Characteristics of Services and Interdependency between Export and Innovation Intensity in the Sector of the Business Services

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Abstract In this chapter, we study services and their unique characteristics. We focus on characteristics of services, such as intangibility, immateriality; invisibility; perishability; temporary existence, sensitivity on time; non storability; inseparability; lack of inventory; sensibility of quality control; high degree of risk or difficulty in experimentation; no return possibility at un-satisfaction; customisation requirements; different distribution channels; and no rivalry. We also analyse the relations between exports, investments in development and innovation activities of Slovene business services sectors in two statistically different periods (2002-2008 and 2010-2016). A two-step approach to examine the firms' performance in the selected business non-financial services sectors was applied. First, we used Simple Probit model, and in the second step, Simultaneous Probit model was used. The preliminary results suggest that the investment in R&D activities encourages export behaviour and that the export behaviour encourages investment in R&D activities.

Ključne besede: • services • attributes and characteristics of services • export intensity • innovation intensity • international trade of services

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1 Introduction

The service sectors contribute to the economy more than production and agriculture sectors. The role of the service sectors increases with the level of economic development of countries. In most developed countries, their share in the gross domestic product (GDP) is more than two-thirds.

During the last two decades, the share of services and service activities in developed countries is also constantly increasing in international trade. Knowledge-based economies and demand for intangible products for the use of consumption and the investment purposes, have led to larger restructuring of many developed economies, with a shift from emphasis on industry and manufacturing to emphasis on services and service-based activities.

Throughout the history, the services were treated as unproductive, marginal, and thus irrelevant. They belonged to tertiary activity whose effects were not measured or seriously treated. However, through the economic history the importance of the services and trade in services have grown rapidly. Only in the last three decades, they have become very important subject of research paralleled with rapid information-communication technological development. However, there is still no unique definition of what the "production of services" is and how it differs from the production of goods/products.

While in the past the growth of the services has been dependent on the growth of productivity in the manufacturing sectors, this has changed completely. In the past three decades, the service activities have become the most dynamic part of the world economy. Within the world economy the so called “services revolution” has happened in that period, that is fundamental on the use of new, on knowledge and high technology-based services (Aw, Roberts, Xu 2008, p. 451-456 or Kox, Rubalcaba 2007).

The fast development of the information and communication technology (ICT) changed the services manufacturing activities so, that technology development is not the consequence, but rather precondition for higher economic growth (Braga, 1996, p. 35). Consequently, productivity of services was always smaller in the past compared to productivity of production (manufacturing). Paradoxically just rapid development of services accelerated the productivity of production activities with innovation and other high-tech services.

In addition to the wide use of know-how and innovations-based activities at manufacturing of new products, service activities can be distinguished between business and technical services, services of ICT, the services of transfer of the new technologies, banking and insurance services and education services. Those elements are triggers that change services production sectors and are pre-condition for the rapid growth of the international trade on goods and services in the past three decades.

The objective of the chapter is to present and analyze services to better understand their meaning and contribution to innovation activities and international trade.

2 Services and service activities

The term services include the "whole spectrum of various intangible and non-tangible products and activities, difficult to define with only one definition. Services are very difficult to separate from production of goods/products because they are so connected in all possible ways." (Hill, 1977, 315).

Classical economists have defined services as products or results of work, which disappear immediately when work is finished. With such determination, services have gained characteristics such as intangibility, fleetness and perishability which are still considered as unexpired till nowadays. Because of these characteristics, services are differentiated from characteristics of production and trade of goods.

Schorra (Bateson and Hoffman, 1999, 10) pointed out the differentiation of basic characteristics of manufactured goods and services, which are all subject of supply and demand in the market with a simplistic definition: "Product is something what a consumer buys, takes away, spends and uses in whatever other way. On the other hand, everything which is not physically tangible for a consumer or cannot be taken away or physically used, we call it a service."

From the perspective of services, there are many sorts of services, which represent inputs in an activity of producing products. These are services aimed to final users, i.e., consumers or trading with them (Deardorff, 1985). As an example, a trade (exchange) of finalized product with a help of transport service can be quoted. Trade (exchange) of product relates to transport services in two ways: first, a need for exchanging (trading) products is the only source of demand for transport services, and second, existence of transport services represents basic condition for trading (exchanging) products. The company must use transport service if it needs to sell its products in a different location. For the company there are no commercial effects within whole business process without financial inputs in services.

From a perspective of supplementing activity to producing products, services can be divided into three categories (Stern and Hoekman, 1988): first, supplementary/complementary ones to production and trade with goods/products, second, compensative ones for trading with goods/products, and third, not in any relationship with production of goods/products. Role of services as inputs into activities of producing goods is supplementary (complementary) one to a production activity itself as well as to exchanging or trading with services as "finalized goods" (Hindley and Smith, 1984). Modern (mass) production of products is almost impossible without

inputs of services directly into production processes. Services are present in all phases of production process, from planning and preparation to marketing, commercial and post-production processes. From differentiation between production activities and service activities, it can be observed that trade of services runs in different ways compared to trade of goods/products. Producer of any product, which is not produced on personal demand (for the consumer known in advance), never knows who the user is, who is the final consumer and where in the world the final product is used/spent/consumed. In accordance with the international rules on money transfer, the producer gets certain payment for his good/product. This way production-consuming circle is concluded, and exchange is accomplished although producer and buyer (consumer) do not know each other.

In case of trade on services, whole process is performed differently. Because of services' characteristic of intangibility/immateriality (for example, medical consulting service is not tangible) most of commercial processes in production and supply of services are different from those involving goods/products. In comparison, performer of service (like health doctor) always knows the consumer/user (patient) of the service wherever and whenever the service is performed. In case when a supplier and a consumer/user of service come from different countries, we talk about international trade of services.

Services cannot be traded by themselves as such (e.g., the medical examination cannot be performed without people/patients). For international trade of services, it is necessary to enable international free flows of elements which are connected to services: objects, capital/money flow, information flows or people. Not all these free flows are enabled evenly by international agreements yet. Consequently, the free trade of services does not exist until completely free trade of labour force, capital and information is established. For example, we can take medical services or painting services. Since supplier and consumer of service are acquainted, they are connected. Trade of service or its exchange/execution without mutual acquaintance is normally not possible. Their direct connection (regardless of the type of connection/relationship; also, remotely through internet) is a basic condition for international trade. Therefore, no medical service could be applied on ill person without some kind of relationship.

2.1 Development of service treatment and international trade of services

Service activities were treated as unproductive throughout economic history. Such treatment of service activities came out from four economic limitations: first, by contrast to production activities - at first manufactures and later industrial production - services did not visibly and any other way contributed to increase of common welfare as a reason that they were treated as unproductive. Second, service activities were only a part of production activities since it was considered that without production of goods there would not have been any demand for services. Third, since service activities were

performed (accomplished) only in premises of production activities (manufactures) and not in premises separate from them, it was thought that the proportion (share) of services in welfare expressed only in a form of input elements in production activities (into manufacturing, industrial production). Finally, in the economic sense in comparison to production (having physical characteristics) the services were (because of their characteristics of invisibility and temporary existence) irrelevant. For (economic) welfare only physical products as a consequence of finalized activities of production counted, and which could be economically evaluated (counted, precisely determined their price value or calculated their productivity).

Because of these limitations services till the middle of 20th century belonged to so called third class (tertiary) sector. Their activities could not be classified among manufacturing or agricultural activities. Each of services was treated separately (discretely) and classified upon different keys.

Countries regulated services with various guild and other codes and legal regulations, which were valid differently from country to country. On the other side of the borders or from one state to another, international trade of services (legally) could not be carried out. Only some service activities, which were connected to interstate trade, were being carried out (for example transport services and services of physical exchange of products themselves).

Services can be included in international trade as: final product and are a subject of direct trade (for example: tourism), input into production activities and are included in indirect trade (for example: computer services, health medical services), carry out substitute function in product trade (for example: transport) or service trade (for example: telecommunication service). In each of these cases there is a trade of services among residents in some economic environment which can be inside one country, between two countries (trade between residents - non-residents) or among more countries globally (trade between residents - non-residents).

On international level, financial transfers of services in the Systems of National Accounts were defined as "invisible". Each of service sectors was treated differently in accordance with different international agreements or under principles of international organisations. As services were not treated as activities where international trade could be carried out (non-tradable), they were not treated in the GATT.

Only in 1960, a group of most developed countries within the Organisation of Economic Cooperation and Development (OECD) called for abolition of these principles which represented obstacles in international trade of services (OECD, 1961). They consensually prepared a set of instruments, which only regulated financial flows of foreign direct investments and mutual payments (OECD, 1976) for accomplished services.

Because of direct consecutiveness of performing services with production activities the problem of measuring effects of services, their share in GDP and other macroeconomic categories only began in the second half of 20th century. The biggest step was made at the time of passing the GATS, which was the first international agreement defining and more precisely regulating ways of financial flows. Significance of the GATS is based on two assumptions: first, to enable orderliness of accepted rules and regulations, and second, to encourage international economic development with successful negotiations about new mutual or multi-party agreements (also in the following negotiation steps), which would even more eliminate trade obstacles (liberalization of trade in services).

Goal of the GATS was to regulate the area of international trade of services in similar way as international trade of goods/products: without discrimination and with agreement of gradual opening of national markets in respect to services to competition from abroad. It would mean international improvement of accessibility to service markets, expansion of national treatments with foreign services and improvement of service activity offers on every level. With other words, agreement would enable a decrease of mutual obstacles in trading of services and disabling of induction and assertion of new obstacles. The agreement does not eliminate all obstacles, but merely some bigger ones, which signatory countries agreed upon. In the process of further mutual communication, it nevertheless enables further levels of liberalization of international trade of services.

During the times of globalization, free flows of three elements which services are connected to are enabled (and even not unconditionally in all countries and with internationally accepted criteria): flows of products, capital, and information. Free flow of labour among countries is not possible. International trade of services is much more complex and limited compared to international trade of goods/products.

2.2 Characteristics of services

The supply and trade of services differentiates from supply and trade of products. Hill (2004) defines supply of services as execution of limited number of tasks for solving limited number of problems of defined group of consumers (customers) in a limited time period. Market of services supply is much more multifaceted and complex compared to production supply since not even two services of the same sort are not exactly the same; services are a combination of products with characteristics of tangibility, materiality and personal approach adapted to consumers; services cannot be produced "on stock" and as such cannot be kept in accounting/business books (as on hold) as they are consumed at the exact moment they are carried out or used. There is, according to the final location of trade, difference in trade of goods/products, which can be physically touched, and trade of services, which are intangible. There were many researchers, who studied service characteristics (e.g., Wolak et al, 1998; Hill 2004), but they only focused on a few characteristics, such as intangibility, immateriality,

invisibility, perishability, and temporary existence. Based on our research we believe there are thirteen characteristics of services worth observing:

First, intangibility/immateriality means that services cannot be materially defined or determined. As opposed to production activities where final product is a product with physical characteristics, final product in services is only accomplished work or satisfaction of some common human needs. As for example, completed purchase, supply of electricity, seeing a movie, successful data transfer or service of giving medical check are all intangible/immaterial.

Second, invisibility means that a service as such cannot be seen as it represents a term and exists in immaterialized form. Only consequences of accomplished service are visible. As for example: finished phone call, while service of enabling a phone call is invisible as the sound between two co-speakers travels invisibly. Third, perishability means that services can be carried out only once, and therefore, they are unrepeatable. Each repetition of service task means a new service task. For example, a doctor can do the same medical test on COVID-19 virus but each repetition of accomplished and paid purchase of test means a new one (service). Service has to represent much closer connection between supplier (for example doctor) and user of service (virus victim) and trust of consumers (patients) has to be much bigger since each repetition of accomplished service means new costs.

Fourth, temporary existence and sensitivity on time means that execution of services is time limited. Existence of service execution is limited till the moment it is finished. Endlessly long execution of any services is not possible. If it does not exist, it does not make any sense. Chosen time for service execution is important. It cannot be delayed with execution of some services such as for example for transport services, including transport of perishable goods, internal transports in between production lines, and services connected with marketing and other advertising businesses. For example, testing people services at the time of virus pandemic must be applied as soon as possible before virus is affected to too many people as time delay can be deadly or innovations have to be sold at the right time that competition does not grasp them.

Fifth, non-storability means that a service cannot be stored for its future use. Services are inappropriate for storage. Service can be done only once or never. Services cannot be kept on stock for later use. They can be used only at the time of order and need. For example, coordination between scientists and global health professionals to accelerating the research for developing new anti-virus vaccine during pandemic could not be kept in store.

Sixth, mutual inseparability between supplier and user (consumer) of services means that for successful trade/exchange supplier and user (consumer) have to get acquainted. To order a service consumer has to connect directly with service supplier which is not

the case when dealing with products. Services cannot be carried out without direct connection even in case of a service being carried out abroad. As for example, during the medicine exam on virus disease the doctor and the patient are connected directly as the doctor is examine the patient body.

Seventh, lack of inventory means that for service execution we normally do not need capitally intensive assets as is the case in production activities. Despite rapid technological development and the fact that to execute some services expensive and sophisticated technological devices are needed, in general for service execution we do not need large production capacities. By contrast, most services are labour intensive meaning that in service sectors number of employees is above average. Only person with relevant qualifications, knowledge and skills can carry out a service of required quality. Employees in services (like doctors in hospitals) can hardly be replaced by machines or robots. Still, the technology is developing constantly and therefore in some service professions high technology devices are irreplaceable.

Eighth, sensibility of quality control is closely connected to temporary existence/sensitivity of time. Direct quality control is different compared to production activities. In service activities, quality control can be carried out only on sample of large number of similar services or on past experience. In individual countries different criteria for execution of specific types of services developed in certain time periods. For example, the insurance services in health sectors are very different in different countries (as to compare USA and EU countries). Guild rules for some crafts are known and knowledge passed down through generations such as shoemakers and pot makers. Even today for most areas of service activities, there are no international rules on quality, but so-called codes of practice exist, and they are differing from country to country. Product salespersons are obliged to share basic data about the product with the consumers regarding international standards such as manuals and shelf life whereas for service suppliers there are no international rules. Each country has its own specific demands regarding basic data which service supplier has to quote.

Ninth, high degree of risk and difficulty of experimentation means that execution of services is always connected to high risk for consumers, as they normally do not have any guarantee that a service will be performed as agreed upon and according to their expectations. In negotiating for execution of service activity between service supplier and consumer/user asymmetric information is always present. How a service is carried out and what are its consequences is well known to the supplier but not the consumer/user as well. From the perspective of game theory, it is always a game with non-zero sum. As for example, when the new vaccine is put on the market, even tested by all medical regulation, it is always risky, if will have positive effects. Because of temporary existence and sensitivity of time experimentation new services are always risky. Certain types of service activities can only be evaluated on basis of past experience.

Tenth, no return possibility in case of unsatisfaction derives from perishability of services and characteristic of high degree of risk. Service buyer is in no position to return or exchange the service in case it does not satisfy him or if the service differs from his expectations. One of staples of modern consumer society is a possibility of an immediate return of goods/products or money back guarantee which cannot be applied in case of services. In case of services, all risk of purchase/order is carried by a customer/buyer. As for example, if the service of the medical operation on patient is not finished successfully, it could not be replaced by another (same) one. That would be new operation / new medical service.

Eleventh, customization of requirements stems from temporary existence and sensitivity on time. Because of sensitivity on time the quality of service depends on experience, knowledge, skills, and qualification of a service supplier. They form supplier's personal characteristics. Therefore, the service execution is dependent on human factor only, as for example on the right doctor`s diagnosis. Because of perishability in services, mistakes usually cannot be fixed. Customization requirements or personal approach also derive from inseparability between service supplier and user.

Twelfth, different distribution channels are being used compared to production ones. If service supplier wants to expand its offer, different methods have to be used than in case of product. Economic science has developed some commercial methods adapted to selling and expanding service activities such as net marketing, direct marketing, and content marketing. Some services demand additional knowledge for their successful use, which is enabled directly by producers. Fair activities are aimed for such activities as part of service activities.

Thirteenth, there is no rivalry resulting from temporary existence or sensitivity on time. No rivalry exists because execution of service activity for one consumer does not minimize/limit execution of the same service activity for another consumer. Many services have characteristic of rivalry due to limited-service capacity. For example, limited number of services for vaccines at the time of virus pandemic - all people, who have access to such services on time are winners in the game of rivalry. All others have to wait for the next vaccine service delivery.

In comparison to production activities, each of described characteristics causes service activity to be executed differently, with more difficulty and with approach that is more personal. Planning, marketing, controlling and other similar activities are completely different in services compared to production. Because of these characteristics of services, there is very apparent difference between flows of goods/products and flows of services from the perspective of international trade. Consequently, productivity of services was always smaller in the past compared to productivity of production. Paradoxically, rapid development of services accelerated the productivity of production activities with innovation and other high-tech services.

3 Empirical model

At the research process we followed established and well-known theoretical cognitions scientists and researchers on theories of endogenous economic growth (Romer, 1986; Grossman and Helpman,1991), sectoral economics of goods and services, international trade on services, research and development (R&D) and innovations in firms. The focus of the existing studies at firm level is concentrated on industry production and manufacturing firms. In this study, we focus on the service sector in the Slovenian economy.

To capture any impact between export and innovation activities and investments in the R&D of firms we apply models of the endogenous economic growth, which are for such research most suitable. Romer (1986; 1996) developed the model of endogenous economic growth, where the inside source of the economic growth is foundation on accumulated knowledge, based on technology development (patents, licences etc.) and innovation activities. When developing the model, he had followed the Austro-Hungarian economist Schumpeterian (Schumpeter, 1934) views on international trade.

In later literature on endogenous theories of growth (Gallouj, 2002; Sahay, 2005; Tether, Howells, 2007) economists argue against one-way influences one-to-another. It is not necessary that innovation activities at firm level are influencing their exporting performance, it might be also opposite, that export activities are impacting innovation activities at firm level. Opening (country) economy to the foreign companies' competition and foreign markets entry could be gainful with positive results (profits, higher economy growth), which could have the consequence for innovation activities at firm level. At the same time, positive results (profit) could be reinvested in the development of firms to accelerate innovation activities. When the economists include demand on higher educated labour force, they find positive impact of innovation to export activities as vice-versa (like in Germany, Ebling and Janz, 1999). To determinate mutual impacts it turns out that the most useful are models, which use binary dependent variables, like probit or logit models.

Our empirical model is based on firm-level evidence (private and public companies) from the different services sectors. We have adopted the approach of firm level studies in the manufacturing sectors (Kumar and Siddharthan, 1994; Wakelin, 1998), and adapted (transform) them to the services sectors. Following the previous studies, we take into account that the innovation activities may depend on export activities and vice-versa for both studied periods (2002-2008 and 2010-2016), and investments in R&D in firms may depend on their export activities and vice-versa (only for the period 2010-2016).

We have to take into account two different periods (2002-2008 and 2010-2016) from the fact that in 2007 the Standard Statistical Activities (SKD 2002) have changed

dramatically to new one (SKD 2008 - Slovenian version of NACE Rev. 2,), because Slovenia has to adjust the Slovenian Statistical Standards to the EU Statistical standards. Slovenia became the EU member in May 2004; hence, all the data had to be adjusted to new standards, especially to be consistent with new classification. The biggest transposition of the data has been in the services sectors. The transposition matrix for data has been available, but we decided to use the model for two different periods and compare them. We have also better available data in the second period (2010-2016), so we use firm-level data on investment in the R&D to see if they are dependent on export activities and vice-versa.

We define a few model specification relationships, which have to be analysed, as

$$EXP_{ij} = f\,(INNO_{ij}, INV_{ij}, ZNAC^{IZV}{}_{ij}, SEKT^{IZV}{}_{j}, EKON^{IZV})$$

where symbols mean the following:

EXP_{ij}	vector of export activities of firms i ($i = 1$ to N_j) in sector j ($j = 1$ to M),
$INNO_{ij}$	vector of innovation activities for firm ij,
INV_{ij}	vector of investment on R&D activities for firm ij,
$ZNAC^{IZV}{}_{ij}$	vector for characteristics of firm i in the sector j,
$SEKT^{IZV}{}_{j}$	vector for characteristics of the sector j.
$EKON^{IZV}$	vector for characteristics of the economy E^{EXP}.

The vectors $ZNAC^{IZV}{}_{ij}$, $SEKT^{IZV}{}_{j}$, and $EKON^{IZV}$ (characteristics of firms, characteristics of the sector, and characteristics of the economy) consist of the variables that are likely to affect the firms export activities. These explanatory variables are predicted as important drivers of exports by traditional and modern theory of the international trade, export behavior and investment on the R&D in firms. We will precisely determine individual vectors with the selection of relevant variables.

We examine the firms' performance in the selected business non-financial services sectors: J – Information and communication (J58.2, J61, J62, J63), L – Real estate, M - Professional, scientific and technical activities (M69 - M74), and N – Other business activities (N77, N80 - N82). All together were selected 15 services sub-sectors.

The theory of sector studies on effects of innovation on international trade or investment in R&D on firm level use several measures of export activities. We have regarded eight different measures in the form of variables (seven different measures for the period 2002-2008).

1. The ratio of exports to total sales is accepted to be appropriate measure of export performance (Wagner, 1996, or Wakelin, 1998 or Vogel and Wagner, 2011)

export intensity (EXP_{ij}) = $(\text{total exports})_{ij} / (\text{total sales})_{ij}$
(firms i = 1, .. , N, sectors j = 1, .. ,15) with values between 0 and 1 [0 .. 1],

2. For differences in relative factor endowments we use unit labour costs as a measure for relative endowment with labour:

labour costs per unit$_{ij}$ = $(\text{total labour costs})_{ij} / (\text{total sales})_{ij}$
(firms i = 1, .. , N, sectors j = 1, .. ,15) with values between 0 and 1 [0 .. 1],

3. The neoclassical extension of production factors to knowledge of human capital we measure with labour skills structure of employees (Oulton, 1996; Wagner, 1996). From labour we divided workers on two (three) categories, employees with university or higher degree and employees with technical skills (middle and technical school degrees, expert skills), and third group with workers with less or no education.

university$_{ij}$ = $(\text{employees with university or higher degree})_{ij} / (\text{number of employees})_{ij}$
(firms i = 1, .. , N, sectors j = 1, .. ,15) with values between 0 and 1 [0 .. 1],
4.
tech_skills$_{ij}$ = $(\text{employees technical skills})_{ij} / (\text{number of employees})_{ij}$
(firms i = 1, .. , N, sectors j = 1, .. ,15) with values between 0 and 1 [0 .. 1],

5. For firms in service sectors to export their services is usually associated with relatively high costs (fixed ones). This is directly related to the firm size. Total number of employees is used as a measure of firm size. This is an important factor for explaining export activities (e.g., Kumar & Siddharthan, 1994). In the relationship between exports and firm size to allow for non-linearities, we add to the list of explanatory variables the logarithm of firm size and the squared logarithm of firm size. Between exports and firm size, an inverse U-shaped relationship is expected (Kumar & Siddharthan, 1994):

size$_{ij}$ = $(\text{logarithm of the number of employees})_{ij}$
(firms i = 1, .. , N, sectors j = 1, .. ,15)
6.
size^2$_{ij}$ = $(\text{logarithm of the number of employees})^2_{ij}$
(firms i = 1, .. , N, sectors j = 1, .. ,15)

To have the appropriate econometric results we use a two-step approach. First, we use Simple Probit model, and then in the second step, we use Simultaneous Probit model (Maddala, 1999).

The variables we used for measuring export activities could not be dealt completely because not all the firms perform export activities. Therefore, in the model we chose (binary) variables EXP#ij so that it is:

$$EXP^{\#}_{ij} = \begin{cases} 1 \text{ if } EXP_{ij} > 0 \\ 0 \text{ if } EXP_{ij} <= 0 \end{cases}$$

With this, we formally defined "exporters" as well as "non-exporters". This enables us to use the Simple Probit model.

7. The studies on effects of innovation on international trade on the sector level use several measures of export activities. We used the ratio of exports to total sales, which is generally taken as appropriate measure of export performance (Wagner, 1996, or Wakelin, 1998 or Vogel and Wagner, 2011). Following the studies of Entorf et al. (1988) in the next step, we define function, which explains innovation activities:

$$INOV_{ij} = g\,(EXP_{ij}, ZNAC^{INOV}_{ij}, SEKT^{INOV}_{j}, EKON^{INOV})$$

where we have:

EXP_{ij}	vector of export activities of firms i (i = 1 to N_j) in sector j (j = 1 to M),
$ZNAC^{IZV}_{ij}$	vector for characteristics of firm i in the sector j,
$SEKT^{IZV}_{j}$	vector for characteristics of the sector j.
$EKON^{IZV}$	vector for characteristics of the economy E^{EXP}.

The chosen measures for the innovation activities $INOV_{ij}$ are the function of the export activities, characteristics of firms $ZNAC^{IZV}_{ij}$, characteristics of the sector $SEKT^{IZV}_{j}$, and characteristics of the economy $EKON^{IZV}$.

Regarding service firms, only a few service subsectors are performing innovation activities, and product innovation can hardly be distinguished from process innovations (Licht et al., 1997).

innovation intensity $(INNO_{ij})_{ij}$ = $(\text{innovations expenditure})_{ij}$ / $(\text{total sales})_{ij}$ (firms i = 1, .. , N, sectors j = 1, .. ,15) with values between 0 and 1 [0 .. 1],

8. As a novelty in the theory, we added an additional important measure. The investment activities are very important for the development of the firms, and we assume they are in relations with the export activities. For this variable we put together four different statistical elements from the R&D base: the investments in employees for R&D activities, the investments in new technical equipment for R&D activities, investment in

services to other firms for the purpose of the R&D activities in firm, and investment in R&D as other costs for R&D activities. In this part total investment in IT can also be included because the investments in IT have significant impact on fast development of ICT, as have been discussed by Licht and Moch (1997). We define the relationship with assuming that more the firms invested in R&D activities more are export oriented (and vice-versa), especially is this the characteristic of small, export-oriented countries, such as Slovenia (during the last two decades more than 80% of goods and services have been exported annually). Because of data availability, we use this data only for the period 2010-2016.

investments intensity (INV_{ij}) = (expenditure for R&D activities)$_{ij}$ / (total sales)$_{ij}$
(firms i = 1, .. , N, sectors j = 1, .. ,15) with values between 0 and 1 [0 .. 1],

9. Additionally, we added one more variable as a dummy variable. We divided 15 services sub-sectors into three different groups:
   a. group of firms, which do not have any innovation nor any investment in R&D activities and do not export their services (e.g., firms in L - real estate sub-sector), all together five sub-sectors,
   b. group of firms, which do not have any innovation nor any investment in R&D activities but are exporting their services (e.g., firms in M73 - advertising and market research sub-sector), all together five sub-sectors, and
   c. group of firms, which do have innovation or investment in R&D activities and are exporting their services (e.g., firms in J61 - telecommunications sub-sector), all together five sub-sectors.

sub-sector$_{ij}$ = (dummy for sub-sectors)$_{ij}$
(firms i = 1, .. , N, sub-sectors j = 1, .. ,3) with values between 1 and 3 (group of point a. with value = 1, group of point b. with value = 2 and group of point c. with value = 3),

The variables we used for measuring export activities, innovation and investments in R&D intensities could not be dealt completely because all the firms do not perform export or innovation activities or invest in R&D. So in the model we chose (binary) variables $EXP\#_{ij}$, $INNO\#_{ij}$ and $INV\#_{ij}$ so that it is:

$$EXP^{\#}_{ij} = \begin{cases} 1 \text{ if } EXP_{ij} > 0 \\ 0 \text{ if } EXP_{ij} <= 0 \end{cases}$$

$$1 \text{ if } INNO_{ij} > 0$$

$$INNO^{\#}_{ij} = \begin{cases} 0 \text{ if } INNO_{ij} <= 0 \\ 1 \text{ if } INV_{ij} > 0 \end{cases}$$

$$INV^{\#}_{ij} = \begin{cases} 0 \text{ if } INV_{ij} <= 0 \end{cases}$$

With this, we formally defined in addition to "exporters" also "non-exporters", in addition to "innovators" also "non-innovators", and in addition to "firms which invest in firms R&D" also "firms which do not invest in firms R&D". This enables us to use the Simultaneous Probit model in the second step.

4 Data set

Data used was collected for two periods: from 2002 to 2008 and from 2010 to 2016. For the first longer period with more stable data, we use data on every second year, that is 2002, 2004, 2006 and 2008, while for the second period 2010, 2012, 2014 and 2016. We have to take into account two different periods from the fact, that at 2007 the Standard Statistical Activities (SKD 2002) have changed dramatically to new one (SKD 2008 - Slovenian version of NACE Rev. 2), and the Slovenian Statistical Standards were adjusted to the EU Statistical standards. Slovenia become the member of the EU in May 2004; hence all the data have to be adjusted to new standards, especially with new classification.

To run the model, we have used 5 different databases with the data on firms micro level. For all of them we have the same encrypted code (ID of firm) for each chosen year (different for the period 2002-2008 and for the period 2010-2016) so that we could combine/merge them. Because of the availability of appropriate data, we used slightly different databases for different periods (2002-2008 and for 2010-2016). In the end, we have two big databases for both periods with all the necessary variables. Because of differences in classification for two periods, it scientifically would not be correct if we just merged them, but it is correct that we compare the econometric results from both investigated periods.

From Statistical Office of the Republic of Slovenia (SORS) we used data from the following data basis: SSP - structural statistics of firms, ZUN TRG - database on international trade on goods and services, SRDAP - statistics register on active employees (labour force), RRD - database on firms R&D activities, and INOV - database on innovation activities in firms.

5 Descriptive statistics

The descriptive statistics are presented and described separately for two investigated periods: 2002-2008 and 2010-2016.

First, the database for the period 2002-2008 contains N = 11,352 firms. The number of firms over the years decreased from 3,447 in 2002 to 2,513 in 2008. This is not in accordance with our expectations that the number of firms should increase over the years, since the Slovenian economy had grown in that period (before and at the time of integration Slovenia into the EU).

From all the firms in this periods only 231 (2.0%) of them reported export and innovation activities (their export was have been > 0), only 613 (5.4 %) of them reported, that they exported services, but did not have any innovation activities. Among all other firms, nine out of ten (10.241 – 90.2%) reported, that they did not export anything to foreign markets, only 267 of them reported innovation activities. The services sector has not been developed very much at that time.

Second, the database for the period 2010-2016 is used for studying two descriptive statistics: export - innovation relationship, and export - investments in R&D relationship. The database consists of N = 73,721 observations in the panel dataset of firms.

For the export - innovation relationship, the number of observations compared to the previous period, increased substantially for each of the measure. This is probably the consequence of the change of statistical classification and the faster growth of the Slovenian economy within the EU immediately after entering the EU. The number of firms over the years increased from 16,681 in 2010 to 19,823 in 2014 but declined to 18,874 in 2016.

From all the firms only 401 (0.5%) firms reported export and innovation activities (their export was > 0), but there were many more firms with exported services (and did not have any innovation activities), i.e., 17,041 (23.1%) or almost a quarter of all of firms. Only 68 (0.1 %) firms reported that they did have innovation activities but did not export any services. Among all other firms, a little less than 3 quarters of them (56,211 or 76.3%) reported that they did not export anything to foreign markets and did not have innovation activities at that period. We divided firms in three groups by a separator based on characteristics of their performance. Separator = 1 contains of firms from group a. (see Dummy, variable no. 9), separator = 2 contains of firms from group b., and separator = 3 contains of firms from group c.

In the group a. were included 13,304 (18.0%) firms (group a. assumes no innovation activities and are not exporters), in the group b. were included 48,121 (65.3%) firms (group b. assumes no innovation activities and are exporters), and in the group c. were included 12,296 (16.7%) firms (group c. assumes innovation activities and are exporters). So, the biggest group b. contains of firms, which do not report any innovation activities, but are exporting their services abroad. This is in line with the

characteristic of Slovenian economy, which is mostly export oriented, not only for goods, but also, as we confirmed here, for services.

For the export - investments in R&D relationship, we use the same database with the same number of observations. From all the firms in this period, 9,872 (13.4%) firms reported export (export > 0) and did have investments in R&D. There were little less firms, 7,570 (10.3%), which reported export of services (and did not have any investments in R&D). Almost quarter of all firms, 17,826 (24.2 %), reported, that they did have investments in R&D, but did not export any services. All other firms, a little more than half of them, 38,453 or 52.2%, reported, that they did not have exporting anything to foreign markets and did not have investments in R&D at that period. Almost a quarter of all firms are exporters (23.6%) and more than a third of them did have investments in R&D (37.6 %), which is very encouraging for business performance.

6 Econometric Results with a Simple Probit model

The econometric results are presented in three phases for the Slovenian services sector. Different models on the same big database are estimated

a. export behaviour on innovation activities for the period 2002-2008,
b. export behaviour on innovation activities and investment in R&D activities for the period 2010- 2016, and
c. innovation activities and investment in R&D activities on export behaviour for the period 2010- 2016,

A two-step estimation approach was applied for each of all three phases. First, we use Simple Probit model to analyse one influence/impact to another (e.g., presence of export activities taking innovation activities as given (and vice-versa), then in the second step we use Simultaneous Probit model (Maddala, 1999).

In regression calculations, we use Likelihood Ratio Chi-Square test that at least one of the predictors` regression coefficient is not equal to zero. The number in the parentheses indicates the degrees of freedom of the Chi-Square distribution used to test the Likelihood Ratio Chi-Square statistics and is defined by the number of predictors in the model.

When computing the model, we used given alpha (α) significance level as 0.1 for all calculations. We used z test statistics, which is the ratio of the Coefficient to the Standard error of the respective predictor. The z value follows a standard normal distribution that is used to test against a two-sided alternative hypothesis that the Coefficient is not equal to zero.

For the testing on the null hypothesis for regression coefficients, we use z test statistics: p > I z I measure. This is the probability the z test statistics would be observed under the

null hypothesis that a particular predictors regression coefficient is zero, given the rest of the predictors are in the model. For a given alpha level ($\alpha = 0.1$), p > I z I determines whether the null hypothesis can be rejected. If p > I z I is less then alpha, (p > I z I < α = 0.1) then the null hypothesis can be rejected, and the parameter estimate is considered statistically significant at the alpha significance level.

Considering the interpretation of the data, it is important to know, that the Probit model regression coefficient interpretation is not similar as at common linear regression models. At given predictor a positive coefficient means that an increase in the predictor leads to an increase in the predicted probability. A negative coefficient means that an increase in the predictor leads to a decrease in the predicted probability (in: UCLA Academic Technology Services, 2010).

We use of three different models to analyse mutual relationships:

a. Export behaviour on innovation activities for the period 2002-2008
   We start with a Probit model of the decision to export and of the decision of innovation activities, and vice-versa.

   The latent model gives the export equitation

$$EXP_{ij} = C + \alpha \times INNO_{ij} + \beta \times ZNAC^{IZV}_{ij} + u_{ij}$$

   where we have:

EXP_{ij}	vector of export activities of firms i (i = 1 to N_j) in sector j (j = 1 to M),
$INNO_{ij}$	vector of innovation activities of firm i in the sector j,
$ZNAC^{IZV}_{ij}$	vector for characteristics of firm i in the sector j,
α , β	parameters to be estimated (computation),
C	regression constant, and
u_{ij}	error term, which is assumed to be iid N(0, σ_u).

   The export measure EXP_{ij} cannot be observed completely. The observed model is given by the binary choice

$$EXP^{\#}_{ij} = \begin{matrix} 1 \text{ if } EXP_{ij} > 0 \\ 0 \text{ if } EXP_{ij} <= 0 \end{matrix}$$

   formally defining an exporter and non-exporter. Results of the Maximum Likelihood estimation for the period 2002 to 2008 are summarized in Table 1 (for the years 2002 and 2004) and in Table 2 (for the years 2006 and 2008).

Table 1: Simple Probit model estimates for the years 2002 and 2004

Year:	2002			2004		
Variables	**Coeffic.**	**Standard error**	**p > I z I**	**Coeffic.**	**Standard Error**	**p > I z I**
Innovation intensity	2.150	0.716	0.003	0.464	1.906	0.808
Labour costs per unit	-4.319	1.054	0.000	-4.888	1.184	0.000
Firm size (log)	2.087	0.626	0.001	0.930	1.628	0.568
Firm size squared (log)	-0.222	0.087	0.011	0.009	0.226	0.969
Constant	-4.085	1.150	0.000	-2.752	2.756	0.318
Log Likelihood	-55.101			-21.471		
N	146			129		
LR chi2(5)*	70.16			68.35		

Source: own calculations

Among the results in Tables 1 and 2 predictors University education and Tech skills education were omitted. At the set out alpha significance level to 0.1, their estimated regression coefficients failed to reject the null hypothesis and can be concluded that their regression coefficients have not been found to be statistically different from zero given all other predictors in the model.

Table 2: Simple Probit model estimates for the years 2006 and 2008

Year:	2006			2008		
Variables	**Coeffic.**	**Standard error**	**p > I z I**	**Coeffic.**	**Standard Error**	**p > I z I**
Innovation intensity	-	-	-	-	-	-
Labour costs per unit	-8.239	0.688	0.000	-6.358	0.486	0.000
Firm size (log)	0.384	0.213	0.071	0.376	0.177	0.033
Firm size squared (log)	0.053	0.038	0.159	0.024	0.030	0.438
Constant	-2.030	0.298	0.000	-2.060	0.246	0.000
Log Likelihood	-168.801			-255.355		
N	2 626			2 513		

LR chi2(5)*	537.82	592.39

Source: own calculations

The results of the Simple Probit model support the hypothesis, that the innovation activities encourage export behaviour, but only in the year 2002. Innovation activities have clear, positive impact on export activities, which can be seen from positive coefficient on innovation intensity (coefficient 2.15 in 2002). It means that any additional unit of innovation activity in 2002 would increase the export activity for F (2,15) = 0.984 (98.4%!). The results for 2004 cannot be explained because the risk level in much higher than allowed, 10% level (coefficient is 0.464 at the risk level p > I z I = 0.808 > 0.1).

The results for the years 2006 and 2008 confirm that the innovation intensity parameter estimate is considered statistically non-significant at the alpha level as a reason that theoretical expectation related to this coefficient was rejected.

The calculated regression coefficient in the model shows that higher costs per unit cause significant decrease the probability for export activities in all analysed years. The regression coefficients are negative suggesting that any additional labour costs per unit would decrease the probability for the export activity.

The regression coefficients pertained to firm size predictors in all analysed years, except for 2004, are significantly positive. This means that any additional employee per unit would increase the probability for the export activity.

b. In investigation of the export behaviour on innovation and investment in R&D activities for the period 2010-2016, we start with a Probit model of the decision to export and the decision of innovation or/and investment in R&D activities (and vice-versa).

The export equitation is given for both innovation and investments in R&D activities by the latent models:

$$EXP_{ij} = C + \alpha \times INNO_{ij} + \beta \times ZNAC^{IZV}_{ij} + u_{ij}$$

$$EXP_{ij} = C + \alpha \times INV_{ij} + \beta \times ZNAC^{IZV}_{ij} + u_{ij}$$

where are:

EXP_{ij} vector of export activities of firms i (i = 1 to N_j) in sector j (j = 1 to M),

$INNO_{ij}$ vector of innovation activities of firm i in the sector j

INV_{ij} vector of investment on R&D activities of firm i in the sector j,

$ZNAC^{IZV}_{ij}$ vector for characteristics of firm i in the sector j,
α , β parameters to be estimated,
C regression constant, and
u_{ij} error term, which is assumed to be iid $N(0, \sigma_u)$.

The export measure EXP_{ij} cannot be observed completely. The observed model is given by the binary choice (for both models):

$$EXP^{\#}_{ij} = \begin{matrix} 1 \text{ if } EXP_{ij} > 0 \\ 0 \text{ if } EXP_{ij} <= 0 \end{matrix}$$

formally defining an exporter and non-exporter. The results of the Maximum Likelihood estimation for the period 2010-2016 are summarized in Table 3 (for the years 2010 and 2012) and in Table 4 (for the years 2014 and 2016). The left part of Tables presents results for innovation activities and the right part of Tables presents results for investment in R&D activities.

Table 3: Simple Probit model estimates for the years 2010 and 2012, relationship between investment intensity or innovation intensity and export activities

	2010				**Year**	**2012**			
	16 681				**No. of firms**	**18 343**			
	"INVESTOR"		**"INNOVATOR"**		**Firm, that is**	**"INVESTOR"**		**"INNOVATOR"**	
	export activities				**Impact on**	**export activities**			
	-7308.74		-7302.52		**Likelihood**	-8629.17		-8636.76	
	1883.29		1895.72		**LR chi2(n)***	1968.88		1953.68	
	Coeffic.	p > I z I	Coeffic.	p > I z I		Coeffic.	p > I z I	Coeffic.	p > I z I
	0.299	0.028			**Investment intensity**	0.609	0.000		
			2.206	0.000	**Innovation intensity**			0.142	0.158
Probability		17.8		17.8	**Probability influence in %**		20.9		21.7
Constant	-1.649	0.000	-1.632	0.000		-1.516	0.000	-1.503	0.000
Labour costs per unit	-0.830	0.000	-0.832	0.000		-0.838	0.000	-0.840	0.000
		0.055		0.055	st. deviation		0.053		0.053
University	0.359	0.000	0.353	0.000		0.323	0.000	0.322	0.000

	2010				Year	2012			
education		0.074		0.074	st. deviation		0.072		0.072
Tech skills education	0.638	0.000	0.629	0.000		0.627	0.000	0.625	0.000
		0.073		0.073	st. deviation		0.070		0.070
Firm size (log)	0.438	0.000	0.437	0.000		0.510	0.000	0.513	0.000
		0.030		0.030	st. deviation		0.029		0.029
Firm size squared (log)	-0.021	0.010	-0.022	0.007		-0.038	0.000	-0.038	0.000
		0.008		0.008	st. deviation		0.008		0.008

Source: own calculations

The estimated Simple Probit models support the hypothesis that the innovation and investment in R&D activities encourage export behaviour in the period 2010-2016. Innovation, as well as investments in R&D activities have significantly positive impact on probability of export activities in firms in all four analysed years.

Table 4: Simple Probit model estimates for the years 2014 and 2016, relationship between investment intensity or innovation intensity and export activities

	2014				Year	2016			
	19 823				**No. of firms**	**18 874**			
	"INVESTOR"		**"INNOVATOR"**		**Firm, that is**	**"INVESTOR"**		**"INNOVATOR"**	
	export activities				**Impact on**	**export activities**			
	-9866.30		-9877.67		**Likelihood**	-10058.17		-7308.74	
	2276.62		2253.89		**LR chi2(n)***	2392.37		1883.29	
	Coeffic.	p > I z I	Coeffic.	p > I z I		Coeffic.	p > I z I	Coeffic.	p > I z I
	0.758	0.000			**Investment intensity**	0.717	0.000		
			0.223	0.493	**Innovation intensity**			1.164	0.011
Probability		22.4		22.7	**Probability influence in %**		26.7		26.8
Constant	-1.348	0.000	-1.334	0.000		-1.244	0.000	-1.227	0.000

	2014				Year	2016			
Labour costs per unit	-0.638	0.000	-0.644	0.000		-0.707	0.000	-0.712	0.000
		0.046		0.046	st. deviation		0.044		0.044
University education	0.191	0.003	0.189	0.003		0.179	0.006	0.180	0.065
		0.065		0.065	st. deviation		0.066		0.006
Tech skills education	0.472	0.000	0.468	0.000		0.491	0.000	0.485	0.000
		0.063		0.063	st. deviation		0.064		0.064
Firm size (log)	0.464	0.000	0.470	0.000		0.459	0.000	0.465	0.000
		0.028		0.027	st. deviation		0.027		0.027
Firm size squared (log)	-0.040	0.000	-0.040	0.000		-0.036	0.000	-0.039	0.000
		0.008		0.008	st. deviation		0.008		0.008

Source: own calculations

For all analyzed years, the calculation shows that innovation activities in firms have a positive effect on export activities in firms. The more the firms invest in innovation activities, the greater is the probability that they will perform export activities. The estimated probabilities by the years are the following: 17.8% in 2010, 21.7% in 2012, 22.7% in 2014, and 26.8% in 2016. The probability has increased permanently over the analyzed years, which is very positive effect from the Slovenian services sectors to export activities.

The calculation shows that investment in R&D activities in firms have a positive effect on export activities in firms. The more the firms invest in R&D the greater is the probability that they will perform export activities. The estimated probabilities by the years are the following: 17.8% in 2010, 20.9% in 2012, 22.4% in 2014, and 26.7% in 2016. The probability has increased permanently over the analyzed years, which is also very positive effect from the Slovenian services sectors to export activities.

A statistically positive regression coefficients pertained to innovation intensity are found for the years 2010 (coefficients 2.206) and 2016 (0.717), but not for 2012 and 2014 when we can reject the null hypothesis.

A statistically positive regression coefficients pertained to investment intensity are found for the years 2010 (coefficients 0.299), 2012 (0.609), 2014 (0.758) and 2016 (0.717). The more the firms invest in R&D, the greater is the probability that they will perform export activities. The probability has increased permanently, except in 2016. The probability almost tripled from 2010 to 2016.

The estimated models show that higher costs per unit significantly decrease the probability for export activities in the analyzed years in both relationships. The regression coefficients are negative, between -0.63 and -0.84, which means that any additional labor costs per unit would strongly decrease the probability for the export activity.

The regression coefficients pertained to the shares of higher education show that the higher (better) educational structure of employees in the analyzed years and in both relationships encouraged export activities. They have a clear positive impact: the coefficient for the share of employees with technical education is between 0.47 and 0.63, and for the share with university education is between 0.17 and 0.36. This means that each additional unit of the educational structure in the analysed years in both relationships increased the probability of the firm's export activity. Therefore, higher average education increases the probability for export behaviour.

The size of the firm slightly encouraged export activities in the analysed years and the relationships. They have a clear positive impact, and the regression coefficients are around 0.45. This means that any additional increases in the size of the firm in the analysed years in both relationships increased the probability of the firm's export activity or larger than the firm was, the more likely it is that it will be an exporter.

c. Innovation and investment in R&D on export activities for the period 2010-2016.
We start with a Probit model regarding the decision for investment in R&D activities and the decision of export activities, and vice-versa.

The innovation and investment in R&D equitation is given by the latent models

$$INNO_{ij} = C + \gamma \times EXP_{ij} + \delta \times ZNAC^{INOV}{}_{ij} + u_{ij}$$

$$INV_{ij} = C + \gamma \times EXP_{ij} + \delta \times ZNAC^{INOV}{}_{ij} + u_{ij}$$

where we have:

$INNO_{ij}$	vector of innovation activities of firm i in the sector j, ($i = 1$ to N_j) in sectorj ($j = 1$ to M),
INV_{ij}	vector of investment on R&D activities firm ij, ($i = 1$ to N_j) in sector j ($j = 1$ to M),
EXP_{ij}	vector of export activities of firm i in the sector j,
$ZNAC^{IZV}{}_{ij}$	vector for characteristics of firm i in the sector j,
α , β	parameters to be estimated,
C	regression constant and
u_{ij}	error term is assumed to be iid $N(0, \sigma_u)$.

The innovation measure $INNO_{ij}$ and investment on R&D measure INV_{ij} cannot be observed completely. The observed models are given by the binary choice:

$$INNO^{\#}_{ij} = \begin{cases} 1 \text{ if } INNO_{ij} > 0 \\ 0 \text{ if } INNO_{ij} <= 0 \end{cases}$$

$$INV^{\#}_{ij} = \begin{cases} 1 \text{ if } INV_{ij} > 0 \\ 0 \text{ if } INV_{ij} <= 0 \end{cases}$$

formally defining an innovator and non-innovator, and separately investor on R&D and non-investor in R&D. The results of the Maximum Likelihood estimation for the period 2010-2016 are summarized in Table 5 (for the years 2010 and 2012) and in Table 6 (for the years 2014 and 2016).

For the years 2010 and 2012 the calculation (the right side of Tables) shows that no impact can be found of export behaviour on innovation activities. Therefore, the null hypothesis can be rejected. However, for the years 2014 and 2016 there is a minor impact of export behavior in firms on innovation activities (coefficient 0.3 in 2014 and 0.28 in 2016).

The calculation shows (on the left side of Tables) that export activities have a positive effect on the probability of investment in R&D behavior in firms in 2012 and 2014, but the coefficients are small (mirror impact). In the year 2010, there is a small negative coefficient (-0.025).

The calculations of the Simple Probit model do not support the hypothesis, that for the period 2010-2016 export behavior encourages innovation activities. The coefficients are almost zero (< 0.01), so we cannot find any impact.

However, the calculations do support the hypothesis, that for the period 2010-2016 the export behavior encouraged investment in R&D activities. Export behaviors have significantly positive impact on the probability of investment in R&D activities in firms in the analyzed years (probability coefficients are 44.0 in 2010, 35.8 in 2012, 33.0 in 2014, and 33.3 in 2016). These results confirmed that more the firms perform export activities, the greater is the probability that they will invest in R&D activities.

Table 5: Simple Probit model estimates for the years 2010 and 2012, relationship between export behavior and investment intensity or innovation intensity

	2010				**Year**	**2012**			
	16 681				**No. of firms**	**18 343**			
	"EXPORTER"				**Firm, that is**	**"EXPORTER"**			
Activities:	**Investment in R&D**		**Innovation activ.**		**Impact on**	**Investment in R&D**		**Innovation acti.**	
	-9614.07		-288.64		**Likelihood**	-10369.05		-286.37	
	3614.85		614.72		**LR chi2(n)***	3651.62		710.56	
	Coeffic.	p > I z I	Coeffic.	p > I z I		Coeffic.	p > I z I	Coeffic.	p > I z I
	-0.025	0.631	0.308	0.148	**export intensity**	0.183	0.000	0.178	0.371
Probability		44.0		< 0.01	**Probability influence in %**		35.8		< 0.01
Constant	-0.982	0.000	-15.293	0.000		-1.035	0.000	-16.158	0.000
Labour costs per unit	-0.591	0.000	-0.383	0.167		-0.677	0.000	0.147	0.576
		0.048		0.277	st. deviation		0.049		0.263
University education	0.311	0.000	10.047	0.000		0.27	0.39	10.215	0.000
		0.057		2.255	st. deviation		0.25		2.481
Tech skills education	0.436	0.000	10.054	0.000		0.34	0.44	10.772	0.000
		0.057		2.193	st. deviation		0.23		2.412
Firm size (log)	0.840	0.000	1.730	0.000		2.56	1.52	2.034	0.000
		0.030		0.237	st. deviation		0.95		0.263
Firm size squared (log)	-0.083	0.000	-0.143	0.000		7.76	3.22	-0.174	0.000
		0.010		0.034	st. deviation		3.74		0.036

Source: own calculations

From the right sides of both Tables, we can see positive regression coefficients (around 0.3) on export intensity, but the null hypothesis can be rejected for the years 2010 and 2012.

From the left sides of both Tables, we can see positive regression coefficients on export intensity, but only for the years 2012 and 2012 (coefficients 0.183 in 2012, and 0.187 in 2014), but the null hypothesis can be rejected for the years 2010 and 2016.

Table 6: Simple Probit model estimates for the years 2014 and 2016, relationship between export behaviour and investment intensity or innovation intensity

	2014				**Year**	**2016**			
	19 823				**No. of firms**	**18 874**			
	"EXPORTER"				**Firm, that is**	**"EXPORTER"**			
Activities:	**Investment in R&D**		**Innovation activ.**		**Impact on**	**Investment in R&D**		**Innovation activ.**	
	-10170.02		-346.12		**Likelihood**	-9985.01		-7308.74	
	4945.26		913.98		**LR chi2(n)***	4697.92		1883.29	
	Coeffic.	p > I z I	Coeffi c.	p > I z I		Coeffic.	p > I z I	Coeffi c.	p > I z I
	0.145	0.000	0.298	0.073	**export intensity**	0.038	0.344	0.276	0.093
Probability		33.0		-	**Probability influence in %**		33.3		-
Constant	-1.287	0.000	-0.832	0.000		-1.319	0.000	-0.832	0.000
Labour costs per unit	-0.730	0.000	-0.033	0.893		-0.687	0.000	-0.193	0.456
		0.047		0.242	st. deviation		0.047		0.259
University education	0.305	0.000	5.055	0.000		0.400	0.000	3.592	0.002
		0.063		1.396	st. deviation		0.066		1.140
Tech skills education	0.385	0.000	5.723	0.000		0.454	0.065	4.656	0.000
		0.062		1.328	st. deviation		0.000		1.078
Firm size (log)	0.866	0.000	2.757	0.000		0.849	0.000	2.152	0.000
		0.030		0.342	st. deviation		0.030		0.241
Firm size squared (log)	-0.084	0.000	-0.295	0.000		-0.075	0.000	-0.194	0.000
		0.010		0.049	st. deviation		0.010		0.033

Source: own calculations

The estimated models show that higher costs per unit significantly decrease the probability for export activities in the analyzed years in both relationships. The coefficients are negative, between -0.59 and -0.73, which means that any additional labor costs per unit would strongly decrease the probability for the export activity. This is according to the theoretical assumption that any additional employee would increase the costs for labor force in firm and consequently lover the firm competitiveness, especially in foreign markets.

The regression coefficients pertained to the shares of higher education show that the higher (better) educational structure of employees in the analyzed years in both relationships encouraged export activities. They have a significantly positive impact: the coefficient for the share of employees with technical education is between 0.38 and 0.44, and for the share with university education is between 0.27 and 0.40. This means that each additional unit of the educational structure in the analyzed years in both relationships increased the probability of the firm's innovations or investments in R&D. So higher average education increases the probability for innovation and investments in R&D activities.

The regression coefficients for the size of the firm slightly encouraged export activities in the analyzed years in both relationships. They have a significantly positive impact, and the coefficients are around 0.85. This means that any additional increase in the size of the firm in the analyzed years in both relationships increased the probability of the firm's innovation and investments in R&D activities, or the larger the company was, the more likely was to perform innovation and investments in R&D activities.

7 Econometric Results with a Simultaneous Probit model

In the second step, we generalized the model and used Simultaneous Probit model (Maddala, 1999) with the two equations (continuous functions). The export equitation is given for both innovation and investments in R&D by the latent models in the first and the second EXP_{ij} equations. We used innovation and investments in R&D activities as endogenous variables in the third $INNO_{ij}$ and fourth INV_{ij} equations:

$$EXP_{ij} = C + \alpha \times INNO_{ij} + \beta \times CFIRM^{IZV}_{ij} + u_{ij}$$

$$EXP_{ij} = C + \gamma \times INV_{ij} + \delta \times CFIRM^{IZV}_{ij} + v_{ij}$$

$$INNO_{ij} = C + \varepsilon \times EXP_{ij} + \theta \times CFIRM^{INOV}_{ij} + z_{ij}$$

$$INV_{ij} = C + \eta \times EXP_{ij} + \rho \times CFIRM^{INOV}_{ij} + w_{ij}$$

where we have:

EXP_{ij}	vector of export activities of firms i (i = 1 to N_j) in the sector j (j = 1 to M),
$INNO_{ij}$	vector of innovation activities of firm i in the sector j
INV_{ij}	vector of investment on R&D activities of firm i in the sector j,
$CFIRM^{IZV}_{ij}$	vector for characteristics of firm i in the sector j,
α , β, γ, δ	parameters to be estimated,
ε , θ, η, ρ	parameters to be estimated,
C	regression constant and
u_{ij}, v_{ij}, z_{ij}, w_{ij}	error term is assumed to be iid N(0, σ_u).

The variables we used for measuring export activities, innovation and investments in R&D intensities could not be delt completely because all the firms do not perform export and innovation activities and the activities of the R&D. So in the model we chose (binary) variables $EXP^{\#}_{ij}$, $INNO^{\#}_{ij}$ and $INV^{\#}_{ij}$ so that it is:

$$EXP^{\#}_{ij} = \begin{cases} 1 \text{ if } EXP_{ij} > 0 \\ 0 \text{ if } EXP_{ij} <= 0 \end{cases}$$

$$INNO^{\#}_{ij} = \begin{cases} 1 \text{ if } INNO_{ij} > 0 \\ 0 \text{ if } INNO_{ij} <= 0 \end{cases}$$

$$INV^{\#}_{ij} = \begin{cases} 1 \text{ if } INV_{ij} > 0 \\ 0 \text{ if } INV_{ij} <= 0 \end{cases}$$

With this we formally defined beside "exporters" also "non-exporters", beside "innovators" also "non-innovators" and beside "firms who invests in firms R&D" also "firms who do not invest in firms R&D". This way enables us to use the Simultaneous Probit model (in the second step).

Again, we use three different models to analyze mutual relationships on combined database for all four measured periods. Combined database includes (combines) data from all four separated databases from each year, as example combined database for the period 2002-2008 have all data for the years 2002, 2004, 2006, and 2008.

Note that not all firms have been in the database for all four years - some of them can be in the database just for a single year or two, and some of them can be in the database for all four analyzed years: 2002, 2004, 2006, and 2008 database or in 2010, 2012, 2014, and 2016 database. Note also that firms from the databases 2002-2008 are in no relations to firms from the databases 2008-2016, as explained in the section “Empirical model”.

The two-step results are summarized in Tables 7, 8 and 9. Table 7 shows the relation between export and innovation activities for the years in the period 2002-2008, Table 8

the same relation for the years in the period 2010-2016, and Table 9 for the relation between export activities and investment in in R&D activities for the years in the periods 2010- 2016.

The left part of Tables presents the relations of innovation/ investment in R&D activities with export behavior, and on the right part the opposite relations.

a. relation between innovation and export activities for the analyzed years in the period 2002-2008

The Simultaneous Probit model supports the hypothesis (see Table 7, the left side), that the innovation activities encourage export behavior. Innovation intensity has significantly positive impact on export activities (coefficient 1.95): any additional unit of innovation activity in all four analyzed years in the period 2002-2008 would substantially increase probability for the export activity.

The model results for the analyzed years in the period 2002-2008 (see Table 7, the right side) cannot support the hypothesis that the export behavior encourages innovation activities, and the null hypothesis can be rejected.

Table 7: Simultaneous "Probit" model estimates for the relationship between export behavior and innovation activities for the years in the period 2002-2008 year

model:	**"exporters"**			**"innovators"**		
Variables	**coeff.**	**standard Error**	**p > I z I**	**coeff.**	**standard error**	**p > I z I**
Export intensity				-0.337	0.525	0.521
Innovation intensity	1.947	0.741	0.009			
Labour costs per unit	-3.973	0.774	0.000	-0.314	0.246	0.202
Tech skills education				1.778	0.502	0.000
University education				1.691	0.486	0.001
Firm size (log)	1.091	0.510	0.032	1.254	0.267	0.000
Firm size squared (log)	-0.082	0.072	0.254	-0.113	0.039	0.003
Constant	-2.633	0.903	0.004	-4.848	0.551	0.000
Likelihood	-62.843			-318.629		
N	244			2,046		
LR chi^2(5)	78.50			94.84		

Source: own calculations

The results show that higher costs per unit significantly decrease the probability for export activities for all four analyzed years in the period 2002-2008. The regression

coefficients are negative (the coefficient -3.97 is very high on the left side, and -0.31 on the right side of Table 7), that means that any additional unit of labor costs per unit would decrease the probability for the export activity quite strongly.

The shares of higher education confirmed the impact only for the exporters innovators (on the right side of Table 7). The regression coefficients show that the higher (better) educational structure of employees in all analyzed years from 2002 to 2008 encouraged innovation activities. They have a clear positive impact as the regression coefficient for the share of employees with technical education is 1.78, and for the share with university education is 1.70. This means that each additional unit of the educational structure in all analyzed years from 2002 to 2008 increased the probability for the firm`s innovation activities or for the firm's export activities. The higher average education increases the probability for export and for innovation behavior.

The size of the firm slightly encouraged innovation (the left side of Table 12) and export activities (the right side of Table 12) in all analyzed years from 2002 to 2008. The regression coefficients (1.09 and 1.25) have a significantly positive impact. This means that any additional increase in the size of the firm in all analyzed years from 2002 to 2008 increased the probability of the firm's innovation and export activities or larger than the company was, the more likely was that it would be an innovator/exporter.

b. The relation between export and innovation activities for the analyzed years in the period 2010-2016

The results of the Simultaneous Probit model support the hypothesis (see Table 83, the left side) that the innovation activities encourage export behavior. For all analyzed years, the results show that innovation activities in firms have a positive effect on export activities in firms. The more the firms invest in innovation behavior, the greater is the probability influence (i.e., 22.1%) that they will perform export activities.

The model results for the four analyzed years in the period 2010-2016support the hypothesis (see Table 8, the right side) that the export behavior encourages innovation activities. The results show that export activities in firms have a significantly positive effect on innovation activities in firms. However, the model as a whole indicates very low probability influence (<0.001%).

Table 8: Simultaneous "Probit" model estimates for the years in the period 2010-2016. The relationship between export behaviour and innovation activities

model:	"exporters"			"innovators"		
Variables	**coeff.**	**Standard Error**	**variables**	**coeff.**	**standard Error**	**p > I z I**
Export intensity				0.256	0.088	0.004
Innovation intensity	0.771	0.193	0.000			
Labour costs per unit	-0.716	0.024	0.000	-0.075	0.128	0.557
Tech skills education	0.255	0.034	0.000	5.848	0.770	0.000
University education	0.560	0.033	0.000	6.379	0.738	0.000
Firm size (log)	0.467	0.014	0.000	1.965	0.120	0.000
Firm size squared (log)	-0.035	0.004	0.000	-1.778	0.017	0.000
Constant	-1.417	0.033	0.000	11.735	0.784	0.000
Probability influence in %	22.1			< 0.001		
Likelihood	36,141.43			1,299.96		
N	73,721			73,721		
LR chi^2(5)	8386.02			3078.96		

Source: own calculations

Innovation intensity has significantly positive impact on export activities (coefficient 0.77). This means that any additional unit of innovation activity in all four analyzed years in the period 2010-2016 increased the probability of the export activity. Higher labor costs per unit significantly decrease the probability for export activities for all 4 analyzed years in the period 2010-2016. The regression coefficient is negative (coefficient -0.72 on the left side) that means that any additional labour costs per unit would decrease the probability for the export activity.

The higher shares of higher education and the higher (better) educational structure of employees in all analyzed years from 2010 to 2016 encouraged innovation and export activities. They have a significantly positive impact. The regression coefficient for the share of employees with technical education on innovation is 5.85, which is quite high, on export activities is 0.26, and for the share with

university education on innovation is 6.38 (higher than that with technical education) and on export activities is 0.56. This means that each additional unit of the educational structure in all analyzed years from 2010 to 2016 increased the probability of the firm's innovation/export activities. The higher average education increases the probability for innovation/export behavior. The size of the firm encouraged innovation (the left side in Table 8) and export activities (the right side of the same table) in all analyzed years from 2010 to 2016. They have a significantly positive impact, and the regression coefficients are 0.47 and 1.97, respectively. This means that any additional increase in the size of the firm in all analyzed years from 2010 to 2016 increased the probability of the firm's innovation and export activities or larger than the firm was, the more likely it is that it will be an innovator/exporter.

c. The relation between export activities and investment in R&D activities for the analyzed years in the period 2010-2016

The Simultaneous Probit model supports the hypothesis (see Table 9, the left side) that the investment in R&D activities encourages export behavior. For all analyzed years from 2010 to 2016 the regression coefficients show that investment in R&D activities in firms have a positive effect on export activities. The more the firms invest in R&D behavior, the greater is the probability that they will perform export activities: the probability influence is estimated at 22.4%.

The estimated model for all four analyzed years in the period 2010-2016 supports the hypothesis (see Table 9, the right side) that the export behavior encourages investment in R&D activities. For all analyzed years, the regression coefficients show that export behavior in firms has a positive effect on investment in R&D activities. The more the firms export, the greater is the probability that they will perform investment in R&D activities: the probability influence is estimate at 36.1%.

Investment intensity in R&D activities has a significantly positive impact on export activities (coefficient 0.55). This means that any additional unit of investment intensity in R&D activities in all four analysed years in the period 2010-2016 increased the probability of the export activity.

The regression model for all four analyzed years in the period 2010-2016 cannot support the hypothesis (see Table 9, the right side) that the export intensity behavior encourages the investment in R&D activities. The regression coefficient (0.07) indicates that the export intensity activities in firms have very small and negative effect on investment in R&D activities.

The estimated model suggests that higher labor costs per unit significantly decrease the probability for export activities for all four analyzed years in the period 2010-

2016. The regression coefficients are negative (-0.71 on the left side and -0.70 on the right side of Table 14) that means that any additional unit of labour costs per unit decreased the probability for the export activity.

Table 9: Simultaneous "Probit" model estimates for the years in the period 2010-2016. The relationship between export behaviour and investment in R&D activities

model:	**"exporters"**			**"investors in R&D"**		
Variables	**coeff.**	**standard error**	**p > I z I**	**coeff.**	**standard Error**	**p > I z I**
Export intensity				-0.073	0.525	0.521
Investment intensity	0.550	0.071	0.000			
Labour costs per unit	-0.714	0.024	0.000	-0.700	0.023	0.000
Tech skills education	0.256	0.034	0.000	0.307	0.030	0.000
University education	0.566	0.033	0.000	0.385	0.030	0.000
Firm size (log)	0.463	0.014	0.000	0.823	0.015	0.000
Firm size squared (log)	-0.034	0.004	0.000	-0.078	0.005	0.000
Constant	-1.432	0.033	0.000	-1.130	0.029	0.000
Probability influence in %	22.4			36.1		
Likelihood	36,121.05			-40,397.17		
N	73,721			73,721		
LR chi^2(5)	8,426.79			16,801.48		

Source: own calculations

The higher shares of higher education and the higher (better) educational structure of employees in all analyzed years from 2010 to 2016 encouraged investment in R&D activities and export activities. They have a significantly positive impact. The coefficient for the share of employees with technical education on investment in R&D activities is 0.31 and on export activities is 0.26 and in the share with university education on investment in R&D activities is 0.39 (higher that with technical education) and on export activities is 0.57. This means that each additional unit of the educational structure in all analyzed years from 2010 to 2016 increased the probability of the firm's

investment in R&D / export activities. The higher average education increased the probability for investment in R&D activities / export behavior.

The size of the firm encouraged investment in R&D activities (the left side in Table 9) and export activities (the right side of the same table) in all analyzed years from 2010 to 2016. They have a significantly positive impact: the regression coefficients are 0.82 and 0.46, respectively. This means that any additional increase in the size of the firm in all analyzed years from 2010 to 2016 increased the probability of the firm's investment in R&D activities and export activities or the larger the company was the more likely was to conduct an investment in R&D activities/export behavior.

8 Conclusion

Through the economic history, the importance of services and trade in services has grown rapidly. Classical economists have defined services as products or results of work, which disappear in the moment the work is accomplished, which is still valid that services differ from production and trade of goods. Service activities are taking more important role in the international economic development. Their share in GDP of developed countries is constantly increasing in the last two decades. Trade of services runs in different ways compared to trade of goods/products. Producer of any product, which is not made-to-order, never knows who the end user/consumer is, and where in the world the final product is used/spent/consumed. The difference between activity of service and its final result or accomplished service means change of state compared to originally one, because original state cannot be regained.

For international trade of services international free flows of elements, which are connected to services such as objects, capital, information flows or people, are needed. Not all these free flows have been enabled evenly by international agreements yet. Consequently, the free trade of services does not exist until completely free trade of labor force, capital and information exists. Because of these limitations services belonged to so called third class (tertiary) sector till the middle of 20th century. Their activities could not be classified among production or agricultural activities. Each of services was treated separately (discretely) and classified using different criteria.

According to the final location of trade, there is a difference in trade of goods/products, which can be physically touched, and trade of services, which are intangible. The following thirteen characteristics of services have been defined: intangibility and immateriality; invisibility; perishability; temporary existence, sensitivity on time; non storability; inseparability; lack of inventory; sensibility of quality control; high degree of risk and difficulty in experimentation; customization requirements; different distribution channels; and no rivalry. Rapid development of services accelerated the productivity of production activities with innovation and other high-tech services.

Through a two-step research that was conducted based on the Simple Probit model as a first step and the Simultaneous Probit model as a second step, the relations between exports, investments in development and innovation activities in the selected business non-financial services sectors in two periods (2002-2008 and 2010-2016) was examined.

The results of the Simple Probit model suggest that the innovation activities encourage export behavior. Innovation activities have clear, positive impact on export activities. It was established that higher costs per unit cause significant decrease of probability for export activities in all analyzed years and any additional labor costs per unit would decrease the probability for the export activity. On the other hand, any additional employee per unit would increase the probability for the export activity. The results show that the higher (better) educational structure of employees encourage export activities. Each additional unit of the educational structure in the analyzed years increased the probability of the firm's export activity. Therefore, higher average education increases the probability for export behavior.

The estimated Simple Probit models also support the hypothesis that the innovation and investment in R&D activities encourage export behavior. Innovation as well as investments in R&D activities have significantly positive impact on probability of export activities in firms. The more the firms invest in R&D, the greater the probability that they will perform export activities. The probability has increased permanently, except in 2016. The probability almost tripled from 2010 to 2016.

The size of the firm slightly encouraged export activities in the analyzed years and the relationships. Any additional increases in the size of the firm increased the probability of the firm's export activity or larger than the firm was, the more likely it is that it will be an exporter.

The Simultaneous Probit model supports the hypothesis that the innovation activities encourage export behavior. Innovation intensity has significantly positive impact on export activities and any additional unit of innovation activity in the period 2002-2008 would substantially increase probability for the export activity. The model results for the period 2002-2008 do not support the hypothesis that the export behavior encourages innovation activities.

The shares of higher education confirmed the impact only for the exporters innovators. The higher (better) educational structure of employees in all analyzed years from 2002 to 2008 encouraged innovation activities. Each additional unit of the educational structure increased the probability for the firm`s innovation activities or for the firm's export activities. The higher average education increases the probability for export and for innovation behavior. The higher shares of higher education and the higher (better) educational structure of employees in all analyzed years from 2010 to 2016 encouraged

innovation and export activities. They have a significantly positive impact. Each additional unit of the educational structure in all analyzed years from 2010 to 2016 increased the probability of the firm's innovation/export activities. The higher average education increases the probability for innovation/export behavior.

The size of the firm slightly encouraged innovation and export activities in all analyzed years from 2002 to 2008. Any additional increase in the size of the firm in increased the probability of the firm's innovation and export activities or larger than the company was, the more likely was that it would be an innovator/exporter.

The results of the Simultaneous Probit model also support the hypothesis that the innovation activities encourage export behavior. For all analyzed years, the results show that innovation activities in firms have a positive effect on export activities in firms. The more the firms invest in innovation behavior, the greater is the probability influence that they will perform export activities.

The model results for the four analyzed years in the period 2010-2016 support the hypothesis that the export behavior encourages innovation activities. The results show that export activities in firms have a significantly positive effect on innovation activities in firms. However, the model as a whole indicates very low probability influence.

The size of the firm encouraged innovation and export activities as well in all analyzed years from 2010 to 2016. Any additional increase in the size of the firm in all analyzed years from 2010 to 2016 increased the probability of the firm's innovation and export activities or larger than the firm was, the more likely it is that it will be an innovator/exporter.

Further, the Simultaneous Probit model supports the hypothesis that the investment in R&D activities encourages export behavior. In all analyzed years from 2010 to 2016 we found that investment in R&D activities in firms have a positive effect on export activities. The more the firms invest in R&D behavior, the greater is the probability that they will perform export activities. Also, the estimated model for all four analyzed years in the period 2010-2016 support the hypothesis that the export behavior encourages investment in R&D activities. The more the firms export, the greater is the probability that they will perform investment in R&D activities.

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