GREEN INNOVATIONS AND ECONOMIC POLICY IN SMALL ECONOMIES

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ABSTRACT
Implementation of innovations takes place in various sectors, but at the present stage, innovations have become particularly important in energy sector. The purpose of the paper is to emphasize the existing and potential tools of economic policy that can develop the innovations and thus improve the country's competitiveness. The domestic economic policy of a developing country significantly makes for the import, creation and dissemination of the technologies. Improving competitiveness is connected with the national and economic securityissues.

KEY WORDS
Green economy, innovation, energy efficiency, economic policy.

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Introduction

The modern world is characterized by global competition, and thus, under such intense competitive environment, every country has to develop and improve various areas of national economy. Innovation-based technologies have gained special importance for small economies, and it is expected that its significance will only increase in the future. With a view to establishing themselves in the global economy, the countries with emerging economies have to ensure rapid economic growth, which is impossible unless the developing industries are based on innovations and research.

Apart from the economic growth and improvement of competitiveness, no less importance is given to environmental protection issues. Innovative infrastructure and activities will gradually mitigate the severity of these problems. The process of transformation of scientific knowledge into the innovation is very hard one, and thus, government has to implement relevant measures in terms of new approaches and introducing new technologies to support producing science-intensive and competitive products. Alignment with the European Union implies the regulation of components of the energy strategy, such as saving and efficient usage of energy, renewable resources, research and so forth. Generally, increasing competitiveness improves the level of a country's security, and the existing and potential economic tools should be applied exactly in this direction.

Innovations, as the tool of economic growth and development, are becoming more and more actual. The economic measures, such as implementation of

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innovations, supporting technological and technical changes, funding innovative and high-risk ideas, are a part of a state level policy. Transformation into innovative economy, or increasing its share in the overall economy, will become the guarantee for positive changes in the future.

Implementation of innovations in small open economies is related to certain difficulties. At the initial stage, which may take several years, the government support is necessary. That is why evaluation of innovative projects and various forecasting methods, including quantitative methods, gain great significance. It is important to specify and identify the sectors, which can support GDP and public welfare growth in the medium or at least in the long term prospect.

Government support has a crucial importance for innovative processes, which subsequently results in improvement of science-intensive sectors and production of competitive goods. Some economic entities can be stimulated by coordinating business with educational system and scientific research. This will largely determine the superiority of national economy in the international competitive environment.

One of the key sectors of the country's economy is energy. Innovations, and particularly green energy-efficient innovations, are given special importance in this sector. In order to prevent a number of problems that might occur because of the use of the environment, some countries are actively searching for alternative energy sources. Traditional energy sources are gradually replaced by the "green", renewable energy, such as wind and solar energies. The matter of economic efficiency in the short and long term, such as summarizing public and private interests, the appropriateness of the state policy measures and other similar issues have become the subject of research. As the topic is important and extensive, we will try to focus on the role of innovations, which should stimulate improvement of the global competitiveness of the emerging economies.

The purpose of this paper is to reveal the role of innovative projects and especially "green" innovations in the development of small economies and thus in improvement of their international competitiveness.

1. Innovation as the driver of national economy

Economic development and prosperity is based on the country's competitiveness, which in turn, largely depends on the implementation of innovations. Innovation has become a central driver of national economic wellbeing and competitiveness – and this is why so many nations are engaged in the race for global innovation advantage (Atkinson, Ezell 2012: 9). Therefore, it is now actual to answer the question – what actually is innovation?

There are many definitions of innovation, e.g. "brand-new thinking, which creates value" (Lyons et al. 2007). According to OECD definition, innovation is "the implementation of a new or significantly improved product (that is a physical good or services), process, a new marketing method, or a new organizational method in business practices, workplace organization, or external relations (The Organization...)". Drucker (1985) claims that innovation is a specific instrument of entrepreneurship, an act that provides new opportunities in the process of creating wealth. In turn, Afuah (2003) is of the opinion that innovation is a process of satisfying customers through adoption of new ideas. And according to Rezeghi (2012), "innovation is not the result of thinking differently; it is the result of thinking deliberately about the problems and needs".

In other words, innovation is bringing new products, processes, services and functionalities to production, to the market-place, and to society that consumers and organizations find useful and valuable. And this is the kind of innovation that is at the heart of the national and global economic prosperity.

Now, more than ever, nations need innovation to remain globally competitive. So, the governments should stimulate innovations (Atkinson, Ezell 2012: 133). Implementation of innovations takes place in various sectors, but at the present stage, innovations have become particularly important in energy sector. Innovations and particularly green energy-efficient innovations are considered particularly significant in this sector. To date, the resources are used unsustainably throughout the world. In order to prevent a number of problems that might occur because of inefficient use of the environment, some countries are actively searching for alternative energy sources. Developed countries are trying their best to support renewable energy and energy-efficient measures. As for the developing countries, they need sufficient efforts to import innovation. Compared to other countries, investment expenditures on the search and development in Georgia are relatively low. That is why according to the Global Competitive Index, which is calculated by 119 criteria, Georgia has the lowest rank (the 121st) in innovations. Besides, there are some problematic areas in the country, such as protection of property rights, secondary and higher education, science and research, the level of competition on the domestic market, access to finances, professional workforce, public trust in politicians and political instability. It can be said that through implementation and support of innovations three of these problematic areas can be improved: secondary and higher education, science and research and domestic competition.

2. Methodology

The work uses the methods of analysis, synthesis and comparison as well as factor analysis and methodological approaches proposed by the International Institutes and methodological basis to calculate statistical data, particularly those used to fix the popular indices of competitiveness. The mathematical and econometric apparatus was used to describe important links between some indicators. Hypotheses were tested about the significance of the coefficients and the whole regression equation.

3. Energy strategy and energy efficiency

Energy strategy of the country has obtained a key role in the process of overcoming important macroeconomic and microeconomic problems, such as inefficient production, irrational resource use, etc. Energy efficiency is the cornerstone of this strategy. Generally, for most countries, the priority of the energy policy lies in the improvement of energy efficiency and development of renewable energy (Nahm, Steinfeld 2014).

Technical and technological changes have led to the changes in energy consumption in the traditional and new sectors. That is why it is important to evaluate and analyze the data, such as the energy intensity of the economy. This indicator is the ratio between the gross inland consumption of energy and the gross domestic product (GDP) in a particular calendar year. It measures the energy consumption of an economy and its overall energy efficiency. The gross inland consumption of energy is calculated as the sum of the gross inland consumption of five energy

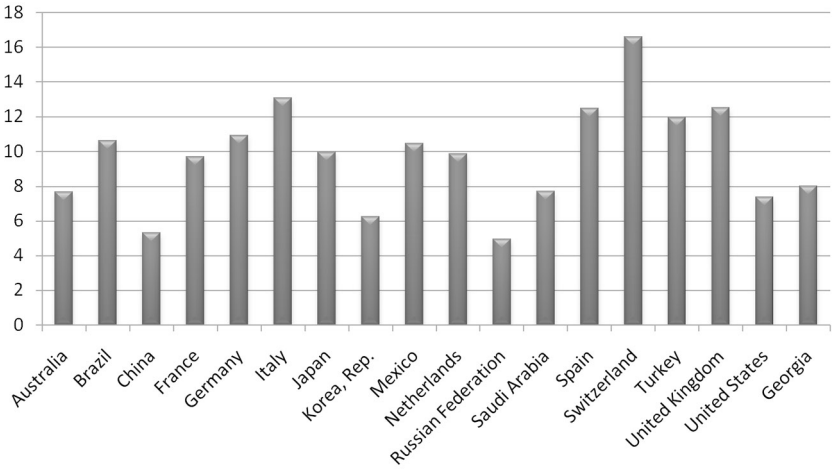
types: coal, electricity, oil, natural gas and renewable energy sources (Eurostat, Energy intensity... 2017).

Comparative analysis of the energy intensity in various countries shows the similarities and differences between the principal trends of the economic policy.

Figure 1 shows the energy intensity of different countries. This indicator depends on the sectoral structure of the country. If such energy-intensive sectors as heavy industry, transport and construction are more developed in the country, then surely, the energy intensity will be higher. However, we should consider encouraging policy of the government in the energy saving technologies. Improving Energy efficiency in the production process using new facilities and other factors may significantly change an energy intensity indicator of the country. Thus, the main goal is to maintain or reduce the level of energy use despite the production growth and quality improvement.

Figure 1 presents energy intensity of various countries. This indicator depends on the sectoral structure of the country. If the energy-intensive sectors, such as heavy industry, transport, construction are more developed in the country, then of course energy intensity will be higher. However, we should consider encouraging policy of the government in the energy saving technologies. Improving Energy efficiency in the process of producing, using new facilities and other factors can emerge significant changes in the energy intensity indicator of the country. Thus, the main goal is to maintain or reduce the level of energy usage, regardless production growth and quality improvement.

Figure 1. GDP per unit of energy use (constant 2011 PPP $ per kg of oil equivalent)



Source: The World Bank, DataBank.

It can be seen from Table 1 that GDP per capita has been growing in Georgia since 2009. As we have already mentioned, rapid economic growth is impossible unless the developing industries are based on innovation and research, and small economies, like Georgia has to pay more attention to its domestic economic policy.

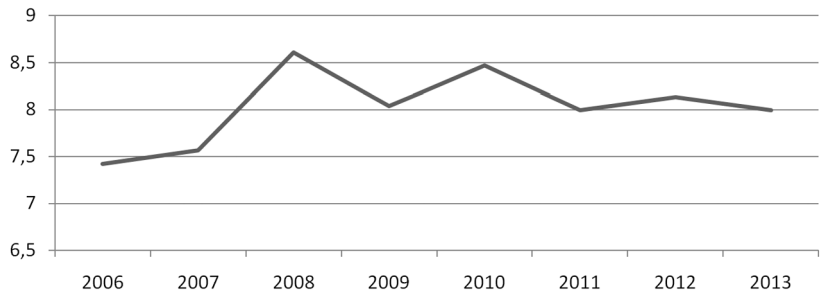
Table 1. GDP per capita, PPP (current international $)

	2008	2009	2010	2011	2012	2013	2014	2015
GDP per capita in Georgia	6,163.8	6,054.2	6,597.6	7,315.1	8,026.5	8,541.8	9,216.3	9,698.9

Source: The World Bank, DataBank 2008-2015.

Innovations and technology readiness is the component of Georgian energy policy. As compared to other countries, with this index, Georgia is in a good position. As shown in Figure 2, in recent years, despite the GDP growth, the energy intensity rate has been stabilizing, and even a downward trend can be observed.

Figure 2. Changes in energy intensity rate of Georgia in the years 2006-2013



Source: The World Bank, DataBank, 2006-2013.

Besides energy-saving, energy efficiency has positive influence on the qualitative improvement in various areas of the public sector. More specifically, we can cite the following fields: ensuring energy security, high productivity and higher levels of health and wellbeing, supporting optimal employment, improving resource management, increasing national savings, reducing environmental pollution, etc. In turn, the productivity growth and reduced energy costs stimulate economic growth and simultaneously, lead to the lower prices on energy market. Thus, the energy system becomes more reliable. The effects of the reduced energy consumption will be greater and will outweigh the energy-efficient investment costs. (National Action... 2009).

Despite the above-mentioned advantages of the energy efficiency, some rebound effects may take place. Unless the energy prices change, the improved energy efficiency with lower costs will lead to the increased energy consumption, and the effect of reduced consumption will be more than the effect of the borne expenses. Potential savings gained from the increased energy efficiency are usually measured by means of basic principles and engineering models. However, practical calculations have shown that the real savings after implementation of the new systems are substantially less than the estimated savings. This can be explained by several reasons, which can be classified by certain characteristics.

Usually, special literature differentiates between the direct and indirect rebound effects. However, in addition, two kinds of rebound effects can be identified: technological/cultural and economic rebound effects (Pears 2004). The former implies that

people seek more and more comfort what is related to the technology development and cultural values as well. Economic rebound effect depends on how the energy savings are used. If the money saved from energy efficiency is used in energy intensive activity, then the total energy consumption will increase. If the savings are spent on purchasing more energy-consuming equipment, energy usage will increase at first glance, but since the households' expenditure on energy will increase at the expense of expenditure on other activities, the total economic effect will be negligible. If the saved money is spent on less energy intensive activity, then there will be a saving amplification effect, and if the savings are invested in energy saving equipment and infrastructure, then an even larger amplification effect will occur.

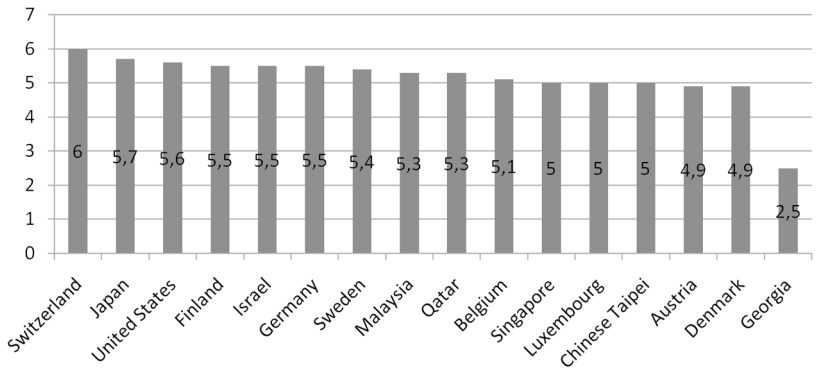
Energy efficiency can be achieved in two main ways: 1) using the same amount of energy to produce higher valued product; 2) refining technology to produce the same amount of production with less energy. Both ways imply the importance of the innovations and new technologies, which can improve the process of production and economic productivity.

Transformation of the energy system into a green and efficient system is not the goal to achieve instantly. In order to describe the process of transformation, we can distinguish three waves of innovation. The first wave combines already available technologies, new business and financial models. The results of this wave will be sizable within the next decade. The second wave will overlap the first and introduction of the green energy supply technologies will increase significantly, and the third wave implies the ideas and projects that seem impractical now.

Market forces alone cannot push these innovation waves forward fast enough. Therefore, the governments should intervene. There are three broad possibilities for governments to support the innovations (Lester 2014: 120-121; Atkinson, Ezell 2012: 142-145). The very first step government should take is improving the environment for innovations, and this means reducing and eliminating obstacles to the flow of financial capital, knowledge, and people toward economically viable options. Second, government can stimulate market demand for low-carbon technologies, thereby creating incentives for private sector investment in climate-friendly innovations. Stimulating mechanisms can be various, e.g., using government procurements to create demand for low-carbon products and services; mandating the use of low-carbon technologies; subsides, loan guarantees, tax credits and other incentives to encourage private investments, and third, government can interfere even more directly in innovation process – for example, it can fund and realize research, development and demonstration activities.

Out of the potential sources of government to interfere, we will focus on the direct intervention – funding research and development and encouraging private sector to invest in R&D. Considering the problem of "a free rider", this kind of policy seems much important. Even the "rational" companies do not have an incentive to invest in new generation technologies, particularly when such an investment is associated with high-level risks and delay in time (Lester 2014: 121-125; Hall, Lerner 2010). Companies are unable to prevent their competitors from access in new knowledge, gained through their innovation activities.

Figure 3. Extent of companies' investing in R&D in different countries



Legend: 1- do not invest at all; 7-invest heavily
Source: Schwab, Sala-i-Martín 2015.

Every year, the World Economic Forum ranks and analyzes the ability of 144 countries to create and maintain the environment in which the national economy can become a more competitive component of the global economy. One of the components of GCI – Global Competitiveness Index – is "a company spending on R&D". Unfortunately, according to the latest annual report, Georgia ranks the 127th among 144 countries. Figure 3 shows the scores of Georgia and top 15 countries by this component (Schwab, Sala-i-Martín 2015).

Innovation is a long process, which starts with different ideas requiring substantial research. Gradually high technologies, technology start-ups, innovations, etc. have become organic for Georgia. The domestic economic policy of a developing country significantly determines the import, creation and dissemination of the new technologies. In this regard, Georgia has had a kind of breakthrough. Under the auspices of the Ministry of Economy and Sustainable Development and Georgia's Innovations and Technology Agency (GITA), the first Tech Park was opened in Georgia. A project with a 5 million GEL budget completed successfully on 11th of January, 2016.

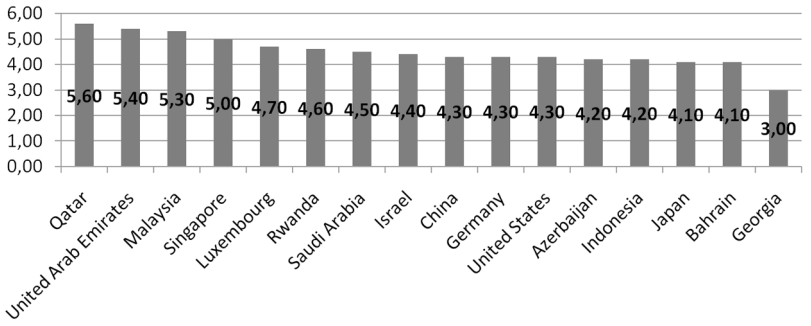
The Tech Park provides access to various types of high-technology equipment, services to develop start-up companies, links to the staff and experts needed for the project implementation and access to the advanced knowledge and experience in innovations and new technologies. This is the place equipped with modern technology where start-ups and small companies are offered the resources, which were hardly available till recently. The popularity of Tech Parks is increasing all over the world. Not only the public, but also the private sector is interested in contributing to the economic growth and development of the regions, which are weak.

It should be noted that for the first time in the Caucasus, Tbilisi International Airport starts using solar electricity. Installation of the solar electricity generating system in the parking area of the airport will be over in 2016. This project implies the implementation of the first steps in using clean energy in Georgia.

Another component, which also determines the GCI of the county, is "government procurement of advanced technology products". In this regard, Georgia has had an improved score over last 10 years,

but nevertheless, in the last Global Competitiveness Report 2015-2016, Georgia ranks the 95th place among 144 countries (Schwab, Sala-i-Martín 2015). Figure 4 shows the ranking of Georgia and top 15 countries by this component.

Figure 4. Extent of fostering innovations through government purchasing decisions in different countries



Legend: 1- not at all; 7-to a great extent
Source: Schwab, Sala-i-Martín 2015.

4. The econometric model

Market size is one of the restrictive elements of a small open economy because scale effect can be a crucial factor in implementation of some innovative projects. Besides, a market size gives us certain information about the volume of the Gross Domestic Product. That is why we chose market size as the endogenous variable.

As for the exogenous factors, they were selected mainly because of the connection with innovations. At the initial stage, the following factors have been considered: capacity for innovations as the variable that describes innovation resources; availability of latest technologies as the utilized resource of the advanced technologies; FDI and technology transfer as the variable that describes the role of foreign capital in the implementation and use of new technologies; firm level technology absorption as the variable describing current processes on the firms' level; government procurement of advanced technology products, because the involvement of the state as of a customer and purchaser is important and technology readiness.

Statistical data for the econometric model is retrieved from annual the Global Competitiveness reports published by World Forum, where each of these variables are evaluated on a 7-point scale, from 1 (the most unfavorable situation) through and 7 (the most favorable situation). As the preliminary analysis showed, the first four factors describe the current processes taking place in small economies to some extent with the certain accuracy. Surely, more sizable observations are desirable, but the innovation process is not that long, and besides, we were unable to acquire any earlier data.

Finally, the model is as follows:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4$$

Where: y is the market size, β_0 is the intercept, x_1 is the capacity for innovations, $x2$ is the availability of latest technologies, x_3 shows the FDI and technology transfer, x_4 shows the firm level technology absorption, β_1, β_2, β_3, β_{04} are regression coefficients.

The data of Georgian economy are given in Table 2. According to this data, the model is as follows:

$y = 6.30268 + 0.673744x_1 + 0.379231x_2 + 0.193084x_3 - 1.89931x_4 + e_i$

Intercept shows the market size if neglecting the factors given in the model. The first regression coefficient shows that the capacity for innovations changes by one point leads to the change of the market size by 0.673744. Besides, there is directly proportional relationship between the endogenous variable and the second (0.379231) and the third (0.19308) factors, but the relationship with the technology absorption level is inversely proportional.

Table 2. Data of the econometric model (values are on a 1-to 7 scale)

Year	Market size	Capacity for innovations	Availability of latest technologies	FDI and technology transfer	Firm level technology absorption	Government procurement of advanced technology products	Technology readiness
	y	x_1	x_2	x_3	x_4	x_5	x_6
2008	2.7	2.7	4	4.6	4.1	3.3	2.8
2009	2.9	2.4	4.3	4.7	4	3.3	2.92
2010	2.8	2.4	4.3	4.3	4	3.2	3.1
2011	2.8	2.6	4.5	4.2	4.1	3.5	3.2
2012	2.9	2.5	4.6	4.2	4	3.7	3.7
2013	3	3	4.4	4.1	4.1	3.6	3.8
2014	3	3.3	4.5	3.9	4.2	3.5	3.8
2015	3	3.4	4.3	3.8	4.2	3	3.8

Source: Schwab, Sala-i-Martín 2015.

With a significance level of 10% (and confidence interval of 90%), all the variables, except the third factor, are statistically significant. The coefficient of determination and the adjusted coefficient of determination are quite high and equal $R^2 = 0.930859$ and $\overline{R}^2 = 0{,}838672$ respectively; the standard error is quite small: $S_e = 0.045226$. This model can be used for forecasting purposes. Besides, according to the coefficients and indicator analysis, the economic and financial sector regulators can develop some guidelines. So, with the practical use of this model, the decision-makers of macroeconomic policy will be able to analyze the current situation and develop some presumptions about future prospects.

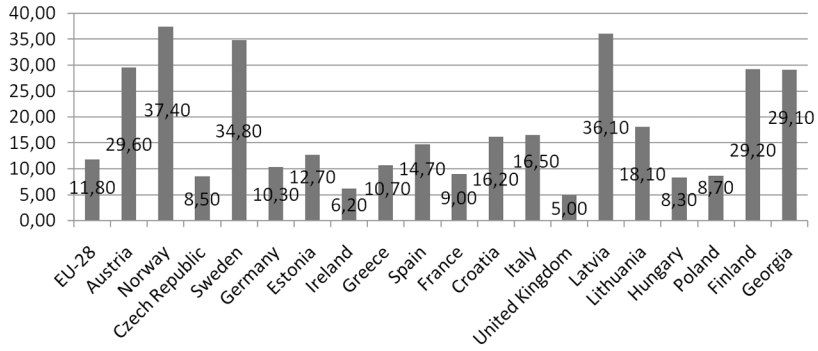
5. Innovation and environmental safety

Apart from the economic growth and competitiveness improvement, no less importance is given to the environmental protection issues. Climate change, the risks of global warming, drinking water scarcity, etc. are the problems that more or less concern every country. Innovative infrastructure and activities will gradually neutralize the severity of these problems. Efficiency has become a drive of the economic wellbeing, and it is only the onset of the new wave of investments in clean energy what can support the continued growth of wellbeing and energy security as well as environmental protection.

Increased energy efficiency investment combats global climate change in two primary ways. First, simply put, "the less energy is used, the fewer emissions are produced". While this general statement overlooks the more complex relationships between energy efficiency and carbon dioxide (CO_2) emissions, it places energy efficiency in a core role for future energy and

climate policies and programs. Second, cost-effective energy efficiency ensures the achievement of these environmental benefits at a low cost, and thus can reduce the economic costs of achieving climate policy goals. The use of renewable energy has many potential benefits, including reduction in greenhouse gas emissions, the diversification of energy supplies and reduced dependence on fossil fuel markets (in particular, oil and gas). The growth of renewable energy sources may also have the potential to stimulate employment in the EU, through the creation of jobs in new "green" technologies. Renewable energy sources include wind power, solar power (thermal, photovoltaic and concentrated), hydroelectric power, tidal power, geothermal energy, biomass and renewable portion of waste.

Figure 5. Share of the renewable energy in gross inland energy consumption (2013)



Source: Eurostat, Statistics Explained 2013.

It is evident that Georgia is one of the leading countries in using renewable energy. Alignment with European Union implies the regulation of components of the energy strategy, such as saving and efficient use of energy, including implementing "smart grid", renewable resources, reforms, innovation, research, education and so forth.

Findings and conclusions

For the European integration and development of a small economy, it is vital to improve the innovation system. In developed countries, the social problems, employment issues, regional disproportions and eradication of poverty are usually solved through the implementation of innovation policy, and this should be exemplary for developing countries;

Innovative development is a long term process. Creating competitive technologies, reforming educational system, which has been protracted in case of Georgia, and developing the scientific sector needs a deliberate policy. Even only the demonstration of the political will can create the basic conditions for realization of the innovative projects.

Founding tech parks, innovation centers, laboratories and business incubators all over the country is crucial for implementing the innovative policy. These are the means for every region to develop. Innovative policy promotes economic growth and establishment of international market standards.

As the econometric analysis shows, there is a fairly close link between the market

size and the exogenous variables, such as: availability of the latest technologies, firm level technology absorption and capacity for innovations. Therefore, it is important to influence this variables to change them is a positive way.

Another crucial issue is energy efficient technologies. It is high-priority for every country to encourage introduction of energy saving technologies, which will influence energy intensity of the country in a long term. In this regard, certain changes can be observed, but to have more significant results more efforts are needed in this direction.

The Caucasus, including Georgia, is the region, where using solar and other natural energy is economically justified. That is why further support and substantiation are needed, in order to have private and public sectors prepared for transition to the renewable energy sources.

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