# TECHNOLOGICAL INNOVATIONS AND NATIONAL ECONOMIC IDENTITY

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Technological innovations represents new technologies, created in the R&D institutions and implemented (absorbed) by private companies for meeting explicitly identified commercial needs. However, to respond on the most challenging realities we have to refer to technological innovations as the new combinations of resources, which should be properly implemented for the structural reforms, undertaken in the local, national and global economies. Besides, the new understanding of technological innovations is required to cope with the "parade of identities" and to manage this move on the basis of "national (regional) comparative advantage". The new insights into "technological innovations" and its application for confronting the most challenging national and local needs will be presented in this article.

When thinking about the prospects of economic development of companies, regions, countries or of the world economy in general one shouldn't ignore the general frame of the contemporary economic beings, which is substantially affected by the ongoing downstream stage in the life cycle of the global economy. Generally speaking, the main sources, spurring the economic growth during the $20^{th}$ century, are almost exhausted. Economic actors whether they are business managers, government decision makers, investors or even householders have been trying to unveil the new prospects for investing money, creating new jobs, launching the long-term projects and hence - retaining their economic growth. The question "where to go" in a sense of economic activities became the main question of our days. Does this

questions could be responsive within the existing economic mainstream? Could the contemporary economic science navigate the global society to the new economic highs through the harsh realities of economic crisis, economic contradictions, trade wars, financial fluctuations and increasing uncertainties and economic risks? The most probably the answer is no.

The increasing mismatch between the real needs of the societies and the dominating mainstream in the economic science restricts the economic development and frustrates the decision makers. The irrelevance of the contemporary economic science, expressed by the American economist Chalmers Johnson, is widespread: "It is helpful to think of the economist as a laboratory scientist. The economist sets up a model and has control over the parameters and exogenous variables. The "experiment" is the model itself. Once the model is setup, the economist starts the experiment and watches to see how the endogenous variables evolve over time…"[1]. Probably, behind the economic monitor detecting the economic trends with data, economic indicators, pictures and graphs the most urgent task is to turn our collective mindset from the scholastic ideas and theories to the reflection of the real economic challenges responding on it in the most appropriate way. Worth mentioning here the words, said by the Nobel laureate American economist Paul Krugman: «The important thing to realize is that at this moment, as we speak, we are witnessing an extraordinary failure of economic policy, something that I think most of us thought could not happen. And what has happened in the public discourse over economic policy has been extraordinary fiscalization of the discussion what is really a crisis that originated in the private sector, clearly a crisis which did not involve misbehavior by a large number of governments has nonetheless been diagnosed as a problem that is essentially fiscal»[2]. In the similar situation during the shocking economic crisis of the middle of 1970th the other outstanding American Prof.Robert Heilbroner opened the meeting of the leading economists, gathered for

[1] Charles I.Jones. Introduction to economic growth. Second edition. 2002. P.27

[2] Пол Кругман об экономическом кризисе / Paul Krugman on economic crisis http://audiorazgovornik.ru/economics/796--paul-krugman-on-economic-crisis

discussion of how to overcome the ongoing recessions, by saying: "There is a word that makes professors of economics wince these days, as I can testify from personal experience. The word is, of course, relevance. ...What has diminishing marginal utility to do with giant corporations, the military-industrial complex, imperialism, ghetto life? Isnt' time spent on the study of marginal utility simply time diverted from the consideration of real issues, such as these? Worse, isn't the very act of taking seriously a figment like " diminishing marginal utility" apt to cultivate an ivory-tower frame of mind that will no longer wish to come to grips with the brute problems of the real world?"...the charge of "irrelevance" is no longer an objection that can be easily overcome, but a serious challenge to the validity of the discipline itself." His concluding question is valuable so far: "Is economics a penetrative and reliable guide to the nature of society?"[3]. His words are actual so far.

Economists need to revise profoundly the essence of the theoretical backbone of its science. The core substance is, of course, technological innovations. The most significant words on that matter was saying by the other outstanding American-Russian economist and Nobel laureate Simon Kuznetc: "...the changing course of economic history can perhaps be subdivided into economic epochs, each identified by the epochal innovation with the distinctive characteristics of growth that it generated"[4]. In some sense the key role of technologies in economic development is not new. One of the most known theory of the technology-based economic growth belongs to the Nobel laureate Robert Solow, who has explained the long term economic growth by the technological progress. However, this is the "exogenous" economic growth model, which means that the technologies have been emerging outside the economic systems and are treated as "the manna from the heaven"[5].

[3] Robert L.Heilbroner, Arthur M.Ford. Economic relevance. A second Look. Goodyear Pub. Co., 1976. P.3.

[4] S.Kuznetc. Modern Economic Growth: Findings and Reflections. Prize Lecture. Lecture to the memory of Alfred Nobel, December 11, 1971 http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1971/kuznets-lecture.html

[5] Charles I.Jones. Introduction to economic growth. Second edition. 2002. P.27

The basic theoretical idea, underlying the Solow's model is the Cobb-Douglas production function[6]:

$$Q(L,K) = A\, L^{\beta} K^{\alpha}$$

Where:

- Q is the quantity of products.
- L is the quantity of labor.
- K is the quantity of capital.
- A is a positive constant.
- β and α are constants between 0 and 1[7].

The Cobb-Douglas and Robert Solow correlations mean that the economic growth, measured by the gross economic output, requires the steadily and proportionally growing capital and labor input. "Today's linear 'take, make, dispose' economic model relies on large quantities of cheap, easily accessible materials and energy, and is a model that is reaching its physical limits" [8]. On the contrary, the new economic mainstream, probably, will consider the technologies as the key economic factor, created within the economic system or emerging endogenously. Hence the new economic mainstream will be based on the endogenous model of economic growth, implying the flexibility of capital-labor cohesion, determined by the rapidly changing technologies. In this regards the more profound understanding of technologies as the main driving force for economic growth is required and we will endeavor to explain some of its peculiar characteristics.

The decisive role of technologies in the economic development is not totally recognized. Reflecting the widespread vision of technology-driven economic growth the polish economist Maciej Wituskyu writes: "The innovation craze that has engulfed policy circles in many environments and countries sometimes strikes me as counterproductive. Spending billions on programs promoting innovation is a way of generating jobs in public

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[6] Source: Cobb-Douglas Production Function - EconomicPoint - September 2013 - http://economicpoint.com/production-function/cobb-douglas

[7] In the most general form the production function is represented as following Q=f(L,K)
Where:
- Q is the quantity of products
- L the quantity of labor applied to the production of Q, for example, hours of labor in a month.
- K the hours of capital applied to the production of Q, for example, hours a machine has been working for the production of Q.

[8] Circular Economy Overview. Ellen Macarthur Foundation.
https://www.ellenmacarthurfoundation.org/circular-economy/overview/concept

administration rather than in high-tech garage start-ups."[9]. To develop the new economic theory we should overcome this misunderstanding of the decisive role of technologies in economic development and the words, says by Simon Kusnets are the most appropriate in this regard: "A country's economic growth may be defined as a long-term rise in capacity to supply increasingly diverse economic goods to its population, this growing capacity based on advancing technology and the institutional and ideological adjustments that it demands"…."if technology is to be employed efficiently and widely, and, indeed, if its own progress is to be stimulated by such use, institutional and ideological adjustments must be made to effect the proper use of innovations generated by the advancing stock of human knowledge"[10]. We are treating this statement as the very significant point of origin for the further theoretical investigations of economic growth and development.

The definition of the key term for technology-driven economic growth should be elaborated properly at the very beginning. It was emphasized in my previous publications: "the existing misunderstanding of technological innovation as a real means for recovering economies from a harsh economic crisis represents one of the most decisive barrier on the way of shifting societies to innovations"[11]. The "IGI Global" gives expressions of the most widespread conceptualizations of the notion "technological innovation":"A variety of scholars from different disciplinary backgrounds have studied how people and companies create new uses for new or existing technologies, and how these new innovations diffuse within populations…."Technological innovation comprises activities that contribute to the research, development and design of new products, services or techniques, or to improving existing products, and generates new technological knowledge"…"The introduction or alteration of some form of technology (often information technology) into an

[9] Maciej Wituskyu. How to make the EU more competitive. In: PISM 9eds.): The EU economy. Response to the crisis and prospects for the new decade. Warsaw.P.77 http://www.pism.pl/files/?id_plik=7536

[10] S.Kuznetc .Modern Economic Growth: Findings and Reflections. Prize Lecture. Lecture to the memory of Alfred Nobel, December 11,
1971 http://www.nobelprize.org/nobel_prizes/economic-sciences/laureates/1971/kuznets-lecture.html

[11] Irina Boyko. Regional Innovation driven Policy in the Baltic Rim Countries in the Age of Global Turbulence. In "Strategies and promotion of innovation in regional policies around the Mare Balticum". Baltic Sea Academy. 2012.P.291

organization"[12]. Our personal definition of the technological innovation is the following: technological innovations[13] are the new technologies, created in R&D institutions and implemented (absorbed) by the private companies for meeting their explicitly identified commercial needs.

Some key characteristics of the technological innovations stemming from the definition given above should be specifically emphasized:

- technology represents the combination of resources, which means that any given technology is specifically distinct from the other in terms of resources (in kind and in volume) it absorbs;
- the resource combinations has a local (spatial) dimension, which means the distinction of any given local resource combinations (or technological innovations) from the others. In other words, to be successful any given technological innovations are to be consistent with a special combinations of resources within any given locality;
- technological innovation emerges when the new technology (know-how), produced in the R&D institutions by the high educated personnel, is selected by the private company to reach some specific and explicit commercial aims mostly introduced in new product or processes.

What are the most important characteristics of the technological innovations?

First, technology represents the core essence of technological innovations. Essentially, technology represents the combination of resources, when any given technology specifically differs from the others by the unique resources (basically natural resources and subsequently the others) it absorbs (in kind and in volume). The first known technologies in the mankind history are, probably, domestication of plants and animals.

The second characteristic is related with the previous. Regarding the uniqueness of the resource combinations technologies are specific in terms of their spatial applications. For example, initially the technologies, which are identical for the coastal regions are quite different from the technologies, which are identical for the inland regions (this kind of distinctions is ignored

[12] What is technological innovation? IGI Global. Disseminator of knowledge. http://www.igi-global.com/dictionary/technological-innovation/29457

[13] We use the term "technological innovation" rather than innovations, emphasizing the technological essence of innovations and their emergence from the production of the real (rather than virtual) values.

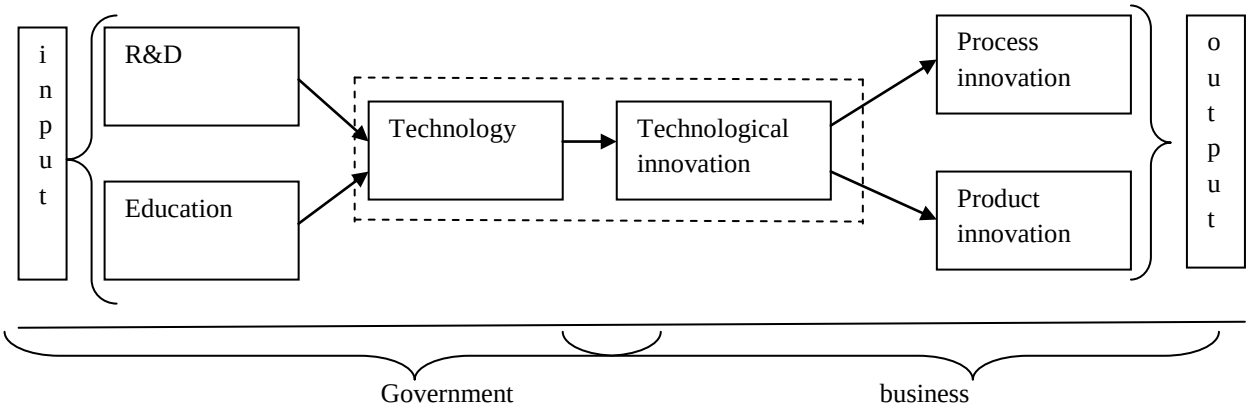
within the Cobb-Douglas, Solow's and the other similar economy-of-scale economic models). In this regards localization of technological development consistently related to the development of specifically local resource combinations represents one of the most important requirements for the successful technological and economic policy, pursued by the local and subsequently national governments.

Third. The economic essence of technologies could be explained within the conception of the division of labor. The classical theory of Adam Smith begins with the division of labor, explaining the process when the "more heads" engaged and specialized in the production processes enable to produce more goods, thus contributing to the accumulation of the wealth of nations. The contemporary division of labor within and between the different societies is more complicated than it was in the Adam Smith's times. Probably, this issue will be a core of special realm in the future theoretical mainstream. In this article we would like to mention the only two specification of the contemporary division of labor: the division of the basic science from the applied research and the division of the local government from the federal government regarding their role and mission in pursuing the technology-based economic policy. Being properly analyzed and conceptualized it will make easier to understand the intersections between business, governments and research institutions in pursuing the national innovation policy, focused on the long lasting economic growth.

Fourth. The key technologies, being the core for the specific industrial clusters, are quite different from the "garage inventions". They are emerging as the output for a very specific input, composed from R&D and education (figure 1). It means that the whole input-output process for the innovation production is more complicated than for any other kind of production. For instance, every unit of R&D investments should be finalized with the increasing output. In case when the basic R&D are not bringing the real commercial benefit the rest investments into R&D (usually less than 10%) should be significantly beneficial. "The commercial success of new technologies applied within a specified business spectrum within a given technological specialization exceeds the market failure of unsuccessful

technologies and thus restricts the risk of innovation undertaken by both the national government and national companies"[14]

Figure 1
R&D, technologies and technological innovations




The distinction between the technological innovations and investment should be explained as well. Decision makers are usually perceive the investments as the premise for taking the "technological" decisions (including R&D development, production of the technology complicated equipment, launching the new innovation projects, support for the innovative companies etc.). In this regard we should remind that the business investments are usually aimed on obtaining the higher profit on an every unit of the financial resources within a short term time frame. On the contrary, the technological development is always the long term process, requiring the long term aims (which, in turn, are more risky than any short term investment decisions). Besides, the question emerges, what is the first and what is the second: the technological innovation, requiring the precise portion of the financial resources among the other resources, or the financial resources determining what technologies (i.e. resource combinations) should be recognized as the appropriate to a specific financial terms and conditions? Moreover, usually the investments are made to extend the life of the existing "market champions" rather than to start the new business, taking risks of application

[14] Irina Boyko. A National Innovation System: Framing new pattern for sustainable development. In "Knowledge based Entrepreneurship: Innovation Policy and dynamic development of knowledge-driven entrepreneurship. Baltic Dynamics 2004". Knowledge Economy Series. EffeElle Editory. Italy.2005. P.137

the new technologies. To prolong the life cycle of the existing economic system is always easier than to create a new system accepting the risk and uncertainty of any step towards unknown. And, finally, the Russian experience reveals that the excessive investments in many cases are "killing" the technological innovation. Probably, we forget that technologies are the means to overcome the scarcity of resources. Therefore, the investment/innovation nexus is the one of the most significant methodological trap, which blockage the further development of the technological innovations issue in theory and practice.

Our special insight relates to "localization" of technological development. S.Kuznetc writes on that matter: "Obviously, community of feeling, a sense of common destiny, and subordination of individual or group interest to that of the whole, are far easier to attain in small and homogenous nations than in large nations with their regional, racial and other diversities"…[15] . And he continues: "Another possible advantage of small units is the rapidity with which they can adjust to changing situations. In a sense this rapidity is related to the greater possible ease of reaching secular decisions. For slowness in adjusting may be due to the disparate effect that changes may have upon different groups within the country, and to the resistance of some to the proper adaptation to the change. A greater community of feelings thus not only helps to make the necessary decisions but also permits them to be made promptly. And since economic growth is a process of continuous adjustment to a changing technological potential and a changing constellation of national structures, the speed with which small nations may be able to make such an adjustment is a great advantage"[16.] .

Why technological innovations should be localized? We explain it by the following facts:

- the resource combinations are special in terms of geography (new geography);
- localization of technological innovations facilitates the diffusion of new technologies between private companies therefore increasing the cumulative commercial revenue for companies and taxes for governments;

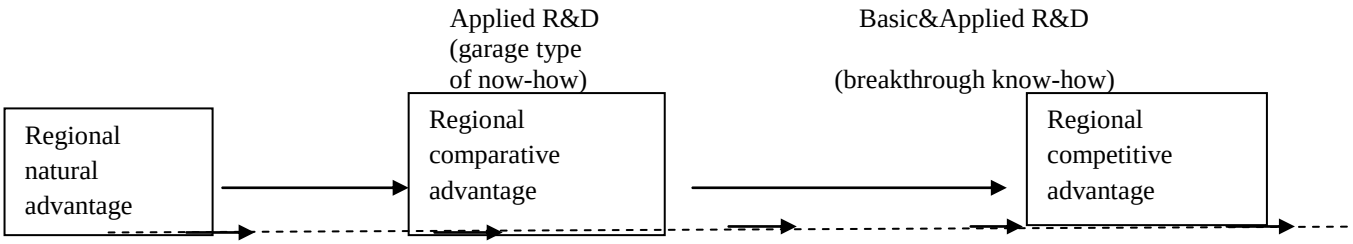
[15] Simon Kuznets. Six lectures on Economic Growth. The Free Press. Third printing. 1966. P.99

[16] Simon Kuznets. Six lectures on Economic Growth. The Free Press. Third printing. P.99-100

- technological innovations enables to overcome very specific economic and resource disadvantageous and to develop a specific economic advantageous, ensuring the long term prospective for the business development, R&D activities and education;
- the relevant decisions toward selection the core technology (sunrise, General Purpose Technologies, targeting industries whatever we call them) enforces the synergy effect, which means the emergence of new technologies in various fields of business activities generated by the market forces (the process of "bee swarm", applying the I.Schumpeter's description for the technological renovation of societies).

The origin of the local technological specialization relates to the specific "regional natural advantage", based on the natural endowments specific for any certain region. In other words, specific combination of recourses represents the economic identity of the every given region, which, in turn, determines the specification of the R&D domain, university graduates competence, business investments priorities (figure 2).

Figure 2.
National (regional) economic identity in progress




Specific regional economic advantage represents a core for the regional economic identity. Technological development should be relevant to the specific "regional advantage" in terms of resources and economic capabilities, endowed and accumulated within any peculiar locality. The "regional advantage" should be presented as dynamic rather than static phenomenon.

The local economic system in its basis has the technology-industrial cluster - a network of the R&D institutions, universities, innovative

companies and various economic actors underpinning the new technologies from its birth until the end of their life cycle. The similarity of technological specialization for the majority of local companies facilitates the rapidity with which the new technologies are absorbed by the local companies (this effect is known as the technological diffusion), thus accumulating the total economic outcomes for the local society.

In this regard the regional economic identity as the part of the regional identity in general have sense and determines the technological prospective of the every local society and through it (as such) – the technological prospective for the heterogeneous societies in general. As we noted previously, "The explicit economic and technological specialization of the country facilitates the establishment of technological, science and education policy objectives. In turn, the economic and technological specialization of the country facilitates the diffusion of new technologies among national companies and increases the cumulative commercial benefits thereby improving the quality of economic growth in the country."[17]

Therefore, technological innovations represent a very unique means for overcoming resource scarcities, various economic bottlenecks and shortages. In this sense the economic crisis is the most favorable conditions to thing about creation of new technologies, new business, new clusters and the new type of the division of labor. Creation the new economies follows the destruction of the existing, even previously powerful, economic systems. It was explained in the Joseph Schumpeter theory of the "creative destruction". However, we should recognize that we are not fully understands the essence of that very complicated phenomenon, which means that the theoretical breakthrough represents one of the most urgent necessity for the global society, troubled by the global economic earthquake.

[17] Irina Boyko. A National Innovation System: Framing new pattern for sustainable development. In "Knowledge based Entrepreneurship: Innovation Policy and dynamic development of knowledge-driven entrepreneurship. Baltic Dynamics 2004". Knowledge Economy Series. EffeElle Editory. Italy.2005. P.137