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Some Critical Issues in Innovation and Economic Development: Lessons from the Recent Turkish Experience

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Abstract

In this article, selected critical characteristics of innovation based development are analyzed. In this context, some inputs of innovation, including R&D and education and strategic approaches are analyzed with the view of "innovation based development." The Turkish experience reveals that simply increasing the expenditures on inputs of innovation *per se* may not return as improvements in innovation. Particularly, making the necessary adjustments and management of details (fine-tuning effect) and components that feed innovation, as well as the general policies, such as, improving effectiveness of R&D expenditures and supports are key determinants of achieving innovation goals. Human resources planning according to the new skill requirements and occupations of the information society, and transforming the education system to an analytical learning from the rote learning based system are other highlighted issues. In this respect, the key policy is to change the main characteristics of examinations, especially the central ones. In addition, as a basic strategy of development, an industrial designs based strategy is recommended.

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Keywords: Innovation; development; R&D; designs; rote learning

1. Introduction

Charles Duell, the Commissioner of the US Patent Office in 1889, has become famous with a widely quoted saying attributed to him as "everything that can be invented has been invented." When he said that, the number of patent applications in the US was close to 39,000 and it exceeded 600,000 in 2016.

Similar predictions about the future were made by even the most knowledgeable people at the times of a rapid

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industrial growth of the early 20th century. Interestingly, they did not foresee today's widely use of most basic goods, such as cars, TVs and so forth.

When a quick visit is made to the late 19th and early 20th centuries, one can find many examples of such quotations, from science people to scientific journals, underestimating the possible future progress of technological developments and their widely use in daily life. Even most of the inventors themselves could not predict the degree and speed of diffusion of their inventions and how they would affect the world and the lives of people.

President Rutherford B. Hayes commented to Alexander Graham Bell in 1876 on viewing the telephone for the first time: "That's an amazing invention, but who would ever want to use one of them?" Graham Bell offered to sell his telephone patent to Western Union for $100,000 in 1876.

Time and experience have proven that the speed of the growth in science, technology and their impact on the lives of people are well beyond above the predictions and expectations. This is due to ever increasing rate of development in knowledge, information, science, technology and their reflections in our lives during the industrial society, but especially in the information society, in which the rate of increase can be described as "light speed".

However, the historical evidence and the accelerated rate of increase in technological developments [1] imply that the future society is likely to be beyond our expectations and predictions. Today, most of us would agree that there is still much to be invented and discovered. We think that the inventions of future will be more extraordinary, advanced and innovative than those which preceded them. Such a speculation can be supported by figures on the industrial property rights. According to the World Intellectual Property Organization (WIPO), in 2017; there were 3,168,900 patent applications (44% by China and 19.7% by the USA), 12,387,600 trademark applications and 1,242,100 industrial design applications in the world. This means that, every minute; approximately 6 patent, 24 trademark and 2 industrial design applications are filed.

This and similar evidences imply that inventions and innovative characteristics of an economy and a society will continue to be crucial in future. In such a world, the key issue for a country in the long run (for a company at micro level in the mid-term) is to be at a good and competitive position and this requires to attach special emphasis on these critical issues, namely, information, science and technology, which requires a knowledge and innovation based economy.

Any country at macro level and any company at micro level both face this challenge and have to respond appropriately to these speedy developments, which means that we face many current issues and challenges related with innovation, such as industry 4.0, education 4.0, management 4.0 and so forth.

Innovation has been appraised mostly for the assumption that it will lead to economic growth and development, a major question for economists, statesmen and international organizations. Apart from the classical economists, such as Adam Smith, David Ricardo, Adam Smith and Karl Marx who implied its basic ingredients in their economic approaches, modern theory of economic growth goes back to Frank Ramsey [2] and has developed in time, however, with varying importance attached by economists and statesmen. Especially after the 2nd World War and founding of the United Nations, "development has captured the attention of economists and statesmen alike. [3] Hence, a more pronounced change came towards the end of the 1960's. Despite the fact that many developing countries achieved quite high economic growth rates, growth per capita income had not eliminated poverty and frequently been accompanied by a widening gap between rich and poor within those countries. [4] Further, as mentioned by various economists, [5] middle income trap (and low income trap) will be there, waiting those countries on the development road.

Today's understanding of development goes beyond the simple traditional definition of economic development as "a rise in the development refers to progress in an economy". Development refers particularly to improvements in the qualitative economic and social indicators such as, income per capita, education, health, etc. which reflect the quality of lives of people. In addition to improvements in the general economic indicators of growth, such as increase of GDP, exports, etc., sustainable development refers to the adoption of new-high technologies, and general improvement in living standards of the common people. Obviously both issues, growth and development are strongly interrelated and are very broad.

After briefing innovation and development issues, this article tries to analyze some selected critical inputs of innovation with a view of their impact on development also referring to the Turkish experience. Rather than the standard and popular advices as "to increase R&D expenditures, invest in innovation" kinds of approaches, selected

qualitative aspects such as developing and adopting a strategic approach, improving the effectiveness of R&D, transforming to an analytical education system from rote learning based education which can increase the effectiveness of investment, as described in this article, the "fine-tuning effect" are the main focus of this article. By "fine-tuning", we mean developing a policy or measure which will stimulate the critical point (similar to acupuncture).

Since both innovation and development are very broad and comprehensive issues, very important elements of them, such as industry 4.0, industrial property rights (patents, trademarks, and industrial designs), creating value added by trademarks, university-industry co-operation and many others are not analyzed here, due to the requirement to limit the content. Nonetheless, the strategic approach and "fine-tuning effect approaches" can be applied to them in like manner. Being aware of the broadness of the both innovation and development, the purpose of this article is not to analyze the whole raised problems thoroughly, but it is limited to highlight and indicate the key issues and give examples and methods how to tackle those problematic issues with reference to the Turkish experience.

2. Innovation and development

In the minds of many people, and certainly in the view of most policy makers, innovation is a key factor of economic growth and development. Economic growth itself can be achieved by putting more factors of production to work (increased investment, use of more land, decrease in unemployment and increase in labour force participation) and by achieving higher levels of output with the same amount of resources (total factor productivity -TFP- growth). Innovation *per se* does not increase the amount of productive resources, hence it affects growth mainly through TFP. [6]

The concept of development has changed in time depending on the new emerging determinants; and hence, innovation and knowledge based development has become more popular and focus of interest today, at a time when the world is experiencing a transition to the information society.

It is generally accepted that there is a correlation between technological and economic development. OECD research and analysis also reveal that innovation is a key driver of growth performance. [7] However, the complexity of the connections that link technological innovation, structural change and the long-term dynamics of advanced capitalist economies [8] necessitates special treatment of the dynamics and determinants of innovation.

The basic input of growth and development is knowledge. "Economic growth comes largely from the accumulation of knowledge" [9] and knowledge based growth and development increases the quality of our lives; how we produce, generate income, how we earn and consume.

Obviously, innovation is one of the most critical, and popular as well, issue in development, which constitutes the main goal that every country tries to achieve. As the importance of innovation as a driver of economic and social change grows; its nature, role and determinants are receiving increasing attention. By its nature, innovation is a broad concept which encompasses a wide range of activities and processes: markets, entrepreneurship, networks and competition, but also skills and organizations, creativity and knowledge transfers. [10]

Innovation is simply a process of transforming the new ideas, new knowledge into practice, i.e., into new products (goods and services). According to the Organisation for Economic Co-operation and Development (OECD), innovation is defined [11] as the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations.

From business point of view, to be called an innovation, an idea must be replicable at an economical cost and must satisfy a specific need. In other words, innovation is the process of translating an idea or invention into a good or service that creates value or for which customers will pay. [12] In this respect, innovation can be described as "turning an idea into a solution that adds value from a customer's perspective." [13]

In terms of per capita income, the way of generation of income is important, not only country wise but also individually. A country may be rich and the source of income may be natural resources. Let us assume that this country is a resource-rich economy and generates a certain high level of GDP by exploiting rich oil sources. Income per capita in this country is very likely to be high. On the other hand, another country may have the same amount of income per capita, however, if the sources of income in this country are productive economic activities, industry, trade, exports, high technologies, knowledge based industries with higher value added; sustainability of economic growth and development, for many reasons, development level and many indicators of development are likely to be better in the latter. First of all, economic structure, development of science and technology, levels of education and skills, the nature of the economic activities, etc. in this country are very likely to affect the determinants of development positively. Furthermore, if we consider development in a broader sense, fair distribution of income, social rights, democratic rights and other human rights are possibly more developed in the latter country.

An innovation based economy can also change lives of individuals. One can earn his/her life by working in a job with heavy and even dangerous or unhealthy working conditions, or he/she can generate the same amount of income by working in a job which requires higher levels of education and skills. Income per capita of both of these individuals may be the same, but the way of generating that income, the quality of work and life will be different. Furthermore, not only earning styles, but also spending and life styles are likely to be different in two ways of earning income. Shortly, innovation based economies are good for us, for people and for countries.

Innovation is gaining prominence in all kinds of economic activities around the world. Not only advanced economies but also developing nations are finding that innovation is one of the main drivers of economic growth. This renewed understanding of the significance of innovation is having a growing impact on the course of policy formulation in many countries. [14]

The Global Innovation Index (GII) helps to create an environment in which innovation factors are continually evaluated. It is emphasized in The Global Innovation Index 2018 that: [15] “all editions of the GII demonstrate the positive link between innovation performance and an economy’s level of development as measured by GDP per capita.”

At its best, innovation is not only a driver of economic growth but also a wellspring of solutions to pressing social problems such as aging, pollution, and the spread of diseases. Furthermore, innovation in goods, services, processes and practices can help accelerate the recovery and put countries back on a path to sustainable -and greener- growth. [16] The impacts and the accomplishments that innovation has achieved and will continue to achieve in the near future are worth more than money and percentage point increases in economic growth. They are central to overcoming important challenges that mankind faces in the 21st century. As it was in the human history, problems of limited resources were by again new technologies and, interestingly, the problems created by new technologies such as exploitation of resources and pollution etc. are trying to be solved again with the help of new technologies.

For example, the energy problem is a major problem that the world faces today. With this in mind, the GII 2018 edition is allocated to the theme of ‘Energizing the World with Innovation’ and elaborates on the opportunities and challenges of the current and future energy innovation landscape. According to the GII 2018, [15] the world will continue to be powered in the context of increased energy demand and increasing concerns with environmental sustainability. This edition of the GII 2018 shows that innovation is squarely in the centre of this effort. Global energy demand is reaching unprecedented levels as a result of a growing world population along with rapid urbanization and industrialization, particularly in developing and emerging economies. Projections indicate that by 2040 the world will require up to 30% more energy than it needs today. As a result of these challenges, higher levels of technological and non-technological innovation are needed on the supply side of the energy equation (including cleaner energy sources), the demand side (including smart cities, homes, and buildings; energy efficient industries; and transport and future mobility).

3. Some critical issues in innovation-based economic development: lessons from the recent Turkish experience

In a rapidly changing world, from industrial to information society, it is natural that the new knowledge based economy and innovation driven development bring various prominent characteristic aspects. With the key assumption that innovation leads to development, most countries concentrate in allocating as much financial resources as possible to the inputs-determinants of innovation. However, translating innovation investments into results is the most important point. Focusing on the best way to translate investments on education, a high number of qualified researchers, and high R&D expenditures into high-quality innovation outputs are sometimes neglected. Despite significant amounts of investment in innovation inputs, some economies do not generate a corresponding level of innovation outputs. Most economies have a linear relationship between innovation inputs and outputs. But there are important outliers (such as China) that strongly over- or under-deliver with respect to obtaining a 'bang for their buck'." [15]

Going beyond the amounts of investment in the well-known inputs of innovation, there are several qualitative issues which will increase the efficiency of these inputs and will be determinant in the degree of success of innovation based development policies. Some critical issues that come into prominence need special attention in this process. In this paper, we will mention only some of them that can help in yielding maximum benefit from innovation practices for development.

3.1. *Need for a strategic approach: Design based development strategy*

In order to reach the main goal is to achieve higher rates of development, the general framework of development -and in our case innovation as well- should be governed appropriately. In this context, a development strategy is a prerequisite in order to shape the general framework in which the whole policies and practices will be applied. Although it is a very broad and complex problem and process, we can very briefly summarize what a country should do in such a strategy.

First of all, the long-term expected future trends of the global economy and technological developments should be analyzed. Taking the related variables including regional factors into consideration, and depending on availability of resources (or possibility and means of making them available), comparative advantages and niche industries should be identified. Of course, the main focus should be on the knowledge based high-tech and high value added industries. (All of these topics have a lot of details, such as selective incentive policies for high-technologies, R&D, innovation, etc.) These should be complemented by planning of resources, internal and external financing (capital), natural resources, and of course the most critical one, human resources. In addition to the qualitative aspects of education, as mentioned below, matching the human resources in terms of occupations and skills with the needs of the strategic targets, i.e., with the needs of the identified high-tech industries is crucial. The rest is mostly formulating appropriate policies, shaping legal and institutional frameworks and governing them with a careful implementation. However, it should not be forgotten that this is a time-wise and issue-wise dynamic process and administrating the whole process and every single ring of the chain, i.e., "fine-tuning effect" is the most important factor that determines the degree of success.

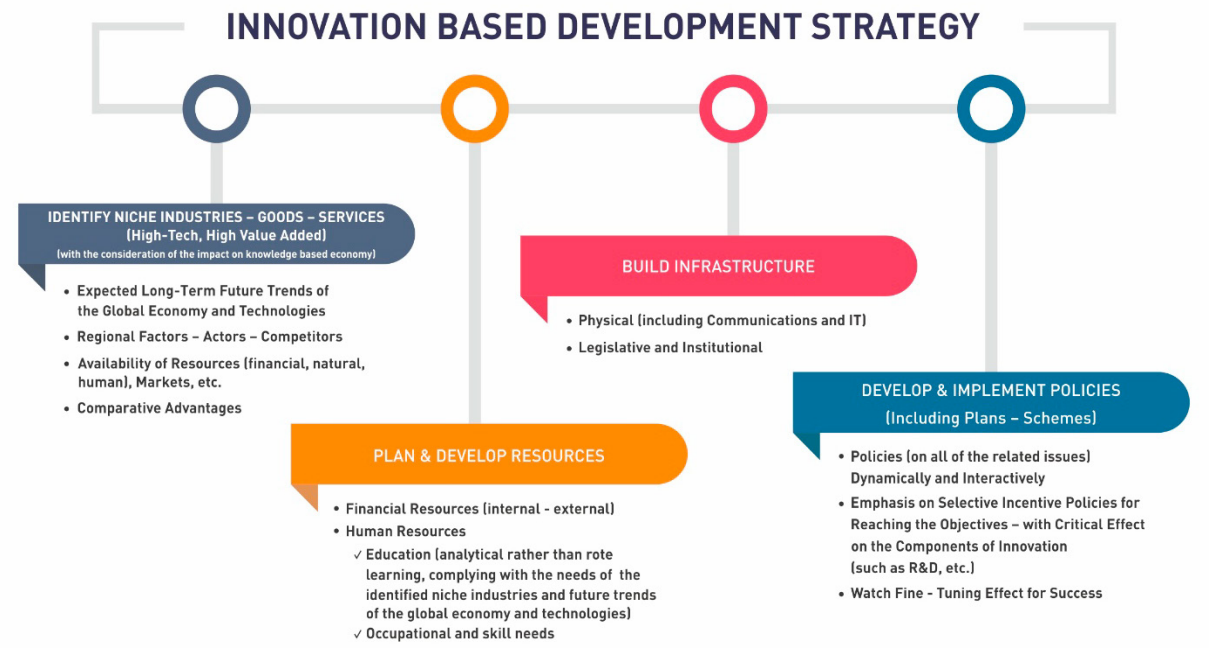


Fig. 1. Innovation based development strategy

If we take the case of Turkey, strategies have been prepared for various fields at various times, but they were individual, i.e., not integrated and have not been implemented and followed up sufficiently. For example, an industrial strategy was prepared in 2008, it was presented in the Cabinet but was almost left there.

Given the approach of the framework in Figure 1, designs can be adopted as an engine and leverage for innovation in the development strategy for Turkey. Industrial designs have various advantages in comparison to technical inventions, which can be summarized as below:

- Development of designs and R&D activities require much less financial resources.
- The necessary human resources for development of designs can easily be provided, developed and employed at lower costs (less costs of education, salaries, etc.).
- Development potential of designs is much higher. In most of the products, from automobiles to furniture and others, technical development is rather slow. However, all products continuously develop their designs in terms of functionality and outlook-aesthetics, which is the most important factor in marketing.
- Designs can be applied in a much wider spectrum of economic activities.
- Possibility of application of designs to practice and get a return of economic value is much higher.
- Intellectual property protection of designs is much easier, faster (average patenting process of technical inventions takes more than 4 years) and less costly.

Shortly, development-application to the economy of designs is easier, less costly and takes less time *vis-à-vis* inventions. With these advantages, an economy like Turkey with limited financial resources can use industrial designs as an engine for innovation and development.

Turkey has some comparative advantages in this strategy. First of all, Turkey is relatively more developed in industries such as textiles, furniture, and many others that benefit a lot from designs. Secondly, despite the stagnation in the last 5 years (10 % decline in the last year), with 42.082 applications in 2018, [17] Turkey is still among the top countries in industrial design applications. Thirdly, Turkey has already opened many design departments in universities and technology and design courses take place in the curriculum of primary schools. Further, many high schools have opened "technology and design" branches in the last decade. Hence, supply of qualified skilled human resources, which is crucial, is another advantage of Turkey.

In order to develop such policies and strategies, coordinate the related activities and to stimulate innovation and development by using designs as a leverage, a high level represented the "Turkish Design Supervisory Council" was founded in 2009. The Council held 18 meetings in 10 years. Despite these positive developments, an integrated and detailed full strategy has not been put into practice so far in Turkey.

The Korean experience is a good example of designs driven innovation and economic development. What Korea did was, they brought good designers from abroad decades ago and at the same time started developing their big brands. They attracted the consumers by the outlook first. After having a good share in the global markets, these companies started to be more competitive in the technology as well. The country adopted a strategic approach and supported it by the education system, founded many design schools, departments etc. However, in the aftermath of the 1997 financial crisis, the Korean economy underwent a paradigm shift, from quantitative expansion to a qualitative improvement in standards. As another byproduct of this shift, Korean society has come to fully recognize advances in design as a core element of the national economic development. In this context, policies by the government to promote design inspired initiatives by companies to improve the standards of design on goods and services, and untiring efforts by designers for the globalization of Korean design have been critical policy instruments. [18]

3.2. R&D and innovation

Assuming its direct and positive influence on innovation, Research and Development (R&D) has been an essential instrument for economic growth and development in the industrial society and its importance increasingly continues in the transition process to the information society. Innovation and thus, economic growth and development have always been associated with R&D. This is because of the general consensus that R&D is the engine of innovation. Therefore, almost all countries attribute special emphasis on R&D and try to do their best in increasing the amount of financial resources allocated to R&D.

Referring to various statistics, GII 2018 states that, [15] from a historical perspective, the global landscape of investment in science and technology as well as in education and human capital has undergone important positive shifts over the last three decades. Today, it is no longer a few high-income economies such as the US, Japan, and certain European countries that carry out R&D. R&D is now a common pursuit or, at a minimum, a serious policy ambition in most economies, including those in Asia where R&D has new momentum.

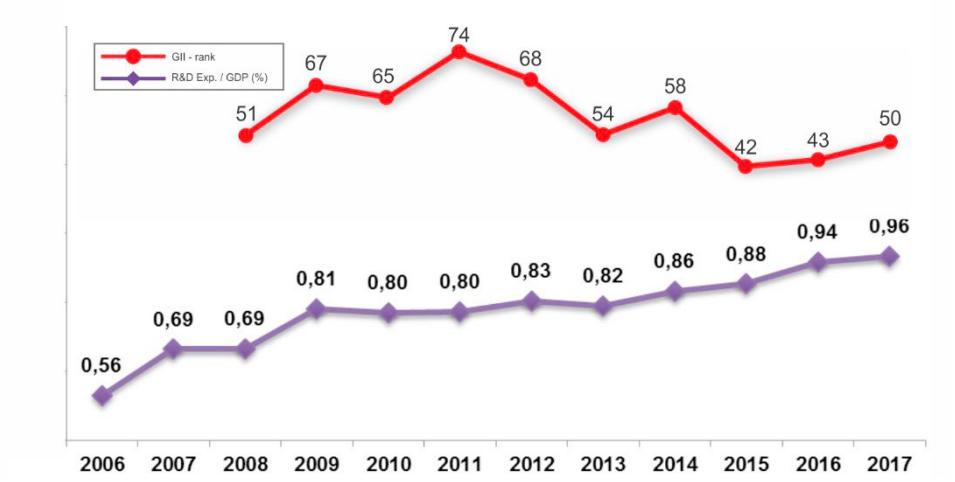
R&D intensity, defined as "R&D expenditures divided by GDP", is used as an indicator of investment in R&D. Using UNESCO estimates, GII 2018 reports [15] that the worldwide estimated total of R&D expenditures has continued to rise, more than doubling over the 20 years between 1996 and 2016, with businesses increasingly bearing the brunt of R&D investments. However, when it comes to R&D intensity, despite the big efforts in order to increase the share of R&D expenditures in GDPs, R&D intensity has been stable or even intensified over recent years. In terms of the world averages, R&D intensity rose from 1.5% only to 1.7% in that period. In the same term, within the Organization for Economic Co-operation and Development (OECD) region, growth in R&D intensity increased from 2.1% to close to 2.4%, an increase in part also affected by negative or lower GDP growth. However, it should be noted that R&D is still highly concentrated in high-income and a very few middle-income economies; the trend is worse for basic R&D, which continues to be conducted mainly in a few high-income economies. Excluding China (which has maintained its steady increase, reaching 2.1% in 2016), in the middle-income economies R&D intensity improved

only marginally, from 0.5% in 2000 to 0.6% in 2016. Low-income economies still hover around 0.2% to 0.4% across 2000-2016, showing how nascent their innovation systems still are.

We know that spending in R&D is necessary for development (by its impact on innovation) but richer countries invest more on R&D. This R&D-high income relation resembles the dilemma of "which comes first, chicken or egg causality." In that case, then a smartly organized R&D should be the main focus in order to reach the general goals and close the gap between richer countries.

3.2.1. R&D expenditures and innovation in Turkey

As a country ambitiously aiming to reach higher growth rates, Turkey has given particular importance to innovation and R&D in the last 15 years. These efforts have been reflected to the increases in R&D intensity indicators for the term 2006 and 2017, from 0.56% to 0.96%, which is well above the world average (See Fig. 3.1.) representing an increase of 74%. However, 44%, the biggest part of this increase was achieved in only 3 years, between 2006-2009, whereas after the global economic crisis, the increase in R&D intensity was only 18% in 8 years. Nevertheless, according to the GII 2015 Report, [19] R&D intensity increases of Turkey, during and post 2008-2009 global economic crisis is found to be quite successful in comparison to many countries.



Source: Cornell University, INSEAD and WIPO *The Global Innovation Index (Various Years)* Ithaca, Fontainebleau, and Geneva; TUBITAK (The Scientific and Technological Research Council of Turkey). [20]

Fig. 2. R&D intensity and GII – Turkey

As mentioned above, the fundamental reason in allocating part of the limited financial resources to R&D is its expected impact on innovations. The major indicator for the success in innovation is a country's ranking in the Global Innovation Indices for various years. A summary takes place in the same Figure 2 together with R&D intensity for various years. (Note that, since impact of increases in R&D intensity on the ranking in the GII will take place with a time-lag, data for R&D expenditures are taken 2 years prior to the available data for the GII.)

3.2.2. Some key policy recommendations for R&D incentives in Turkey

Despite the fact that Turkey spent relatively more than the world average and many countries in R&D, its position in the GII ranking has not changed (51st in 2008 and still 50th in 2017) in 10 years. This picture simply means that, *inter alia*, there is an efficiency problem in the R&D expenditures. This situation necessitates to question and analyze the R&D expenditures and of course corresponding incentives in a qualitative manner.

Actually, there are some inefficiencies in the Turkish R&D support system. First of all, still, R&D activities mostly belong to the public sector and public universities, which implies that inefficiencies embodied in the public sector constitute a major problem for the public R&D expenditures as well. However, the key role of the public should be to build appropriate infrastructure for innovation and to stimulate private R&D culture, private investments and practices.

The major problem with the Turkish R&D incentive system is the actual use of these incentives in practice. When the R&D incentives were mainly started by TUBITAK (The Scientific and Technological Research Council of Turkey) in the early 2000's, the incentives were not selective enough with an intention of creating a big momentum at the initial stage. However, this character continued more and less in the following years. Many beneficiaries, universities etc. allocated those funds for buying computers, or to already ongoing projects. In order to be eligible for some R&D incentives, many beneficiary companies from various industries changed the status of the engineers they already employed to R&D staff.

Furthermore, a somehow chaotic structure of the R&D incentives decreased the efficiency of these R&D supports due to around 15 bodies providing mostly repetitive R&D supports. If such deficiencies can be improved by a smart fine-tuning, the same amount of R&D expenditures will result in a higher innovative impact.

3.3. Education and innovation

Education in every sense is one of the fundamental factors of development. No country can achieve sustainable economic development without substantial investment in human capital. Education enriches people's understanding of themselves and the world. It improves the quality of their lives and leads to broad social benefits to individuals and society. Education raises people's productivity and creativity and promotes entrepreneurship and technological advances. Further, it plays a crucial role in securing economic and social progress and improving income distribution. [21]

In addition to the direct impact of education and skills level of the workforce on economic growth, education is among the most important determinants of innovation. Education and innovation are deeply intertwined. Multiple studies have demonstrated the importance of education and training for the innovative capacity and performance of businesses and entire economies. [22]

Being aware of the crucial role of education in general development as well as its impact on innovation in particular, all governments and policymakers attributed special emphasis on education. However, the degree of success varies in different practices and cases.

3.3.1. Analysis of innovation performance of Turkey and education expenditures

In terms of giving high priority to education, Turkey is not an exception. Turkey invested in education in the past 17 years a considerable portion of its scarce resources. Figure 3 demonstrates that the share of education expenditures in the GDP increased from 2.6% in 2000 to 3.6% in 2017, [23] which corresponds to a 38% increase, a high record in the recent history.

However, the same figure reveals that such substantial increases on education expenditures are not reflected in the general performance of the Global Innovation Indices during the last decade.

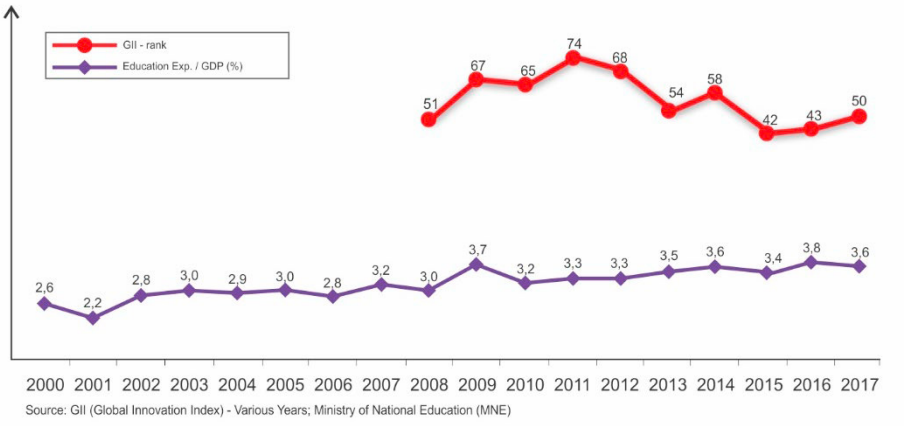


Fig. 3. Share of education expenditures in GDP - GII rankings of Turkey

In order to have a better understanding of the expected positive results of the investment in education on the quality of education, PISA (Programme for International Student Assessment) provides some useful indicators. According to the PISA results, the averages of the scores of the Turkish students are below the OECD averages and show a declining trend in rankings. [24]

	SCIENCE		MATHS		READING	
YEAR	**SCORE**	**RANK**	**SCORE**	**RANK**	**SCORE**	**RANK**
2006	424	43/57*	424	28/40	447	28/57
2009	454	43/65	445	43/65	464	41/65
2012	463	44/65	448	44/65	475	43/65
2015	425	52/70	420	51/70	428	50/70

SOURCE: OECD, PISA Results in Various Years' Reports.
*43rd among 57 countries.

Table 1. PISA scores and rankings of Turkey

When the situation of success of the Turkish students (15 years old) in terms of their scores is compared between 2006-2015, despite the sharp increases in the financial resources allocated to education, it is observed that the level of scores of science and math have not changed, but reading scores have even declined. Furthermore, "reading" scores of the Turkish students declined 18 points on average in the last three years (2013, 2014, 2015). [25] Actually, there had been some improvements until 2009 but the performance of the students went back later (See Table 1, Figures 4, 5).

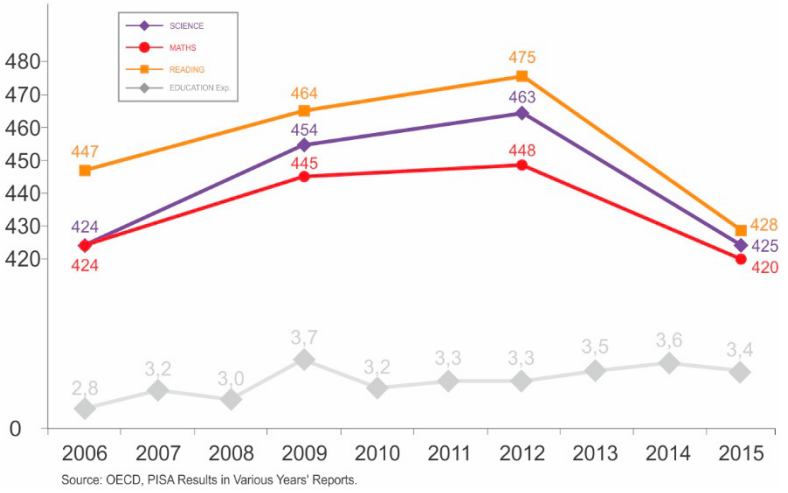


Fig. 4. PISA scores of Turkey & share of education expenditure in GDP

During 2006-2015, against a substantial increase in the share of financial resources allocated to education the country ranking of Turkey dropped behind 11 ranks in science, 23 ranks in mathematics and 22 ranks in reading (Fig. 5). During this period, some countries such as Argentine, Bulgaria, Romania, UAE and Uruguay got ahead of Turkey. [24]

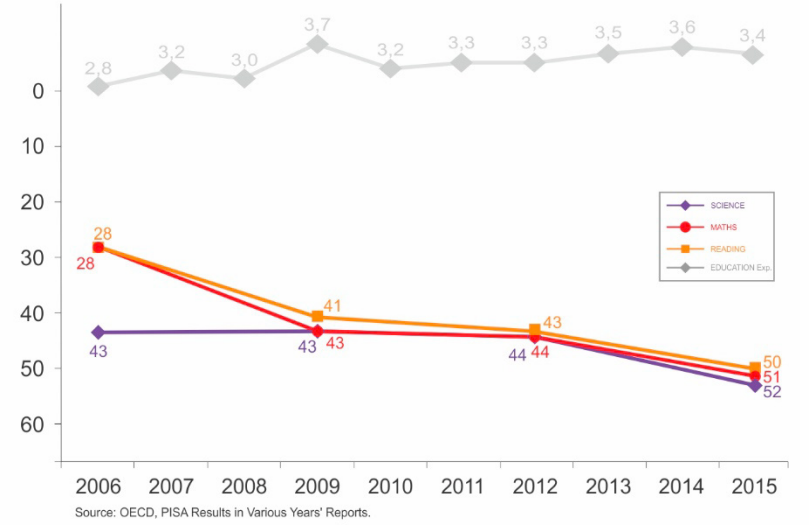


Fig. 5. PISA rankings of Turkey & share of education expenditure in GDP

The whole picture summarized above indicates that, especially from point of innovation, there is a problem in the Turkish education system and this is not related to financial problems. It is something beyond “money”. Since education is a very broad and important issue, we can mention some of the fundamental problems that have a negative impact on the Turkish education system.

3.3.2. Some key policy recommendations for innovative education in Turkey

Certainly, education is a very broad and comprehensive problem. Therefore, we will highlight a few critical issues which have negative impact on the innovative capacity of human resources and on the negative trend in the PISA rankings of the Turkish students and decrease the efficiency of high investments in education. Of course, we will indicate some key policy issues regarding these problems.

The Turkish education system is wholly regulated by the government and government policies, and therefore regulations and decisions are very determinative on the system. First of all, there is a consensus that very frequent system changes constitute the fundamental problem in the Turkish education system. Despite the fact that the same ruling party is in power for more than 16 years, there were 7 different national education ministers having different policies, understandings and projects, and of course all of them came with many "brilliant" reforms. Even during the same Minister's term, completely different practices were experienced. The system can be described as trial and error (mostly error) system. The instability has been such that a student entered a phase of education, e.g., starting high school, generally graduated from it in a different system. At the meantime, students' major goal of the "central university exam" that they were preparing with studying day and night would possibly be changed until they graduated.

Thus, in order to have a stable education system, developing and adopting a well-studied system and persevering in that is crucial. The fine-tuning clue regards with the decision making mechanism, and the key point is not to decide to a fundamental change, which will affect lives and future of millions of students and their families, very quickly, and not to implement it immediately without having sufficient analysis and discussions with stakeholders; but rather to study it thoroughly, discuss with all stakeholders in a process including the advisory councils. In the past, reform process was like that and decision and implementation of fundamental reforms generally took many years.

Second key issue is directly related with the efficiency of the investments in education, particularly investing in the use of technological products, namely distributing tablets to every student in primary to tertiary education. The total cost of the project was announced to be 30 bil. USD and the government has spent approximately 1 bil. USD so far. However, the return of this investment has been totally negative. Due to many reasons, the positive outcomes of interactive smart boards could not be yielded in practice. This practice, especially distributing tablets to students probably affected the PISA reading scores negatively by its weakening effect on reading-understanding skills. [26] This is an ironic situation that the teachers and the parents are trying to keep the children and students away from smart phones and computers on the one hand, but we are giving them tablets on the other, without making the necessary preparations, including training of teachers how to benefit from the new education technologies. In conclusion, in order to increase the quality of education, those resources should rather be allocated to the physical (schools, classrooms) and human (to salaries and training of teachers) infrastructure.

Another major qualitative problem of the Turkish education system which is closely related with innovative capacity of human resources is the traditionally dominant rote learning education.

Rote learning is the memorization of information based on repetition. Memorization isn't the most effective way to learn, but it is a method many students and teachers still use. A common rote learning technique is preparing quickly for a test, also known as cramming. [27] However, besides rote memorization of content at a certain degree, deep learning skills should be developed in students to help them to become lifelong learners. The prevailing education system only fosters rote memorization ability in the students at all levels of education in many countries. [28] Another negative implication of rote learning education is curriculum and instructor oriented education vs student centered learning.

Importance of Albert Einstein's saying "Education is not the learning of facts, but the training of minds to think." has been better understood today. In the process of transition to the information society, developing creative minds through education has been a major goal. In order reform the system and eliminate rote learning, many projects, such as "pilot schools" have been implemented in Turkey. Nevertheless, all such discourses and efforts have yet been successful in achieving a substantial practice and success.

Indeed, it is possible to reform the system in a short period of time. The way of transforming the Turkish education system from rote-learning to analytic education is changing the content of the centrally organized exams, which are taken by all students, that exclusively determine the entrance to high schools, universities and public jobs.

In these exams, the main purpose should be evaluating the analytical capability such as critical thinking, comparing, problem solving and inducing, instead of letter-perfect data. In this case, since the main target of the actors of the education in Turkey is to be successful in these exams, all education institutions (primary-secondary-high schools, universities, and supportive course institutions), teachers-lecturers and students will adapt themselves to the new system.

Regarding the tests, almost the whole Turkish education system has been predominantly using tests (choosing among the options) rather than open ended questions for more than three decades. This certainly has a negative direct impact on development of writing skills and indirectly on reading-understanding (for writing is a very important element of language skills). Turkish education has to return to a system of examinations where classical questions and written answers are used at least at a certain degree.

Another key issue regarding education, which we will not get in its details, is the occupational structure of the schools, especially universities in the Turkish education system. In the current system, from primary to high school, education does not provide an occupation to the students. Youth generally obtain an occupation after they graduate from a university. In this system, the universities currently are not providing education in the fields that there is need but in the fields where supply of education is easier and less costly, i.e., there is no need (supply surplus). For example, teachers are employed mostly by the government schools, i.e., demand comes from the government side. On the other side, supply of teachers are also is provided by public universities. Ironically, there is a huge mismatch between supply and demand and many teachers in various fields are unemployed.

Briefly, what actually the country needs from the education system, that is the human resource supplier mechanism is to provide qualified, creative manpower in the fields which match with the needs of the society, rather than standard graduates in fields where they will be very likely unemployed. Certainly, this is waste of scared resources of the country. The education system should be rearranged such that it would provide the students with occupations and skills for the real life in general. Also, there should be a planning of occupations, study fields and departments according to the actual needs of the society/economy and future needs of the information society, as mentioned in 3.1 (innovation strategy) above.

3.4. Promotion of differences: thinking different

In the industrial society, production, processes, goods and services and even the optimum mode of production, modes of working, education, regulations, systems were generally standard. [29] In that society, standards increased productivity. Therefore, a predominant characteristics of industrial societies were development and predominance of standards, whereas the most prominent features of the information society are creating difference, thinking differently, and being distinctive in all fields, from modes of production to products and services, from labour relations to regulations and organizational structures, and to almost all fields. Flexibility, ability to change, openness and creativity, being distinct and unconventional and thinking differently have become the key characteristics and motto of the information society.

Since innovation implies difference, in order to reach a knowledge based economy and information society, it is crucial to reform the education system at the outset (which is discussed above) and organizational structures of business and all of governmental and non-governmental organizations in such a way that they would permit, open paths and promote existence of differences and different thinking. Ability to think differently and create differences is a key and horizontal factor for success in innovation efforts. However, it requires not only organizational and institutional changes, but also changes in minds and mentality.

4. Conclusion

Undoubtedly, sustainable development is a priority for all countries in today's world. Whilst going into a new era, information age, innovation lies at the core of development challenge that the whole countries face. The speed of development and diffusion of knowledge and high technologies has substantially increased in the information age. In this context, in order to achieve higher economic growth and development rates, countries allocate their scarce resources to innovation and invest in innovation and inputs of innovation as much as possible.

GII data for various years prove the positive link between innovation performance and an economy's level of development. Innovation does not only function as a driver for economic growth and development, but also increases the quality of an economy, society and lives of individuals as well.

Many countries, including Turkey, try to implement innovation based development policies. However, despite significant amounts of investment in innovation inputs, some economies, in particular Turkey do not generate a corresponding level of innovation outputs per unit input.

What is lacking, *inter alia,* is adoption and implementation of well-studied innovation based strategies. A design driven innovation strategy, as proposed in the paper, has a lot of advantages, as shown for the Turkish case and can be used as an engine and leverage for innovation in the development strategy for Turkey.

Furthermore, rather than focusing merely on the amounts of investments, as the Turkish experience also reveals, focusing on translating innovation investments into results is the more important point. Analysis of the statistics on the ranking of Turkey in GII *vis-à-vis* R&D intensity and share of education expenditures in the GDP *vis-à-vis* PISA scores and rankings of the Turkish students indicate that relatively high investments on R&D and education could not be translated into high-quality innovation outputs sufficiently.

It is necessary to prioritize the policies and incentives that foster new sources of innovation-driven growth. Efficiency of investments in innovation are central in this goal. For R&D incentives, to be more selective as a part of the fine-tuning approach and having a simpler and efficiently organized system are among the key recommendations of the paper. In the process of transition to the information society, developing creative minds and changes in minds, mentality and education is a critical issue. Regarding the education, after emphasizing the importance of having a well-studied stable system, current rote learning education system and examinations, especially centrally organized tests are analyzed in the paper. As a key policy implication, the main purpose of the education system is recommended to be equipping the youth with analytical capability such as critical thinking, comparing, problem solving and inducing, instead of memorising based education. As a fine-tuning effect, *inter alia*, transforming the questions, especially the ones in the central exams which are crucial for all Turkish students to a more analytical nature is recommended. This change will stimulate the expected structural changes in the Turkish education system.

To spur innovation as a tool for development, innovation process should be considered like a chain with various rings, from education to university-industry co-operation, from innovation strategies to R&D incentives, from intellectual property rights (patents, trademarks, designs) to commercializing of patents and designs and creating global trademarks and so forth. Although we could analyze only a few of them, given the limited scope of the paper, administrating the whole process with a system-wide approach and every single ring of the chain, not only in terms of general policies but also with special emphasis on details, i.e., "fine-tuning effect" is the most important factor that determines the degree of success.

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