBS respectively[3]. The data was collected in 2015 in 14 major Russian cities[4] during two-stage sampling procedure ensuring the representativeness of the sample in terms of the geographical distribution, industry and size. At the first stage location quotas was established, while at the second stage based on the current state of these industries in each city additional quotas on size and industry were established. The data was collected through structured interviews either with the owner of the KIBS firm or with a key-position employee like CEO. All the variables used are self-reported measures which is in line with Anning-Dorson (2018) who argued that such measures are quite reliable when dealing with private companies that do not disclose their financial statements. After the exclusion of observations with missing data the final dataset used for empirical analysis consists from 441 companies.

[3] P-KIBS include audit, accountancy, human resources consulting, B2B financial intermediation, legal services, development and real estate services; T-KIBS include information technology and engineering; C-KIBS include advertising, informational communication consulting, web and digital services.

[4] Moscow, St. Petersburg, Tyumen, Krasnodar, Yekaterinburg, Kazan, Ufa, Krasnoyarsk, Samara, Nizhny Novgorod, Rostov-on-Don, Perm, Chelyabinsk, Novosibirsk.

Empirical Results and Discussion

The results of model estimation are presented in table 1. Both models are based on the robust standard errors to cope with heteroscedasticity issue. VIF values show that multicollinearity issue does not affect the results. The goodness of fit for all models is verified by Hosmer-Lemeshow statistics.

Table 1. The results of model testing for technological (1-3) and non-technological (4-6) innovations (marginal effects) using different coproduction measures

	Technological innovation			Non-technological innovation		
	(1)	(2)	(3)	(4)	(5)	(6)
Innovation drivers						
Share of HR development expenditures	0.0159*** (0.00449)	0.0158*** (0.00437)	0.0182*** (0.00432)	0.00375 (0.00449)	0.00468 (0.00438)	0.00710* (0.00421)
Share of advertising expenditures	0.00834* (0.00438)	0.00885** (0.00436)	0.00686 (0.00474)	0.00959** (0.00424)	0.0103** (0.00427)	0.00832* (0.00461)
Branches	0.249*** (0.0590)	0.262*** (0.0592)	0.235*** (0.0570)	0.116** (0.0558)	0.135** (0.0555)	0.125** (0.0539)
Standardization	0.155** (0.0634)	0.155** (0.0642)	0.157** (0.0641)	0.0741 (0.0732)	0.0795 (0.0735)	0.0855 (0.0711)
Standardization^2	-0.0214*** (0.00665)	-0.0219*** (0.00670)	-0.0220*** (0.00669)	-0.0108 (0.00775)	0.0121 (0.00774)	-0.0122 (0.00751)
Coproduction	0.0141* (0.00725)			0.0173** (0.00867)		
High frequency of knowledge coproduction		0.135* (0.0704)			0.168** (0.0821)	
Medium frequency of knowledge coproduction			0.239*** (0.0530)			0.228*** (0.0503)
Controls						
Moscow	-0.0820* (0.0455)	-0.0700 (0.0458)	-0.0500 (0.0447)	0.00182 (0.0518)	0.00926 (0.0518)	0.0340 (0.0523)
T-KIBS	0.179*** (0.0595)	0.180*** (0.0597)	0.175*** (0.0565)	-0.164** (0.0654)	-0.164** (0.0659)	-0.164*** (0.0634)
C-KIBS	0.119** (0.0472)	0.107** (0.0470)	0.101** (0.0462)	-0.0247 (0.0529)	-0.0353 (0.0524)	-0.0457 (0.0527)
Age	-0.0119 (0.0332)	-0.00977 (0.0331)	-0.00965 (0.0335)	-0.0120 (0.0364)	-0.00525 (0.0364)	-0.00450 (0.0359)
Size	-0.0357 (0.0450)	-0.0326 (0.0437)	-0.0340 (0.0426)	-0.00545 (0.0464)	-0.00727 (0.0467)	-0.0114 (0.0440)
Standard errors in parentheses. ***p< 0.01, **p< 0.05, *p< 0.10						

The assessment of the impact caused by coproduction in terms of its intensity on KIBS innovativeness are presented in columns (1) for technological innovations and (4) for non-technological innovations respectively. The results confirm that all considered innovation drivers have a significant influence on the implementation of both technological and non-technological

innovations in KIBS. For instance, advertising expenditures and multiregional branch network were found to be significant drivers of the implementation of both technological and non-technological innovations. The positive impact of HR expenditures is observed only for technological ones which is in line with Corrocher et al. (2009) and Asikainen (2015) who reported that investments in human development and R&D trainings in KIBS significantly increase their focus on introduction of both types of technological innovations – product and process ones respectively. In addition, the relationship between standardization and technological innovations is non-linear and is described by the inverted U-shaped curve which means that while medium level of customization is beneficial for implementation of technological innovations, both low and high levels cause negative effects and reduce the probability of the implementation of technological innovations. Similar results could be also found in Cabigiosu & Campagnolo (2019).

According to the results, the heterogeneous nature of KIBS also affects probability of implementing innovations in such firms. Technological KIBS (T-KIBS) like IT or engineering are more concentrated on the implementation of technological innovations and less focused on non-technological ones than creative (C-KIBS) or professional (P-KIBS) KIBS. C-KIBS were also found to implement more technological innovation than P-KIBS which probably is a result of the fast digitalization of creative industries like web-design or digital marketing that have already become technology-intensive (Berezin, 2016).

The findings also support the research hypothesis, as coproduction was found to cause a positive and significant impact on the innovativeness of KIBS in terms of the implementation of both technological and non-technological innovations. This finding is in line with empirical studies in this field. For instance, Santos-Vijande et al. (2013) reported that customer involvement is service innovations has a positive effect on both innovation rate and overall performance of KIBS firms, while Carmona-Lavado et al. (2013) showed that in T-KIBS the success of the service innovation increases when the company has intense client collaborations. In addition, Ryzhkova (2015) based on the sample of gazelle companies, she found that the probability to introduce a service innovation is more than 2% higher for those companies who collaborate with their customers online than for those who do not. Although this effect is rather modest it confirms that customer interactions positively influence the innovation output. However, in contrast to Ryzhkova (2015) who argued that customer relationships are typically considered as potentially beneficial for product innovation rather than for other types, in this paper it was found that the probability of the implementation of both technological (including product) and non-technological innovations increases with the increase of the level of

coproduction. Moreover, the impact caused by coproduction intensity is even higher for non-technological innovations (0.0173, column 4 in Table 1) than for technological ones (0.0141, column 1 in Table 1).

Finally, two alternative coproduction measures that reflect its frequency are used to check the robustness of the results. The results of the assessment of the impact caused on KIBS innovativeness by the high frequency of knowledge coproduction is presented in Table 1 for technological (column 2) and non-technological innovation (column 4). Those companies that report frequent usage of knowledge coproduced with their customers or learned from them during the interaction tend to implement more both technological and non-technological innovations. It is in line with den Hertog (2010) who argued that tacit knowledge developed or transferred during KIBS provider-customers interaction may enhance innovation activity not only in client firm, but also in KIBS. These insightful customer knowledge and expertise helps companies to discover additional opportunities at the market. In that case, KIBS often follow the market-pull approach and develop their innovative solutions in line with market insights they obtain during customer interactions (Camapagnolo & Cabigiosu, 2015). Moreover, similar results are obtained even for medium frequency of knowledge coproduction (columns 3 and 6 for technological and non-technological innovations respectively).

Thus, the impact of coproduction on innovation activities remains positive and significant, while all other effects were also found to be stable across the specifications in both cases. The robustness of the results is important as it shows that positive effects of coproduction may exist not only at developed markets, but also at emerging ones. These findings may be important for the further development of coproduction concept, as previous studies (e.g. Etgar, 2008; Anning-Dorson, 2018) argued that coproduction process could be significant only for those companies operating at mature markets.

Conclusions

The results support that coproduction could be considered as a mechanism that may contribute to the implementation of innovations in KIBS. KIBS may benefit either by more intensive engagement of their customers into the production of services or by more frequent coproduction of knowledge. More tight relationships with their customers help KIBS providers to enhance their innovation activity, which is in line with Greer & Lei (2012). Jouny-Rivier & Ngobo (2016) argued that developing these relationships or networks determines the success of KIBS innovation projects as they help to integrate KIBS professional expertise and client

industry-specific information. The development of KIBS also requires a lot of non-codified tacit knowledge which in turn requires deeper collaboration with the customer (Kohtamaki & Rajala, 2016).

From the practical point of view these findings suggest that the development of coproduction-based strategies may help KIBS not only to improve their service offerings as it is widely acknowledge in the literature, but also to become more innovative. In contrast, low levels of customer involvement in coproduction may undermine the performance of KIBS firm as it hinders the probability of implementation of innovation and by doing so decreases KIBS' competitive advantages. In addition, as most KIBS firms could not allow themselves to work only with those customers that are able to be perfect coproducers they may use customer' opportunity and willingness to coproduce as an additional criteria for better differentiation of services being offered and development of appropriate marketing strategies.

One of the main challenges in studying coproduction is its measurement. Most of the existing studies in this field are theoretical, while others are based on a limited amount of case studies or in-depth interviews that makes it difficult to create an appropriate tool to measure the phenomenon of coproduction (Skarzauskaite, 2013). The first used measure of coproduction is focused only on the average intensity of customer involvement and neglects some important characteristics of this process. On the one hand, the level of coproduction intensity may vary across different project stages. On the other hand, this level may also vary across different customer segments due to the client characteristics. In addition, the used measure does not focus on the duration of coproduction and its quality. The alternative measures of coproduction look at the frequency of knowledge coproduction. Although knowledge is the most crucial production factor of KIBS, some other customer resources (labor or managerial implications) may also be exchanged during coproduction. New more sophisticated measures of coproduction that overcome these limitations will be very useful for coproduction studies. In addition, comparative studies that cover different countries or longitudinal researches may also contribute to the understanding of the impact of coproduction on innovation activity in KIBS.

References

1. Aarikka-Stenroos, L. & Jaakkola, E. (2012). Value co-creation in knowledge intensive business services: A dyadic perspective on the joint problem solving process. Industrial Marketing Management, 41, 15–26.
2. Aarikka-Stenroos, L., & Jaakkola, E. (2010). Value co-creation within buyer-seller relationships in knowledge-intensive business services, in IMP2010 conference. Budapest, Hungary, p. 21.
3. Anning-Dorson, T. (2018). Customer involvement capability and service firm performance: The mediating role of innovation. Journal of Business Research, 86. 269–280.
4. Asikainen, A. (2015). Innovation modes and strategies in knowledge intensive business services. Service Business, 9(1), 77–95.
5. Baltova, S. & Baltov, M. (2017).Value creation and value co-creation in professional business services: a challenge in digital environment. Bulgarian Journal of Business Research, 3, 31–44.
6. Berezin, I. (2016). Экспертные оценки объема и динамики рынков интеллектуальных услуг в России в2005-2015 2013 [Experts' estimations on the market value and dynamics of intellectual services in Russia in 2005–2013]. In I. S. Berezin (Ed.),Marketing v Rossii 2016 [marketing in Russia 2016](pp. 33–69). Moscow: Marketers Guild.
7. Bettiol, M., Di Maria, E., & Grandinetti, R. (2015). Service customisation and standardisation in combinatory knowledge-intensive business services. International Journal of Knowledge-Based Development, 6(3), 241–260.
8. Cabigiosu, A., & Campagnolo, D. (2019). Innovation and growth in KIBS: The role of clients' collaboration and service customisation. Industry and Innovation. 26(5). 592-618.
9. Campagnolo, D., & Cabigiosu, A. (2015). Innovation, service types, and performance in knowledge intensive business services. In R. Agarwal, W. Selen, G. Roos, & R. Green (Eds.), The Handbook of service innovation(pp. 109–121). London: Springer.
10. Carmona-Lavado, A., G. Cuevas-Rodríguez, & Cabello-Medina, C. (2013). Document Service Innovativeness and Innovation Success in Technology-Based Knowledge-Intensive Business Services: An Intellectual Capital Approach. Industry and Innovation, 20(2), 133–156.

11. Chesbrough, H. (2012). Open innovation: Where we've been and where we're going. Research-Technology Management, 55(4), 20-27.
12. Chichkanov, N., Miles, I. & Belousova, V. (2019a). Conditions for Innovation in KIBS: Evidence from Russia (HSE WP BRP Science, technology and innovation no 92). Moscow: NRU Higher Schoolof Economics.
13. Chichkanov N., Miles I. D., & Belousova V. (2019b). Drivers for innovation in KIBS: evidence from Russia. Service Industries Journal, 1-23 (in print).
14. Ciriaci, D., Montresor, S., & Palma, D. (2015). Do KIBS make manufacturing more innovative? An empirical investigation of four European countries. Technological Forecasting and Social Change, 95, 135–151.
15. Corrocher, N., Cusmano, L., & Morrison, A. (2009). Modes of innovation in knowledge-intensive business services evidence from Lombardy. Journal of Evolutionary Economics, 19(2), 173–196.
16. Corsaro, D. (2019). Capturing the broader picture of value co-creation management. European Management Journal, 37. 99-116.
17. Cui, A. S. & Wu, F. (2016). Utilizing customer knowledge in innovation: antecedents and impact of customer involvement on new product performance. Journal of the Academy of Marketing Science, 44(4), 516–538.
18. D'Este, P., Iammarino, S., Savona, M., & von Tunzelmann, N. (2012). What hampers innovation? Revealed barriers versus deterring barriers. Research Policy, 41(2), 482–488.
19. D'Este, P., Rentocchini, F., & Vega-Jurado, J. (2014). The role of human capital in lowering the barriers to engaging in innovation: Evidence from the Spanish innovation survey. Industry and Innovation, 21(1), 1–19.
20. den Hertog, P. (2000). Knowledge-intensive business services as Co-producers of innovation. International Journal of Innovation Management, 4(4), 491–528.
21. den Hertog, P. (2010). A systemic approach: Knowledge Intensive Business Services as co-producers of innovation. in den Hertog, P. (ed.) Managing service innovation: firm-level dynamic capabilities and policy options (pp. 204–218). Utrecht, Netherlands.
22. Deza, X.V. & López, M.G. (2014). Regional concentration of knowledge-intensive business services in Europe. Environment and Planning C: Government and Policy, 32(6), 1036-1058.
23. Díaz-Méndez, M. & Saren, M. (2019). Managing advertising agency client partnerships for value co-creation: Characteristics, categories, and challenges. Marketing Theory, 19(1), 9-26.

24. Djellal, F., & Gallouj, F. (2001). Patterns of innovation organisation in service firms: Postal survey results and theoretical models. Science and Public Policy, 28(1), 57–67.
25. Doloreux, D., & Gomez, I. (2017). A review of (almost) 20 years of regional innovation systems research. European Planning Studies, 25(3), 371–387.
26. Doroshenko, M., & Vinogradov, D. (2014). Value (co)creation in emerging KIBS industries: Absorptive capacity matters. Evidence from Russia. in Proceedings of XXIV Annual RESER Conference, pp. 368–377.
27. Doroshenko, M., Miles, I., & Vinogradov, D. (2013). Knowledge intensive business services as generators of innovations (HSE WP BRP Science, technology and innovation no 12). Moscow: NRU Higher School of Economics.
28. Duchek, S. (2013). Capturing absorptive capacity: a critical review and future prospects. Schmalenbach Business Review, 65. 312-329.
29. Etgar, M. (2008). A descriptive model of the consumer co-production process. Journal of the Academy of Marketing Science, 36(1), 97–108.
30. Fuentes, M., Smyth, H. & Davies, A. (2019). Co-creation of value outcomes: A client perspective on service provision in projects. International Journal of Project Management, 37(5), 696-715.
31. González-Blanco, J., Coca-Pérez, J. L., & Guisado-González, M. (2019). Relations between technological and non-technological innovations in the service sector. The Service Industries Journal, 39(2), 134–153.
32. Gotsch, M., Hipp, C., Gallego, J., & Rubalcaba, L. (2011). Sectoral innovation watch: Knowledge intensive services sector. Europe INNOVA Sectoral Innovation Watch, for DG Enterprise and Industry, European Commission.
33. Grandinetti, R. (2018). The KIBS paradox and structural holes. Knowledge Management Research & Practice, 16(2), 161–172.
34. Greer, C. R., & Lei, D. (2012). Collaborative Innovation with Customers: A Review of the Literature and Suggestions for Future Research. International Journal of Management Reviews, 14(1), 63–84.
35. Grönroos, C. & Ravald, A. (2011). Service as business logic: Implications for value creation and marketing. Journal of Service Management, 22(1), 5–22.
36. Grönroos, C. (2011).Value co-creation in service logic: A critical analysis. Marketing Theory, 11(3), 279–301.

37. Heikka, E. L., Frandsen, T. & Hsuan, J. (2018). Matching value propositions with varied customer needs: The role of service modularity. Knowledge and Process Management, 25(1), 64–73.
38. Heirati, N., O'Cass, A., Schoefer, K., & Siahtiri, V. (2016). Do professional service firms benefit from customer and supplier collaborations in competitive, turbulent environments? Industrial Marketing Management, 55, 50–58.
39. Hipp, C., Gallego, J., & Rubalcaba, L. (2015). Shaping innovation in European knowledge-intensive business services. Service Business, 9(1), 41–55.
40. Johansson E., Raddats, C. & Witell, L. (2019). The role of customer knowledge development for incremental and radical service innovation in servitized manufacturers. Journal of Business Research, 98. 328-338.
41. Jouny-Rivier, E. & Ngobo, P. V. (2016). Drivers of companies' willingness to co-create B2B services. Recherche et Applications en Marketing, 31(3), 61–87.
42. Kohtamäki, M. & Rajala, R. (2016). Theory and practice of value co-creation in B2B systems. Industrial Marketing Management, 56, 4–13.
43. Kukk, J., Leppiman, A. & Pohjola, A. (2014). Designing a Business Service experience: Customer's Perspective on Value Co-creation. Research in Economics & Business: Central & Eastern Europe, 6(1), 51–64.
44. Kukk, J. & Leppiman, A. (2016). Value creation in business services through the prism of experience economy: Conceptualizing value-in-experience. Journal of Creating Value, 2(2), 231-245.
45. Kuula, S., Haapasalo, H., & Tolonen, A. (2018). Cost-efficient co-creation of knowledge intensive business services. Service Business, 12(4). 779-808.
46. Kuusisto, A. (2008). Customer roles in business service production implications for involving the customer in service innovation. in A. Kuusisto, A., S. Päällysaho. Customer role in service production and innovation – looking for directions for future research. Tutkimusraportti – Research Report 195 (pp. 4-29): Lappeenranta, Finland.
47. Landry, R., Amara, N., & Doloreux, D. (2012). Knowledge-exchange strategies between KIBS firms and their clients. Service Industries Journal, 32(2), 291–320.
48. Leclercq, T., Hammedi, W. & Poncin, I. (2016). Ten years of value cocreation: An integrative review. Recherche et Applications en Marketing, 31(3), 26–60.
49. Lingyun, W., Muhos, M., & Kess, P. (2011). Motivations, Modes and challenges of KIBS in the internationalisation to China. Journal of Modern Accounting and Auditing, 7(6), 588–600.

50. Marcos-Cuevas, J., Nätti, S., Palo, T., & Baumann, J. (2016). Value co-creation practices and capabilities: Sustained purposeful engagement across B2B systems. Industrial Marketing Management, 56, 97–107.
51. Masiello, B., Marasco, A., Izzo, F. & Amato, U. (2014). Exploring clients' role in the innovation of advertising services: a European survey. Presented at 21st IPDM Conference–Innovation through Engineering, Business and Design, Limerick, Ireland, (15-17 June), available at: www.researchgate.net/publication/276936668_EXPLORING_CLIENTS%27_ROLE_IN_THE_INNOVATION_OF_ADVERTISING_SERVICES_A_EUROPEAN_SURVEY (accessed 15 August 2019).
52. Miles, I. (2005). Knowledge intensive business services: Prospects and policies. Foresight, 7(6), 39–63.
53. Miles, I. (2008). Patterns of innovation in service industries. IBM Systems Journal, 47(1), 115–128.
54. Miles, I. (2012). KIBS and knowledge Dynamics in client-supplier Interaction. In E. Di Maria (Ed.), Exploring knowledge-intensive business services: Knowledge management strategies(pp. 13–34). London: Palgrave Macmillan.
55. Miles, I. D., Belousova, V., & Chichkanov, N. (2019). Knowledge intensive business services: innovation and occupations. Foresight, 21(3), 377-408.
56. Miles, I., Belousova, V., & Chichkanov, N. (2018). Knowledge intensive business services: Ambiguities and continuities. Foresight, 20(1), 1–26.
57. Muller, E., & Zenker, A. (2001). Business services as actors of knowledge transformation: The role of KIBS in regional and national innovation systems. Research Policy, 30(9), 1501–1516.
58. Mustak, M. (2019). Customer participation in knowledge intensive business services: Perceived value outcomes from a dyadic perspective. Industrial Marketing Management, 78, 76-87.
59. Mustak, M., Jaakkola, E., & Halinen, A. (2013). Customer participation and value creation: A systematic review and research implications. Managing Service Quality, 23(4). 341–359.
60. Päällysaho, S. (2008). Customer interaction in service innovations a review of literature. in A. Kuusisto, A., S. Päällysaho. Customer role in service production and innovation – looking for directions for future research. Tutkimusraportti – Research Report 195 (pp. 30-60): Lappeenranta, Finland.

61. Prior, D., Keränen, J. & Koskela, S. (2019). Customer participation antecedents, profiles and value-in-use goals in complex B2B service exchange. Industrial Marketing Management, 1-17 (in print).
62. Ryzhkova, N. (2015). Does online collaboration with customers drive innovation performance? Journal of Service Theory and Practice, 25(3), 327–347.
63. Santos-Vijande, M. L., González-Mieres, C. & López-Sánchez, J. Á. (2013). An assessment of innovativeness in KIBS: Implications on KIBS' co-creation culture, innovation capability, and performance. Journal of Business and Industrial Marketing, 28(2), 86–102.
64. Santos, J.B. & Spring, M. (2015). Are knowledge intensive business services really co-produced? Overcoming lack of customer participation in KIBS. Industrial marketing management, 50, 85-96.
65. Schricke, E., Zenker, A., & Stahlecker, T. (2012). Knowledge-Intensive (business) services in Europe. Luxembourg: Publications Office of the European Union.
66. Shearmur, R., & Doloreux, D. (2013). Innovation and knowledge-intensive business service: the contribution of knowledge-intensive business service to innovation in manufacturing establishments. Economics of Innovation and New Technology, 22(8), 751-774.
67. Shearmur, R., & Doloreux, D. (2019). KIBS as both innovators and knowledge intermediaries in the innovation process: Intermediation as a contingent role. Papers in Regional Science, 98, 191–209.
68. Skaržauskaitė, M. (2013). Measuring and Managing Value Co-Creation Process: Overview of Existing Theoretical Models. Social Technologies. 3(1), 115–129.
69. Vargo, S. L., & Lusch, R. F. (2004). Evolving to a New Dominant Logic for Marketing. Journal of Marketing, 68(1), 1–17.
70. Weber, M. & Schaper-Rinkel, P. (2017). European sectoral innovation foresight: Identifying emerging cross-sectoral patterns and policy issues. Technological Forecasting and Social Change, 115, 240-250.
71. Zaborek, P. & Mazur, J. (2019). Enabling value co-creation with consumers as a driver of business performance: A dual perspective of Polish manufacturing and service SMEs. Journal of Business Research, 1-11 (in press).
72. Zhou, D., Kautonen, M., & Wei, J. (2015). The effect of external KISA on innovation in manufacturing firms. Innovation: Management, Policy & Practice, 17(4), 508-523.

Appendix A. Descriptive statistics of used variables

	Description	Min	Max	Share with value =1	Mean	St. dev.
Technological Innovation	1 if company implemented technological innovation (including innovative products and services) in the 1st half of 2015, 0 otherwise	0	1	64%	0.64	0.48
Non-technological innovation	1 if company implemented non-technological innovation (marketing and/or organizational) in the 1st half of 2015, 0 otherwise	0	1	41%	0.41	0.49
Share of HR development expenditures	Share of expenditures on recruiting and training in total expenditures of the company in the 1st half of 2015	0	25	n.a.	4.98	5.76
Share of advertising expenditures	Share of expenditures on advertising in total expenditures of the company in the 1st half of 2015	0	40	n.a.	6.73	5.59
Branches	1 if in the 1st half of 2015 the company have branches in other regions, 0 otherwise	0	1	27%	0.27	0.44
Standardization	7 categories: 1 if the share of standardized services in 2014 was less than 10%, 2 for 10-20%, 3 for 21-40%, 4 for 41-60%, 5 for 61-80%, 6 for 81-90%, 7 if the share of standardized services exceeded 90%	1	7	n.a.	5.34	1.55
Standardization^2	Square of the standardization variable (for non-linearity testing)	1	49	n.a.	30.96	14.77
Coproduction	Company's self-assessment of the average level of customer engagement in service production process from 1 (the lowest customer engagement) to 10 (the highest customer engagement).	1	10	n.a.	5.93	2.80
High frequency of knowledge coproduction	1 if the company often apply the knowledge learned from or developed during the interaction with the one customer to the service development for other customers, 0 otherwise	0	1	8%	0.08	0.27
Medium frequency of knowledge coproduction	1 if the company sometimes apply the knowledge learned from or developed during the interaction with the one customer to the service development for other customers, 0 otherwise	0	1	22%	0.22	0.41
Control variables						
Moscow	1 if the company is located in Moscow, 0 otherwise	0	1	31%	0.31	0.46
T-KIBS	1 if the company belongs to	0	1	18%	0.18	0.39

	information technology or engineering industries, 0 otherwise					
C-KIBS	1 if the company belongs to advertising, information-communication consulting or web, design and digital services industries, 0 otherwise	0	1	32%	0.32	0.47
Size	1 for small enterprises (7-50 employees), 2 for medium-sized enterprises (51-249 employees) and 3 for large enterprises (more than 250 employees)	1	3	n.a.	1.36	0.57
Age	Natural logarithm of the company age	0	4.17	n.a.	2.14	0.69

Contact details:

Nikolay Chichkanov

Institute for Statistical Studies and Economics of Knowledge, National Research University Higher School of Economics, Moscow, Russia. E-mail address: nchichkanov@hse.ru

Any opinions or claims contained in this Working Paper do not necessarily reflect the views of HSE.