Relation between Investment and Gross Value Added in ICT Sector

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Abstract

Information and communication technologies (ICT) have become the important drivers for socioeconomic development in recent years. This article presents an empirical analysis of gross value added (GVA) levels determinants in ICT sector in Slovakia. The analysis is based on panel data covering the period 2001–2010 and using regional data at NUTS3 level. Our results suggest that the level of regional GVA in the ICT sector is positively affected by the level of investment (which are proxied by the amount of loans) in the ICT sector. A 1% increase in the level of investment into ICT leads to increase in the level of regional GVA in the ICT sector by 0.42%.

Key words: gross value added, investments, loans, ICT, panel data

JEL Classification: C51, L20

1 Introduction

A country`s economy is the result of a set of processes that can be connected or otherwise functionally linked. For the understanding and exploring of the economy as a whole, it is necessary to understand and also examine its individual components. There are many determinants that affect its functioning, growth or recession. It's certain that information and communication technologies (ICT) are important in the structure of a country´s economy as well as the impact of level of establishment of the ICT in country and economic growth (Kim, Kang, Sanders, Lee, 2008; Welfens, Perret, 2013; Khuong, 2013; Miygawa, Yukito, Nobuyuki, 2004). These authors confirmed positive correlation/dependence between economic growth of the country and a level of establishment of the ICT in the country. The ICT sector in the economy operates as an independent sector but ICT also forms a significant part of almost all other sectors and public sector. With growing innovations and the connectivity of the ICT sector, support in other sectors is growing as well. Those sectors are unable to work without the support of IT technology. The most complete index for measuring ICT sectors in various countries is *The Networked Readiness Index* published by *The World Economic Forum*. In the ranking of countries, is Slovakia according to this index on the 59th place. The other countries of V4 (Visegrad countries) Czech Republic, Hungary and Poland are in 42th 47th and 49th place.

Within this index there are several sub-indexes. In the subi-ndexess, the Government Usage in Slovakia is in the 106th place - for comparison, South Africa is in the 103th place (*The Networked Readiness Index*, Report 2014). Authors of the listed studies examined the impact of the level of ICT on economic growth. In this paper we focus on the sector of the economy representing ICT sector, thus sector J according to the SK-NACE statistical classification of economic activities. Companies involved in this sector „produce ICT output“. In understanding the above-mentioned authors and their research, the ICT sector in Slovakia is rapidly taking hold as evidenced by the continuous growth of companies operating in this sector – in 2001 it was 1,091 firms and in 2010 already 5845 companies.

2 Hypothesis

In this paper, we focus on the link between the investments in companies operating in the ICT sector and the growth of the industry through the Gross Value Added (GVA) indicator at the regional level. We can establish the following hypothesis:

H: There is a demonstrable link between the level of regional gross added value in the ICT sector and the investments in the enterprises in the ICT sector

By verifying or refuting the hypothesis, we make another step in the chain of investigations of the dependence between ICT and economic growth. According to the studies mentioned above, there is demonstrable relation between the level of ICT in economy and economic growth. We assume, that the level of ICT in economy is related to the amount of value added in the enterprises in the ICT sector.

In this paper, we will be interested in the impact of investments in the enterprises on the total sector output represented by GVA. Investments are generally considered to be a catalyst for growth and development. Investments will be represented by different sector ratios that are closely related to investments and are well interpretable.

3 Estimation Method and Model Specification

Based on the basic panel data regression model according to Greene (2003), the model is:

$$y_{it} = \beta_1 x_{it1} + \beta_2 x_{it2} + \cdots + \beta_k x_{itk} + \alpha_1 z_{i1} + \alpha_2 z_{i2} + ... + \alpha_q z_{iq} + u_{it}, \qquad (1)$$

where the index *i* denotes the cross-sectional dimension *i=1, … n* the index t time dimension *t=1, …, T* the variables $x_1, x_2, ..., x_k$ are the independent variables that do not include the vector unit and the variables $z_1, z_2, ..., z_k$ are the individual effects, i.e. the diversity that distinguishes an individual, respectively group from other entities. Individual effects are changing over time.

We are using standard methodology for estimating regression models for longitudinal data. To estimate the plm standard package model (Croissant, Millo, 2008) in R software (R Core Team, 2014) is used. Estimated model is tested for assumptions and standards that are imposed on this type of model. We are using Chow`s poolability test for testing the poolability (testing if panel data structure is necessary), also testing individual and time effects via Breusch and Pagan, Honda tests. Testing the cross-sectional correlation via Peasaran test, the serial correlation using Breusch-Godfrey and Wooldridge tests. Also Maddala-Wu stationarity test and heteroscedasticity testing via Breusch-Pagan test (Baltagi, 2005). In many cases, the serial correlation, heteroscedasticity and cross-sectional correlation occurs in econometric models based on panel data structure. It causes distorted estimate of the standard deviations of the estimated coefficients and we can come to incorrect results and conclusions regarding the significance of regression coefficients. For these reasons, it is recommended to use a robust variance-covariance matrix (Croissant, Millo, 2008).

Model Specification

$$\log(GVA) = \alpha + \beta_1 \log(LOA) + \beta_2 RAT1 + \beta_3 RAT2 + \beta_4 RAT3 + \beta_5 RAT4 + u_t$$

where

GVA – gross value added

LOA – loans

RAT1 – ratio of labor cost/ revenues

RAT2 – ratio of depreciation/total assets

RAT3 – ratio of loans/non-current assets

RAT4 – ratio of loans/value added

Data and Model Variables

Data are drawn from two sources. The first is Eurostat database, where we get data of GVA for each region (NUTS 3) and sector J of the SK-NACE statistical classification of economic activities (in the area of information and communication).

The second source is anonymised data from the financial statements of enterprises operating in this sector provided by the Financial Administration od Slovak Republic for research purposes.

Used data include the period 2001-2010 and are classified on the NUTS 3 regional level.

Dependent Variable

As an indicator of economic growth, we chose the GVA – Gross Value Added - indicator. Gross Value Added can be defined as “that part of the units output which is newly created by its activities”. This indicator includes the value of gross production (gross output) minus the intermediate consumption, provided that both indicators are valued at the same prices. Figure 1 shows the progress of GVA in Slovakia. Figure 1 shows regional disparities in the formation of GVA in 2010. Because of high variability and high values for this variable we will use the +logarithmic values in further analysis.

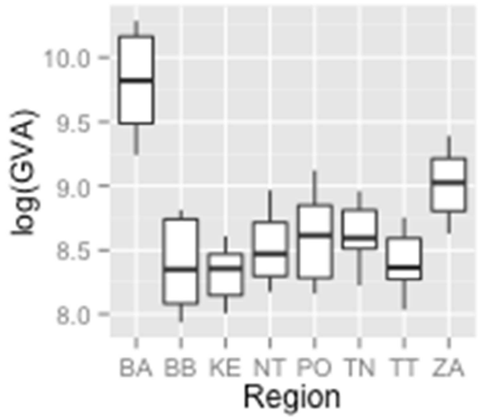

Fig. 1 Regional disparities in the formation of GVA in 2010. Own construction.

Independent Variables

Loans

The first independent variable in the model is the aggregate value of loans (short-term + long-term loans). Loans are closely related to investments, respectively, with financing investments in enterprises and can be used as a measure of foreign capital in the business.

Figure 2 shows the correlation between dependent variable GVA and amount of loans for each year of observation (both logarithmic).

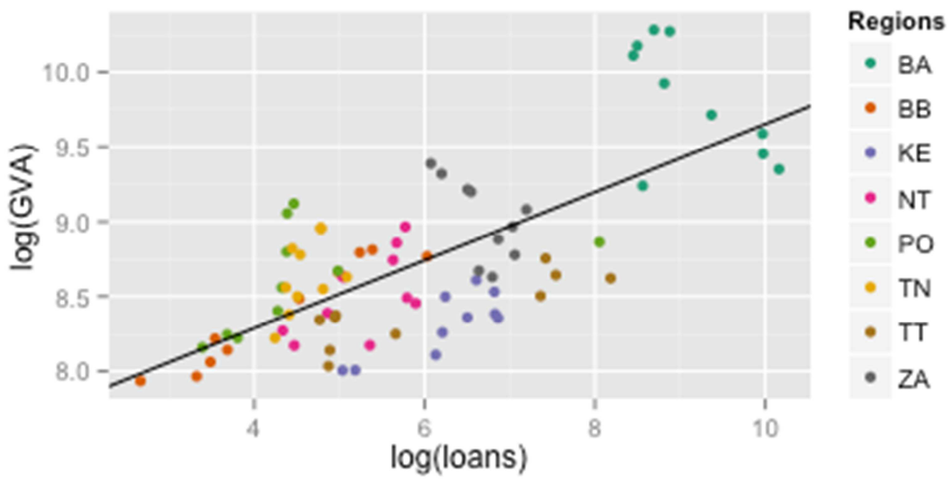

Fig. 2 Correlation between GVA and amount of loans for each year. Own construction

Ratio of Depreciation and Total Assests

Depreciation is related to the level of investment in enterprises. Firms can depreciate every tangible and intangible asset that has a value of more than € 1,700 and the useful life longer than one year (vehicles, buildings, software licenses etc.). Changes in this ratio represent the changes in the level of investment in enterprises.

Ratio of Labour Cost and Revenues

This ratio represents wage costs – in general, if the value of this ratio is growing (an increase in the wage level without an increase in revenues), there are two options:

1. the employment of experts, whose value in the labour market is high (high wage)
2. increasing the number of employees – a higher level and quality of services

Ratio of Loans and Non-current Assets

This ratio indicator gives to value the ratio with a value of fixed assests (which represents the tangible and intangible investments in the company) and represents the level of funding these assets through loans.

Ratio of Loans and Value Added

This ratio represents the profitability of loans.

3 Estimation Method and Model Specification

Model Estimate

Tab. 1 Model Estimate

Variable	Estimate	Std. Error	t-value	Pr(>|t|)	
log(LOA)	0.4108	0.0369	11.1254	< 0.00001	***
RAT1	1.2787	0.4107	3.1136	0.0027	**
RAT2	-5.4496	1.1912	-4.5749	< 0.00001	***
RAT3	-0.9560	0.1299	-7.3612	< 0.00001	***
RAT4	-0.4000	0.0718	-5.5698	< 0.00001	***
F-statistic: F=26.1068, p-value=1.57e-14			R-Squared=0.66082		

Assumption Verification

Tab. 2 Assumption Verification

	statistic	p-value
Individual or Time Effects		
F-test for individual effects	*2.0774*	*1.351e-15*
LM Test – time effects (-Honda)	*normal = 9.4916*	*<2.2e-16*
Serial Correlation		
Wooldridge's test for unobserved individual effects	*z = 1.4287*	*0.1531*
Breusch-Godfrey/Wooldridge test for serial correlation in panel models	*chisq = 45.6263*	*1.676e-06*
Wooldridge's test for serial correlation in FE panels	*chisq = 24.2432*	*8.491e-07*
Cross-sectional Correlation		

Pesaran CD test for cross-sectional dependence in panels	*z = 2.951*	*0.003167*
Stationarity		
Maddala-Wu Unit-Root Test		*< 2.2e-16*
Heteroscedasticity		
Studentized Breusch-Pagan test	*20.4299*	*0.001038*

In Tab.2, where are the results of diagnostic tests of the model, we can see that several assumptions are violated (the cross-sectional correlation, serial correlation and heteroscedasticity). Annotated results justify the use of a robust variance-covariance matrix.

The interpretation of the regression coefficients should be based on the results of estimation of the robust variance-covariance matrix:

Tab. 3 Robust Variance-Covariance Matrix

Variable	Estimate	Std. Error	t-value	Pr(>|t|)	
log(LOA)	0.41078	0.046818	8.4100	9.724e-13	***
RAT1	1.27868	0.605609	2.1114	0.038471	*
RAT2	-5.4960	1.360024	-4.0070	0.000157	***
RAT3	-0.95601	0.139989	-6.8291	3.059e-09	***
RAT4	-0.40009	0.065536	-6.1049	5.823e-08	***

The multicollinearity test involves the use of VIF – Variance Inflation Factor, which reflects an increase in variability of the regression coefficients caused by multicollinearity (Fox, Weisberg, 2011). Level of multicollinearity is normal (Belsley et al. 2004).

Poolability Test: Chow Test

F stability test (Chow test) for the coefficients of the panel P – the value is less than the significance level of 0.05, so we can lean toward the alternative hypothesis H1 and consider the panel data structure (F = 6.5859, p-value = 2.697e-07)

Model Results

The hypothesis H we have managed to verify and therefore it can be argued that there is a demonstrable link between the level of regional gross value added in the ICT sector and ICT investments in enterprises sector. We confirmed the hypothesis proving the significance of the model as a whole (F - test – p - value = 1.5742 E - 14). The verification of hypotheses also with the coefficient of determination at 0.66, which tells about a high quality model (because it is a longitudinal data as warranted; in this case the considered values > 0.30). The verification tests with subsequent the final model coefficients via a robust variance-covariance matrix, we came in addition to verified hypotheses and to several other conclusions arising from the very nature of variables in the model specification.

The value of the regression coefficient for the variable log (LOA) 0.41 demonstrates the positive impact of the explanatory variable to GVA and knowledge that could be interpreted as 1% change in the level of loans in the ICT sector which will cause a positive change in the value of

GVA by 0.41%. Investments (amount of loans) in this sector have a positive impact on the gross value added in the sector.

Another interesting finding is the finding related to ratio RAT1, which represents the ratio of personnel costs to revenues. As was already mentioned - increasing the value of this ratio is improving the quality of outputs, respectively increases in wages and employment in this sector. This increase has on the basis of our examination positive impacts in terms of GVA - the increase in the ratio of 1 increases the production of GVA by 1.27%. The growth of this ratio can be achieved not only by increasing wage demands, respectively wage increases or expansion of jobs. This ratio can grow even if revenues are reduced and the level of personnel costs is preserved. A positive indication of such a change can be the stability and guarantee of jobs during the recession.

Ratio RAT3 represents part of the loans invested in fixed assets (tangible and intangible assets - such as real investments - licenses, software, real estate, etc.). If this ratio increases by 1, the indicator of GVA decreases by 0.95%. This ratio increases when increasing the level of loans, while the value of non-current assets is not changing. Thus, the firm draws on the loan but does not use it for investment but for other purposes (e.g. operating costs, paying taxes, etc.). This is a bad signal - it was also reflected negatively on the value of the variable GVA.
RAT4 represents the ratio of loans and added value. The growth of this ratio is sending bad signal to the company. From the output of variance - covariance matrix and the estimates of individual coefficients we can see the negative impact on the variable GVA in case of the growth of this ratio.

4 Conclusion

The findings besides verified hypotheses showed the positive impact of investment for the creation of GVA, while increasing the level of loans in companies by 1 % will cause a 0.46 % increase in the value of GVA. However, it is necessary to look at the model as a whole - here, among others we can read that these loans must be used to invest in the company and may not be used for compensation of the operating costs of the company, otherwise the opposite effect appears.

ICT industry is built on quality and skilled labour. Increasing labour cost per employee also has a positive impact on gross value added. Since this is one of the indicators, which suggests good management of businesses.

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