https://doi.org/10.22364/hssl.29.2.03

KNOWLEDGE INTENSIVE BUSINESS SECTOR IN LATVIAN NATIONAL ECONOMY: RANDOM EFFECT FACTOR OUTLOOK

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Abstract

Global experience shows that sustainable economic development takes place in countries with economies focused on the creation and intensive use of knowledge. Entrepreneurs are interested in investing in knowledge, using obtained findings in the company's development.

Investment knowledge strengthens company's market position, thus increasing the probability of successful implementation of its new products and services. Based on the general idea of tailor-made mix of content, structure, and functioning mechanism of market relations, it can be stated that knowledge is necessary for market participants in order to reach broader market share, take business advantage from innovations, increase competitiveness and uptake new markets, as well as ensure higher satisfaction regarding both goods and services for their customers.

Investing in large-scale research projects enables opportunity to accumulate knowledge is a power for large corporations, which further determines their dominance in the global market. However, knowledge in terms of disruptive services is still more important among owners and managers of small and medium-sized enterprises (SMEs). The expansion of knowledge in the medium and especially in the small business environment promoted the emergence of a specific business niche known as the knowledge intensive business. The knowledge-based economy is gradually "displacing" the resource-based economy, stimulating entrepreneurs to put more focus on the use of information resources as a feature of the knowledge-intensive economy, thus pacing overall growth dynamics of segment.

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This article focuses on the identification and analysis of factors affecting the knowledge intensive business development business sector in Latvian national economy with random effects regression model. Random effects regression was used since it best suited for panel data. Compiled available repeated observations on the same units allowing to enrich the model by inserting an additional term in the regression, capturing individual-specific, time-invariant factors affecting the dependent variable.

Keywords: Latvia, knowledge intensive business, national economy, innovations.

Introduction

The idea of a knowledge-based economy is not simply a description of high-tech industries. It describes a range of new sources with competitive advantage that can be applied in all sectors, in all companies and in all regions, from agriculture and retail to software and biotechnology (Leadbeater et al., 1999). Economic success is increasingly based on the efficient use of intangible assets, namely knowledge, skills, and innovative potential. The term "knowledge economy" is used to describe this emerging economic structure. The knowledge society as a concept is more than just an increased focus on research and development. It covers every aspect of today's economy, where knowledge is at the heart of added value, from high-tech manufacturing and ICT, through knowledge-intensive services to highly creative industries such as media and architecture (Kok et al., 2004). Some experts believe that the emergence of a knowledge-based economy is a major shift, a "new economy" that offers endless productivity gains, faster non-inflationary growth, and continued growth in securities markets. It has been argued that the ICT revolution has enabled companies to take advantage of scientific and technical knowledge bases, giving them an unprecedented competitive advantage through, for example, ever-falling transaction and recycling costs. In turn, the new knowledge economy would encourage the emergence of new organizational forms both within and between companies, as well as radical changes in employment relationships, with more and more knowledge workers becoming portfolio workers, franchisors or the self-employed. However, this view was hit by the crisis of the dot-com bubble and the failure to bring about the expected change in employment (for example, a reduction in the number of employees with more than one job). Consequently, the use of the term "new economy" is no longer "in vogue". In part, in response to all the objections, the opposite view was also expressed, which questioned the existence of the knowledge economy at all.

It is also argued that, in reality, knowledge has always driven the economy, leading to innovation and technological change, and that knowledge-based institutions have helped to preserve and share knowledge over centuries.

What is happening today is nearly the same, only on a larger scale and at a higher speed. In the economic field, there has been enough discussion about whether certain sectors are particularly knowledge-intensive. Great efforts have been made to analyse the contribution of these sectors to productivity growth (Brynjolfsson, Hitt et al., 2000). As the expansion of knowledge-intensive industries and the associated productivity gains took place in the context of the unusual macroeconomic and financial market events of the 1990s, quite a large part of the popular literature argued that there was something fundamentally different in the knowledge economy. The key components of the knowledge economy include greater reliance on intellectual capacity than on physical work or natural resources, combined with actions to integrate improvements at every stage of the production process, from R&D labs to factory premises and customer interactions. The knowledge economy is often seen and sometimes defined as the production and use of ICT based on knowledge-intensive industries and/or a high proportion of highly educated workers. Sector definitions initially focused on production and often used R&D intensity as an indicator to distinguish between high, medium, and low technology sectors. The definition has been constantly expanded to include service sectors that invest little in R&D but make intensive use of ICT technologies and/or employ a highly skilled workforce, taking advantage of technological innovation.

On the other hand, considering open market competition and free workforce flow within the EU, the issues of growth factors significantly arise for both industry and policy makers. This article analyses broad scope of factors affecting the knowledge intensive business development, highlighting necessary prerequisites for its sustainable growth in Latvian national economy.

Model description

Generalized Least Squares estimators of the parameters of such a model are more efficient (Benfratello et al., 2014) than those obtained in the simpler model neglecting these unobserved factors. The random-effects regression model is also proposed for analysis of clustered data. Unlike ordinary regression analysis of clustered data, random-effects regression models do not assume that each observation is independent but do assume that data within clusters are dependent to some degree. The degree of this dependency is estimated along with estimates of the usual model parameters, thus adjusting these effects for the dependency resulting from the clustering of the data. An analysis of a dataset in which parameters are clustered within group is used to illustrate features of random-effects regression analysis, relative to both individual-level analysis that ignores

the clustering of the data, and factor-level analysis that aggregates the individual data.

For this analysis author used available STATA version 15 software; Calculations based on equation:

$$Y_{it}=\beta_1 X_{1,it}+...+\beta_k X_{k,it}+u_{it}$$

Where Y_{it} is a dependent variable, β_1 *up — to* β_k are coefficients, $X_{k,it}$ represents independent variables and u_{it} which is an idiosyncratic error term. All RHS and LHS variables are converted into natural logarithms. A log-log model allows for easy interpretation of the effect of independent variables on the dependent variables, in terms of elasticity.

Table 1. Model description

Nr.	Dependent variable	Independent variables (regressors)	Control variables
1.	Ease of doing business	Institutional environment	GDP
2.	Innovation	Infrastructure	Population
3.	Business sophistication	Macroeconomic environment	Year dummies
4.	Labour market efficiency	Healthy workforce	Country category
5.	Technological readiness		

Source: Table made by authors based on author's datasets using custom query from available data from Doing Business, World Bank, and International Monetary Fund.

Description of the variables

Dependent variables

The ease of doing business score captures the gap between an economy's performance and a measure of best practice across the entire sample of 41 indicators for 10 Doing Business topics (the labour market regulation indicators are excluded). Calculating the ease of doing business score for each economy involves two main steps.

In the first step individual component indicators are normalized to a common unit where each of the 41 component indicators y (except for the total tax and contribution rate) is rescaled using the linear transformation (worst − y) / (worst − best). In this formulation the highest score represents the best regulatory performance on the indicator across all economies since 2005 or the third year in which data for the indicator were collected. Both the best regulatory performance and the worst regulatory performance are

established every five years based on the Doing Business data for the year in which they are established and remain at that level for the five years regardless of any changes in data in interim years. Thus, an economy may establish the best regulatory performance for an indicator even though it may not have the highest score in a subsequent year. Conversely, an economy may score higher than the best regulatory performance if the economy reforms after the best regulatory performance is set.

In the second step for calculating the ease of doing business score, the scores obtained for individual indicators for each economy are aggregated through simple averaging into one score, first or each topic and then across all 10 topics: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts and resolving insolvency. More complex aggregation methods – such as principal components and unobserved components – yield a ranking nearly identical to the simple average used by Doing Business. Thus, Doing Business uses the simplest method: weighting all topics equally and, within each topic, giving equal weight to each of the topic components. An economy's score is indicated on a scale from 0 to 100, where 0 represents the worst regulatory performance and 100 the best regulatory performance. All score calculations are based on a maximum of five decimals. However, topic ranking calculations and the ease of doing business ranking calculations are based on two decimals.

Innovation is particularly important for economies as they approach the frontiers of knowledge, and the possibility of generating more value by merely integrating and adapting exogenous technologies tends to disappear. In these economies, firms must design and develop cutting-edge products and processes to maintain a competitive edge and move toward even higher value-added activities. This progression requires an environment that is conducive to innovative activity and supported by both the public and the private sectors. In particular, it means sufficient investment in research and development (R&D), especially by the private sector; the presence of high-quality scientific research institutions that can generate the basic knowledge needed to build the new technologies; extensive collaboration in research and technological developments between universities and industry; and the protection of intellectual property.

Business sophistication concerns two elements that are intricately linked: the quality of a country's overall business networks and the quality of individual firms' operations and strategies. These factors are especially important for countries at an advanced stage of development when, to a large extent, the more basic sources of productivity improvements have been exhausted. The quality of a country's business networks and supporting industries, as measured by the quantity and

quality of local suppliers and the extent of their interaction, is important for a variety of reasons. When companies and suppliers from a particular sector are interconnected in geographically proximate groups, called clusters, efficiency is heightened, greater opportunities for innovation in processes and products are created, and barriers to entry for new firms are reduced.

The efficiency and flexibility of the labour market are critical for ensuring that workers are allocated to their most effective use in the economy and provided with incentives to give their best effort in their jobs. Labour markets must therefore have the flexibility to shift workers from one economic activity to another rapidly and at low cost, and to allow for wage fluctuations without much social disruption. Efficient labour markets must also ensure clear strong incentives for employees and promote meritocracy at the workplace, and they must provide equity in the business environment between women and men. Taken together these factors have a positive effect on worker performance and the attractiveness of the country for talent, two aspects of the labour market that are growing more important as talent shortages loom on the horizon.

The technological readiness measures the agility with which an economy adopts existing technologies to enhance the productivity of its industries, with specific emphasis on its capacity to fully leverage information and communication technologies (ICTs) in daily activities and production processes for increased efficiency and enabling innovation for competitiveness. Whether the technology used has or has not been developed within national borders is irrelevant for its ability to enhance productivity. The central point is that the firms operating in the country need to have access to advanced products and blueprints and the ability to absorb and use them. Among the main sources of foreign technology, foreign direct investment (FDI) often plays a key role, especially for countries at a less advanced stage of technological development.

Independent variables (regressors)

The institutional environment of a country depends on the efficiency and the behaviour of both public and private stakeholders. The legal and administrative framework within which individuals, firms, and governments interact determines the quality of the public institutions of a country and has a strong bearing on competitiveness and growth. It influences investment decisions and the organization of production and plays a key role in the ways in which societies distribute the benefits and bear the costs of development strategies and policies. Good

private institutions are also important for the sound and sustainable development of an economy. The 2007–08 global financial crisis, along with numerous corporate scandals, has highlighted the relevance of accounting and reporting standards and transparency for preventing fraud and mismanagement, ensuring good governance, and maintaining investor and consumer confidence.

Extensive and efficient infrastructure is critical for ensuring the effective functioning of the economy. Effective modes of transport-including high-quality roads, railroads, ports, and air transport-enable entrepreneurs to get their goods and services to market in a secure and timely manner and facilitate the movement of workers to the most suitable jobs. Economies also depend on electricity supplies that are free from interruptions and shortages so that businesses and factories can work unimpeded. Finally, a solid and extensive telecommunications network allows for a rapid and free flow of information, which increases overall economic efficiency by helping to ensure that businesses can communicate and decisions are made by economic actors taking into account all available relevant information.

The stability of the macroeconomic environment is important for business and, therefore, is significant for the overall competitiveness of a country. Although it is certainly true that macroeconomic stability alone cannot increase the productivity of a nation, it is also recognized that macroeconomic disarray harms the economy, as we have seen in recent years, conspicuously in the European context. The government cannot provide services efficiently if it has to make high-interest payments on its past debts. Running fiscal deficits limits the government's future ability to react to business cycles. Firms cannot operate efficiently when inflation rates are out of hand. In sum, the economy cannot grow in a sustainable manner unless the macro environment is stable.

A health and primary education (healthy workforce) are vital to a country's competitiveness and productivity. Workers who are ill cannot function to their potential and will be less productive. Poor health leads to significant costs to business, as sick workers are often absent or operate at lower levels of efficiency. Investment in the provision of health services is thus critical for clear economic, as well as moral, considerations. In addition to health, this pillar takes into account the quantity and quality of the basic education received by the population, which is fundamental in today's economy. Basic education increases the efficiency of each individual worker.

Control variables includes GDP, Population, Year dummies and categories of countries by income level and geographical location.

Countries are divided into 6 groups based both on income level and geographical location:

Table 2. Country Groups

Nr.	Geographical scope	Countries	Level of income
1	Baltic states	Latvia, Lithuania, Estonia	High-income
2	Scandinavian countries	Finland, Denmark, Sweden	High-income
3	Western Europe	Germany, France, United Kingdom	High-income
4	World, high-income	United States, Japan, Israel	High-income
5	World, upper-middle income	Brazil, China	Upper-middle income
6	Europe, lower-middle income	Armenia, Ukraine	Lower-middle income

Source: Table made by authors based on World Bank data.

Values are based upon GDP in national currency converted to U.S. dollars using market exchange rates (yearly average). Exchange rate projections are provided by country economists for the group of other emerging market and developing countries.

Descriptive statistics

In order to summarize data and provide general overview author provides table describing the relationship between variables below. Descriptive statistics include number of observations, standard deviation, mean as well as minimal and maximum values for each variable.

Table 3. Descriptive statistics

Variable	Number of observations	Mean	Standard deviation	Min	Max
Ease of doing business	112	74.6804	9.3368	40.8	84.7
Innovation	176	4.4954	1.0100	2.6322	5.8381
Business sophistication	176	4.8528	0.7579	3.2553	5.9346
Labour market efficiency	176	4.7367	0.4239	3.6661	5.7918
Technological readiness	176	5.0497	0.9979	2.5535	6.3294

Source: Table made by authors based on author's calculations.

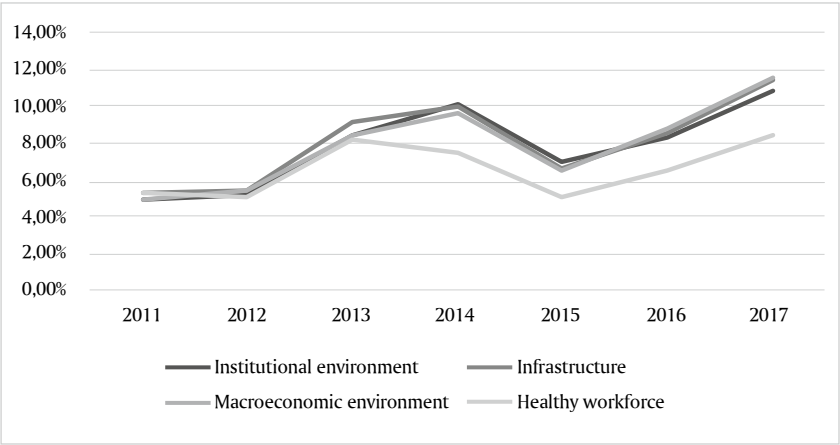
Overall number of observations used in model per each variable is not higher than number of observations provided in descriptive statistics. Ease of doing business has less observation due to the lack of data. Detailed evaluation of each variable is provided below. each section is supplied with chart visualizing changes of impacts made by regressors on variable within the set time period.

Analysis of the results

Ease of doing business

Due to the lack of data, for this variable there were 115 observations done in 15 countries divided into 6 groups.

Figure 1. Impact on Easy of Doing Business, %, 2011–2017



Source: Author's conclusion is based on author's calculations.

Based on calculations it might be concluded that the most important regressor affecting Ease of doing business is the workforce with 1.220 per cent impact. Infrastructure has 0,868 per cent impacts and institutions reaches 0.558. All three are very significant for both Baltic states as well other groups (2, 3, 4) with high income. Macroeconomics in terms of Ease of doing business is less significant with overall 0.071 per cent impact rate.

It should be noticed that all the above mentioned regressor have a negative impact in Group 5 and Group 6 on the variable, which might be explained by the influence of other regressors that are not included in this model. This observation might be evaluated within different research.

In terms of control variables, it might be observed that GDP is very significant for all the variables used, and have a negative impact with average –0.3125 point per 1% change. Despite that generally, economic growth is good for the welfare of an economy, such negative impact might be explained with Schumpeter's term 'creative destruction' (Caballero et al., 2010) which highlights how the progress brought on by economic growth could lead to a destruction of an old economic structure, in the process of creating a new one, thus growth is brought by the introduction of new technologies and creation of new firms, and these replace firms and technologies currently in existence. Population is also very significant for the Ease of doing business, but unlike the GDP, have a positive impact on all variables with average of 0.3083 point per 1% change.

There is strong relationship between the model and the dependent variable shown by R^2 value regarding both between and within variables. Within, the highest for health and primary education (0.571), and average R^2 value of 0.5195. Between, the highest for Institutions (0.809), and average R^2 value of 0.7123. Overall, there is a 0.476 variance within separate panel units and 0.859 variance between the units' model accounts for, thus, indicating a high fit for the model.

Innovations

For this variable there were 165 observations done in 15 countries divided into 6 groups.

Based on calculation it might be concluded that the most important regressor Innovation is the same as for the Ease of doing business – workforce with 0.66 per cent impact. Institutional capacity has 0.369 per cent impact and less significant macroeconomics reaches 0.066, and non-significant infrastructure regressor has only 0.049 change impact on Innovation. Workforce and Institutions are very significant for both Baltic states as well other groups (2, 3, 4) with high income.

It should be noticed that all the above mentioned regressor have a negative impact in Group 5 and Group 6 on the variable, which might be explained by the influence of other regressors that are not included in this model. This observation might be evaluated within different research.

Neither GDP nor Population have significant impact on Innovation or any of variables, still the overall impact is positive.

There is strong relationship between the model and the dependent variable shown by R^2 value regarding both between and within variables. Within, the highest for health and primary education (0.571), and average R^2 value of 0.5195. Between, the highest for Institutions (0,809), and average R^2 value of 0,7123. Thus, indicating a high fit for the model.

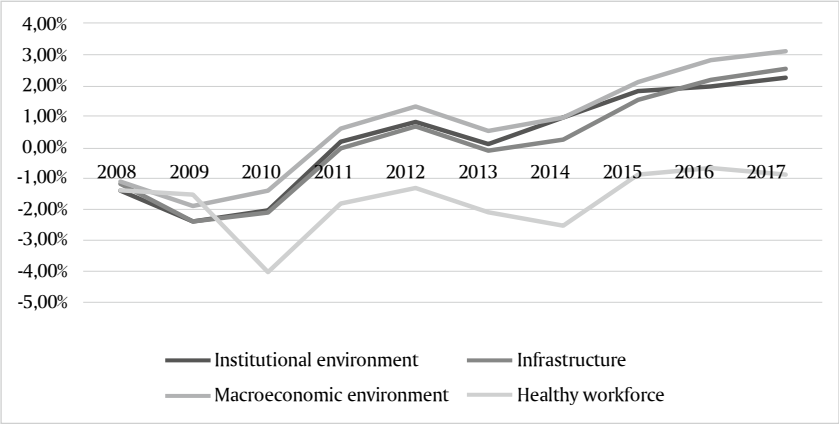


Figure 2. Impact on Innovations, %, 2008–2017

Source: Author's conclusion is based on author's calculations.

There is strong relationship between the model and the dependent variable shown by R^2 value regarding both between and within variables. Within, the highest for Institutions (0.425), and average R^2 value of 0.3618. Same situations might be evaluated in between with the highest for Institutions (0.968), and average R^2 value of 0.9623. Overall, there is a 0.496 variance within separate panel units and 0.975 variance between the units' model accounts for, thus, indicating a high fit for the model.

Business sophistication

For this variable there were 165 observations done in 15 countries divided into 6 groups.

Based on calculation it might be concluded that the most important regressor affecting Business sophistications are the workforce with 0.664 per cent impact. Institutions has 0.525 per cent impacts and infrastructure reaches 0.197. All three are very significant for both Baltic states, but have spread among other groups, e.g. Institutions are significant only for Baltic States and Group 4, other regressor has the same importance only for group 2. Macroeconomics in terms of Business sophistications is not significant for the Baltic States with overall 0.031 per cent impact rate, but has high significance for groups 2 and 4.

It should be noticed that all the above mentioned regressor have a negative impact in Group 5 and Group 6 on the variable, which might be explained by the influence of other regressors that are not included in this model. This observation might be evaluated within different research.

In terms of Business sophistication, GDP have significant to very significant (macroeconomics and health) positive impact on all the regressors with average 0.0342 point per 1% change. Unlike the GDP, Population do not provide any significant impacts regarding Business sophistication.

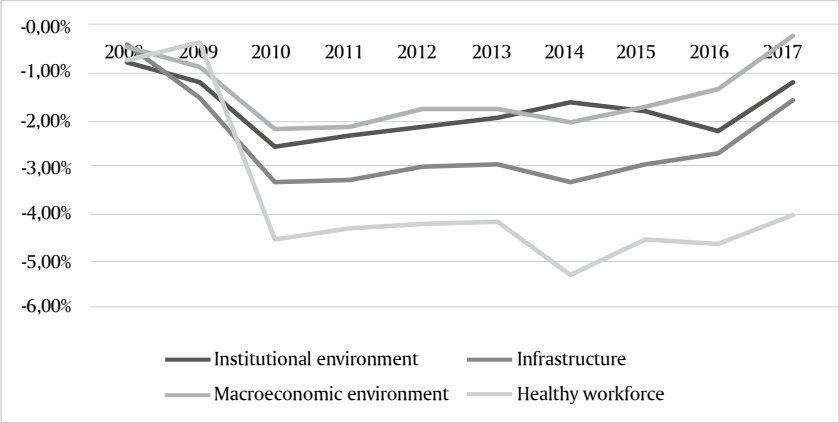


Figure 3. Impact on Business sophistication, %, 2008–2017

Source: Author's conclusion is based on author's calculations.

There is strong relationship between the model and the dependent variable shown by R^2 value regarding both between and within variables. Within, the highest for Institutions (0.538), and average R^2 value of 0.2976. In between the highest for Infrastructure (0.972), and average R^2 value of 0.9618. Overall, there is a 0.581 variance within separate panel units and 0.938 variance between the units' model accounts for, thus, indicating a high fit for the model.

Labour market efficiency

For this variable there were 165 observations done in 15 countries divided into 6 groups.

Based on calculation it might be concluded that the most important regressor affecting Labour market efficiency are the workforce with 0.293 per cent impact. Institutions has 0.195 per cent impact and macroeconomics reaches 0.166. Both Workforce and Institutions are very significant for the Baltic states group, Macroeconomics is less significant comparing to others, but still has a positive rate of 0.166. Infrastructure capacity is significant, but has a negative impact rate for all the groups.

It should be noticed that all the above mentioned regressor have a negative impact on the variable among all other groups, which might be

explained by larger labour market capacity and economies in general. This might be discussed within a specific research paper.

Neither GDP nor Population have significant impact on Labour market efficiency or any of variables, still the overall impact is positive. This might be explained with knowledge intensive business specifics as well as EU border free market.

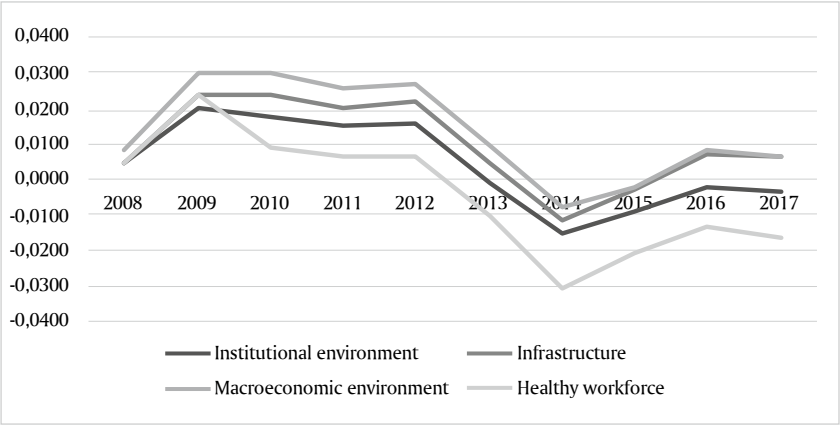


Figure 4. Impact on Labour market efficiency, %, 2008–2017

Source: Author's conclusion is based on author's calculations.

Comparing to the other dependent variable evaluation, there is slightly less strong relationship between the model and the dependent variable shown by R^2 value regarding both between and within variables. Within, the highest for Macroeconomic environment (0.283), and average R^2 value of 0.2243. In between the highest for Institutions (0.631), and average R^2 value of 0.5495. Overall, there is a 0.397 variance within separate panel units and 0.634 variance between the units' model accounts for, thus, indicating a high enough fit for the model.

Technological readiness

For this variable there were 165 observations done in 15 countries divided into 6 groups.

Based on calculation it might be concluded that the most important regressor affecting Technological readiness are the workforce with 0.644 per cent impact. Infrastructure has 0.411 per cent impact and Institutions reaches 0.293. All three indicators are very significant for the Baltic states group, but not significant for other Groups except Group 6, where whose regressors have negative impact.

Macroeconomics is less significant comparing to others, and has a negative rate of –0.01 per cent, which might be related to the amounts of co-financing from EU structural funds allocated based on economic development of the region.

It should be noticed that all the above mentioned regressor have a negative impact on the variable among all other groups, which might be explained by larger labour market capacity and economies in general. This might be discussed within specific research paper.

In terms of Technological readiness both GDP and Population have significant impact. GDP brings positive response from all of the regressor with average change of 0.051 point per 1% change, especially important for the macroeconomics (0.0602) and, health and primary education (0.0614).

Technological readiness has the highest R^2 values comparing to the other dependent variable evaluation, there is a very strong relationship between the model and the dependent variable shown by R^2 value regarding both between and within variables Within the highest for Infrastructure (0.778), and average R^2 value of 0.743. In between the highest for Macroeconomic environment (0.968), and average R^2 value of 0.5495. Overall, there is a 0.791 variance within separate panel units and 0.949 variance between the units' model accounts for, thus, indicating a high enough fit for the model.

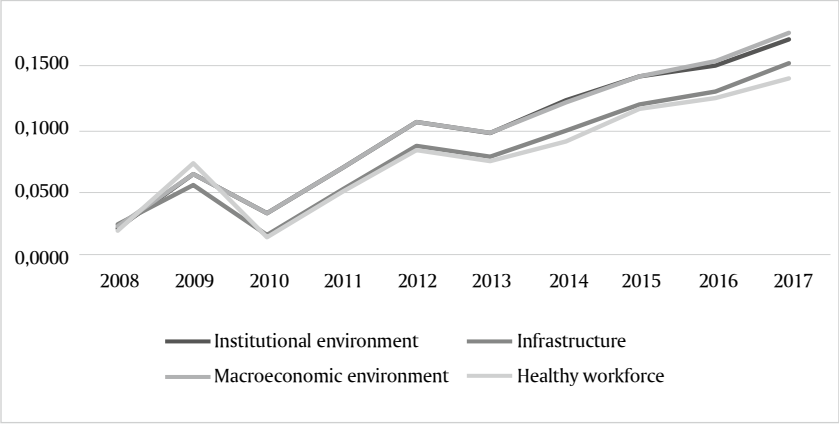


Figure 5. Impact on Technological readiness, %, 2008–2017

Source: Author's conclusion is based on author's calculations

Conclusions

Based on results obtained from the developed random effects regression model, it might be concluded that Workforce is the most important and significant regressor, followed by Institutional capacity and Infrastructure, as for the Macroeconomic environment it remains less important for the knowledge intensive business development in national economies across the Baltic States.

Evaluating difference between various country groups it should be stated, that the Baltic States have more similar trends in common with High developed countries with High income, thus leading to the conclusion that in order to boost the capacity of knowledge intensive sector in national economy, Latvia should keep to the EU common strategy in terms of sustainable development, with special focus on enhancing existing workforce and major infrastructure.

In addition, it should be mentioned that within the selected time period, there were no significant annual changes noticed in terms of significance or importance of the analysed regressors.

Thus, it might be concluded that the prerequisites for the knowledge intensive business development is no directly linked to the macroeconomics factors, which lead to the confirmation of the formulated hypothesis that the expansion of the innovative business segment in the Latvian economy depends more on internal political factors than on market conditions and external financing.

The Technological readiness, comparing to the other dependent variables, has the highest R^2 values (71.9% within and 94.9% between), the lowest R^2 values are observed for the Labour market efficiency (39.7% within and 63.4% between). The average *R*-square is above the 54% in all regression (total number of columns per dependent variable) which means that more than 54% of variation on dependent variable can be explained by the independent variables.

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