

ECONOMIC RELATIONS & THE IMPACT OF SUBSIDIES ON INNOVATIONS IN ICT

[Ekonomické vazby & vliv dotací na inovace v oboru ICT]

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Abstract: The following work should briefly outline environmental conditions for innovative entrepreneurs and start-ups in an area of information and telecommunication technologies, conditions in the Czech Republic and present research of the effect of subsidies on innovative companies and innovation results. Although some studies show correlations among subsidies in ICT, innovations and economic growth, it is usually reflected only in some industry sectors and in some stage of economy evolution. Or there is a correlation only if there are also other fulfilled conditions as investments into human resources. In general, studies mostly yield evidence of strong positive correlations between ICT areas and economic growth in modern economies as it participates in the reduction of transaction costs, increases production factor productivity and creates completely new solutions for current problems.

Keywords: Economic growth, Environmental conditions, ICT, Innovation, Subsidies.

JEL classification: C12, H25, O33, Q55

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1 Introduction

Information and communication technologies can be considered from two angles; from the production of ICT as the supply side and consumption of ICT as the demand side. Material production of ICT can be very important for its creation of a substantial part of an economic output and can be preferable in some phase of economic development to be supported by state authorities. The considered supply side then must be diversified by size of the added value of its production. Also, the consumption side is important as it is responsible for effective functions and elements used by people, e.g. E-government applications, internet connectivity and coverage, etc. There are many synergy co-effects and correlations between both sides, which are important to be mentioned with ICT a sustainable economic growth. The first part of the article summarize relations among economic growth and ICT development with major focus on the innovation environment and its functionality. The second part of the article will follow-up with research of subsidies and their effect on ICT innovations.

1.1 Importance of ICT for economy

Initial studies that bring together ICT, the economy and productivity growth were done by Oliner and Sichel (2001) on a global level, followed by a series of studies by authors Jorgenson and Stiroh (1999) with the study of the US economy, Oulton (2001) with the study of ICT influence on the economy in the United Kingdom. The majority of authors agree with the correlation between investments into ICT and economic growth (INSEAD 2015).

For illustration, we can specify the following:

- increasing broadband penetration by 10% will increase GDP by 1.21 % in developed countries, by 1.38 % in developing countries (MTI 2016),

- ICT participate on GDP by 5 % in the USA, in the EU by 3.5 %, in Israel 17 % and in Czech Republic by 4.5 % (OECD 2017),
- The field of ICT participates on the increase of overall productivity by 20 % and 30 % by investments in ICT (UNESCO 2016),
- ICT globally account for 6 % of the global economy, 20% of the economic value of ICT come from the ICT industry, developing hardware and goods, and 80% of benefits come from using ICT (Oulton 2001).

As the area is complex with global links and under turbulent development, there are also studies indicating a neutral correlation between ICT and economic growth in some sectors (Machkova 2015). Nevertheless, it can be generally stressed that slow acceptance of new ICT innovations is the reason for the backwardness of European countries in contrast with Asia or high-tech countries like Israel. The European Commission published a document called Digital Agenda in 2015; it is one of the seven pillars of the Europe 2020 strategy (EC 2014). Digital Agenda focuses on ICT to help with economic progress and innovations as European Commission strongly recommend to focus on ICT development.

The ICT pillar concentrates on the following topics:

- achieving a digital single market,
- enhancing interoperability and standards,
- strengthening online trust and security,
- promoting fast and ultra-fast internet access for all,
- investing in research and innovation,
- promoting digital literacy, skills and inclusion,
- ICT-enabled benefits for EU society.

The European Commission targets to digital society which brings benefits from the digital single market. It is meant to be a developed and harmonised set of services working globally among EU citizens such as E-government, E-health, Telemedicine, Smart-cities, etc.

2 Effects of subsidies & ICT innovations

Focusing closer on ICT and innovation, we would find also currently quite common practice in OECD countries as is widely used some kind of public intervention or subsidies. The Czech Republic government usually provides certain services to entrepreneurs of different types: advice, training, law support, financial subsidies. Although public support through the different intervention programs is widely used, most of the authors researching this did not find a common consensus on intervention effectivity regarding innovations. Therefore, whether those interventions are effective and are adding overall productivity to the economy or pushing a higher innovative environment is the next part of this work with a focus on the ICT area.

If we look to some other studies, we can find as one of the conclusions studies that were done by authors Catozzella and Vivarelli (2011). They used firm-level data drawn from the third Italian Community Innovation Survey (CIS 3) over the period of 1998-2000 with focusing on the sample of 7,965 firms. The results of the subsidy effect on innovation activity were negative.

“Despite it being current common practice to publicly support innovation, government intervention actually appears to induce higher expenses, while the efficiency associated with

such innovative expenditures is affected negatively, at least as far as product innovations are concerned.” (Catozzella and Vivarelli 2011). To broaden the theoretical conclusion, we can find the following positive and also negative results of studies:

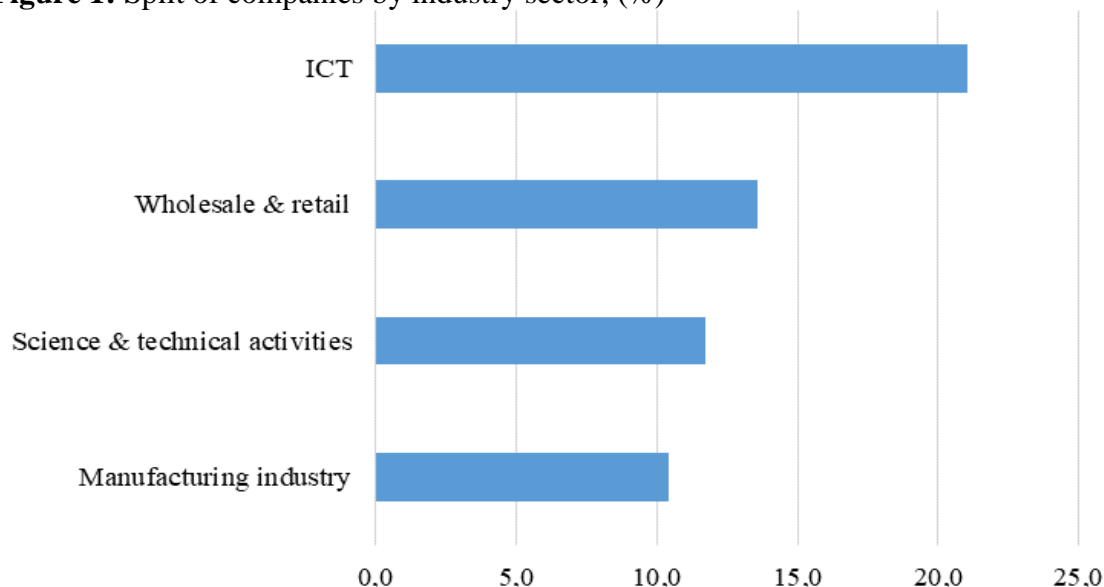
- R&D tax credits to have no impact on patenting activity and the introduction of new products by beneficiary firms in Norway (Cappelen et al. 2012),
- R&D grants completely crowd out firm-financed R&D spending (Wallsten 2000)
- no direct effect of government intervention on innovative turnover once the indirect effect of a higher level of R&D expenditures has been accounted for (Czarnitzki and Licht 2006)
- procuring R&D subsidies had a significant impact on the number of patents, more significantly in the case of smaller firms (Bronzini and Piselli 2012),
- another study from Germany found that subsidies for individual research do not have a statistically significant impact on R&D and patenting, but the innovative performance could be improved by additional incentives for collaboration (Garcia and Mohnen 2010).

2.1 Empirical results

Subsidies and public grants are widely used in the EU for different parts of the economy such as agriculture or the manufacturing industry. To obtain closer and detailed data, this work was developed based on information received from 257 companies located in the Czech Republic. The dataset consists of the set of general information (industry field, size, age) as well as the set of data with the innovative background (reason for innovation, the result of innovation, cooperation with universities, access and use of public funding, etc.). The purpose of this work was to find out information about effectiveness of the subsidy system for innovative companies with a focus on the field of ICT. The important part of the work was to find out how many companies are involved in the subsidy and public support system, their industry field, what their experiences are and what could be changed based on their experiences. Information about the size of companies and industry fields is presented first.

Figure 1 shows four the most frequent industries in the research. The biggest group were ICT enterprises represent by 21 %. The second most frequent group were wholesale and retail enterprises with participation of 13.6 %. The third most frequent type of enterprises were science and technical activities with 11.7 % and the fourth group were enterprises from manufacturing industry with 10.4 %.

Figure 1: Split of companies by industry sector, (%)



Source: Own elaboration

Table 1 gives us information about the ratio of subsidy demand and receiving subsidy sorted by the size of companies. More than 50 % of receiving subsidies is based in the medium and large enterprise segment. In the segment of large enterprises is the total percentage of entrepreneurs that received subsidy 75.4 %. On the other side of the table are micro-enterprises with considerably lower support for their innovation activity: 29 %. The ratio is a bit higher in the segment of small enterprises: 38.6 %. Another piece of important information acquired by research is the ratio of enterprises that were not interested in obtaining any public support. Micro-enterprises make up the highest number in this segment: 51.6 %. The small enterprise segment is also represented in this category by a high result: 43.9 %. The opposite situation is in the segment of medium and large enterprises, which are represented in this category by 19.2 % and 15%, respectively. Although this part of the research shows the high number of subsidy use, on the other hand, there is also the considerably low use of subsidies in the segment of micro and small enterprises.

Table 1: Received subsidies by size of enterprises, (%)

	Micro-enterprises	Small enterprises	Medium enterprises	Large enterprises
Did not attempt to gain a subsidy	51.6	43.9	19.2	15.0
Applied but did not receive the subsidy	19.4	17.5	14.3	9.6
The subsidy received and it partly helped to innovate	25.6	27.3	48.9	60.7
The subsidy was the main reason for innovation	3.4	11.3	17.6	14.7

Source: Own elaboration

Table 2 describes information about the percentage of receiving subsidy split by industry field. Moreover, this table expands information gained in Table 1. To this table were chosen 4 the most often fields from research organised downwardly. In the table, we can see a high percentage of companies from the ICT field that did not apply for subsidies (32.2 %) and also a high percentage of refused subsidy applications (20.4 %). Also, subsidies or other support in this sector were not the reason for creation of innovation but only a medium for support. Subsidies helped partially in 37.8 % of cases and only in 9.6 % of cases were the main reason of innovative behaviour of companies. This result could also be supported by the hypothesis that ICT companies are very often creators of innovative solutions and their entrepreneurship is based on it. Conversely, the manufacturing industry – including those that manufacture agriculture products like bakeries or meat-processing plants – are at the other end of the table. In the manufacturing segment, 10.9 % of companies did not attempt to gain a subsidy and only 5.2 % were not successful in acquiring subsidies. The overall portion of manufacturing companies that received any kind of support was 83.9 %. This result gives us a good idea of differences in the support of one the most innovative segments as ICT industry compare to traditional industry sector as manufacturing industry.

Table 2: Received subsidies by type of enterprise, (%)

	ICT	Wholesale & retail	Science & technical activities	Manufacturing industry
Did not attempt to gain a subsidy	32.2	38.9	40.6	10.9
Applied but did not received subsidy	20.4	17.3	14.7	5.2
Subsidy received and it partly help to innovate	37.8	30.7	27.5	43.0
Subsidy was the main reason of innovation	9.6	13.1	17.2	40.9

Source: Own elaboration

In table 3 are stated the results of research which also represent valuable information about a perceiving of public subsidies sorted by the most often industry field research. Generally are the public subsidies seen for the most of companies as a not sufficient. The worst is seen the process of support consider by the companies from the segment of information and communication technologies (11.3 %). On the opposite site is manufacturing segment with the share of 22.9 %. Problem with size of the financial support is seen with less than one quarter of entrepreneurs, the most in the sector of professional, scientific and technical activities (26.9 %). Contrariwise overall companies see the difficulties in administration process. The highest from the researched companies in the area of information and communication technologies (62.8 %). Another category which the entrepreneurs saw as malfunctioning is the system of sharing information about available subsidies. In this category, more than one-third of the entrepreneurs consider the system of public support as inefficient. Again are the most dissatisfied entrepreneurs from the segment of ICT with ratio 43.6 % of not satisfied entrepreneurs. The highest differences come from the overall perception of subsidy system where 78.5 % of ICT entrepreneurs did not see support as sufficient compared to 26.9 % of entrepreneurs from the manufacturing industry. This difference could be explained that the most of the companies from manufacturing industry received some kind of public support or at least have some positive experiences with it.

Table 3: Opinions on subsidy systems by type of enterprises, (%)

	ICT	Wholesale & retail	Science & technical activities	Manufacturing industry
Subsidy system is set up correctly	11.3	15.6	12.0	22.9
Increase financial support	21.4	25.3	26.9	15.5
Simplify administration processes	62.8	47.7	56.3	51.2
Increase information about subsidy system	43.6	38.2	36.5	34.2
Change system and increase support of innovative entrepreneurs	78.5	44.3	60.4	26.9

Source: Own elaboration

The most important part of the research was the creation of correlation analysis between variables of final innovation results and obtaining public support.

There are different types of questions used in the research: dichotomy (yes-no), alternative (choose one or a few options). Question coding was done using dichotomy values, when 0 stands for “no” and 1 stands for “yes”.

Retrieved answers were enlist to the table. After table creation, variable names and text values were added. Pivot tables with adjusted data were created in MS EXCEL and afterwards the pivot tables were uploaded to the PQSTAT statistic program.

After examine the final data, these coefficients were choose for testing (Bergsma et al. 2013):

Pearson correlation coefficient

$$P = \sqrt{\frac{\chi^2}{n + \chi^2}} \quad (1)$$

χ^2 derived from Pearson's chi-squared test
 n grand total of observations

With values $0 \leq P < 1$, where value 1 can never be reached.

Cramer correlation coefficient

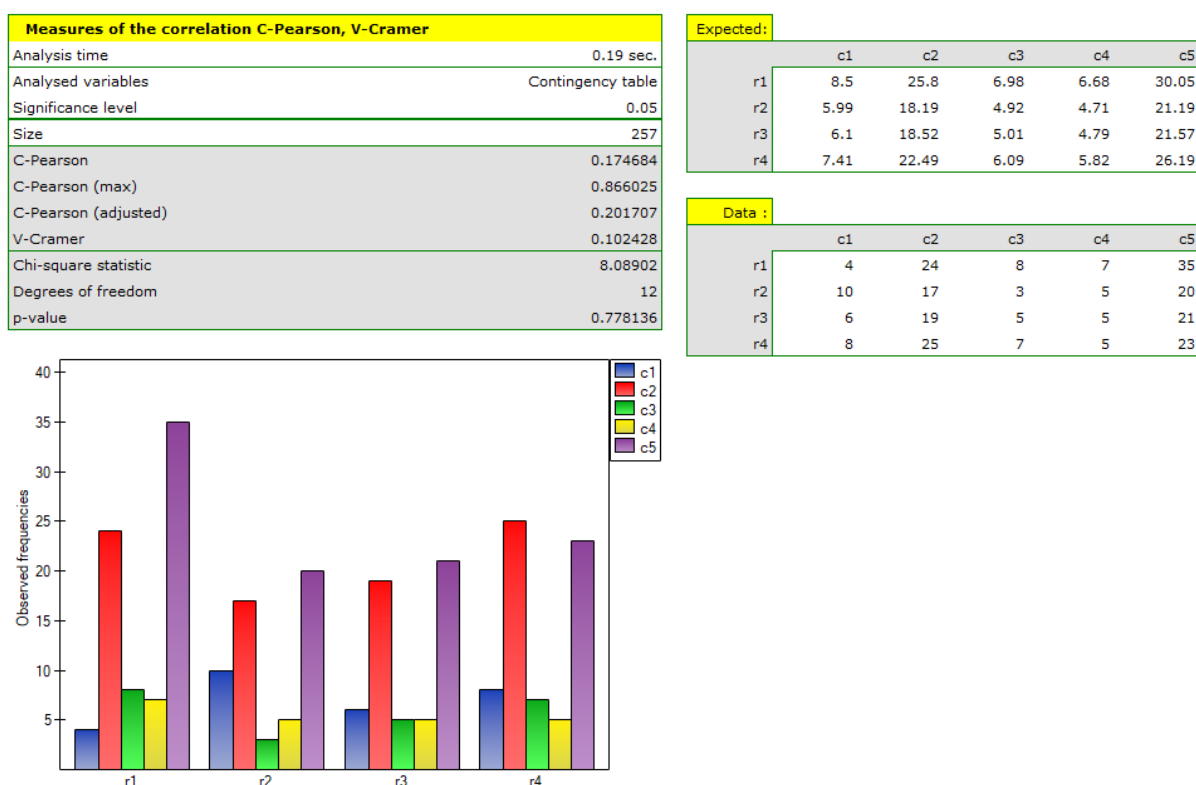
$$C = \sqrt{\frac{\chi^2}{n \cdot \min \{(r-1)(s-1)\}}} \quad (2)$$

χ^2 derived from Pearson's chi-squared test
 n grand total of observations
 r number of rows
 s number of columns

With values $0 \leq C \leq 1$, the aspect $\min \{(r-1)(s-1)\}$ gives the lower number from numbers, which are generated by lowering number of rows, respectively columns, by 1.

As null hypothesis was determined $H_0: P = 0$ (i.e. correlation does not exist between results of innovation and receiving public subsidies). The alternative hypothesis was set up as $H_1: P > 0$ (i.e. correlation exists between results of innovation and receiving public subsidies). The significance level was chosen at 5%, i.e. $\alpha = 0.05$. The result of analysis $p = 0.7781$ by the relation of $\alpha < p$, i.e. we do not reject hypothesis H_0 and so we can declare correlation with the large number of tested data as weak. It can tentatively refer to the weak impact of public support on entrepreneurs' innovation effectivity which can be a case of the type of entrepreneurs tested. Also, the lower innovation efficiency of subsidies may be characterised by externally-funded innovation expenditures. Research findings and results comply with other studies and evidence emphasised in section 2.1.

Table 4: Correlation analysis of innovation results and public subsidies



Source: Own elaboration by program PQStat

Conclusion

Information and communication technologies are an instrument that can bring new and effective ways and solutions to the economy and social environment. Their support on a national level through the sustainability of a correct business atmosphere with the proper legal environment, supporting public research and development, subsidising ideas of new entrepreneurs and start-ups is the proper way of creating and increasing national wealth.

Goals of the work defined in the beginning of the article were fulfilled. Based on facts of the work were defined relations among economic growth and ICT development with the major focus on innovation environment. In the second part of the work were successfully detected the current views of entrepreneurs on the system of subsidies with accent on ICT companies.

The dataset consists of more than 21 % of ICT companies which in more than 50 % of cases did not apply for subsidy or their request for subsidy was rejected and, moreover, it is expected that they would try to innovate without external support. But this is a special case of ICT companies, it is not applicable to the whole micro and small entrepreneurs segment. Also, 40.9 % of companies from the manufacturing industry stated subsidies as the main reason for innovation and it is expected that they would not innovate without public subsidy support. Two variables were examined to find a correlation among them: receiving a subsidy as one variable and innovation results as the second. Results refer to the weak impact of public support of entrepreneurs' innovative effectivity which can be partly a case of the type of entrepreneurs tested. Also, lower innovation efficiency may be characterised by externally-funded innovation expenditures of some types of companies. There is also the question if subsidies have an effect on true innovations or it is just perceiving of firms which think that they innovate because of receiving subsidy.

The Czech Republic can improve economic growth instead of supporting new investments of companies producing low added value goods and subsidise traditional industries by supporting different types of public R&D subsidies and new innovative start-ups to become a high-tech country. We demonstrated subsidy structure and areas that could be improved and which are specific and related to the geopolitical situation. At the beginning of conclusion, a part of the article asked why results and directions from this work could be important. It is also necessary to point out that for the topic of this width and complexity, it is necessary to significantly extend the work with additional insights to cover more interactions which co-exist together and form the entire economic environment.

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