The International Journal of Business Management and Technology, Volume 5 Issue 2 March–April 2021
ISSN: 2581-3889

Research Article Open Access

Assessment of Turkey's Innovation Performance duringthe European UnionCandidacy Period

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Abstract: Turkey is one of the countries that has taken part in innovation assessments by the European Union since the start of the candidateship period. The main goal of this study is to present an overview of Turkey's long term innovation performance in comparison with the European Union. Within this framework an evaluation is conducted based on the indicators of European Innovation Scoreboard reports between 2003 and 2019. There includes a discussion of related strengths, weaknesses, and policies in progress as areas for improvement in Turkey. The main areas of strength, however, are related to SME capabilities, although further improvement is required regarding patent application and human resources.

Keywords: Innovation, scoreboard, assessment, performance, Turkey

I. INTRODUCTION

Innovation is an efficient tool for renewal of products and services in certain markets, the development of new manufacturing and supply methodologies, and improvements in the skills of workers. Moreover, innovation is a support mechanism that can be used to enhance the strategic skills of firms along with their organizational talents. Innovation has also been an integral part of competitiveness in the European Union (EU) since the 1990s. As such, enhancing innovation and economic reform also became a part of the Lisbon Strategy in 2000.

One of the important activities that took place after the Lisbon Decisions was the assessment of innovation in the EU in comparison with other countries (see part 2), in which Turkey as a candidate country has been included since the beginning. European Innovation Scoreboard (EIS) reports (Union Innovation Scoreboard between years 2011 and 2015 and EIS again) are published on an annual basis. The EIS mainly summarizes national, regional, and industrial indicators in order to formulate policies and establish an index among countries with similar characteristics. Using different indicator classifications, the EIS measures related conditions for innovative potential, R&D investments, firm-based innovative performance, and implementation of innovations in industries based on commercial activities and their added value. It also summarizes successful outputs within the framework of intellectual property rights.

The goal of this study was to provide an overview of Turkey's performance in EIS reports from year 2003 to year 2019. This involved comparing Turkey's performance to the mean value of EU countries based on related indicators, the number of which has fluctuated during this time (see part 3). The study consists of 4 parts; the introduction, an assessment of EIS scorings, a discussion of the findings, and an overall conclusion. The results of the study are expected to enlighten Turkey's innovation performance in general terms between the years in question.

In order to evaluate the innovation capability of a country, various indicators can be used. This is in fact done in EIS with an input-output approach, where, inputs are considered as human resources and funding for innovation as a result of which they are converted to outputs such as patent applications. It can be inferred that firm capabilities act as moderators in here. In EIS reports, different indicators have been assessed in this stage. We begin by evaluating literature concerning some of the selecting indicators.

Keeping in mind the indicators which are focused in the EIS reports, the first group of selected studies are mainly related to the components, outputs of or affecting factors for innovation. One of them are the R&D activities as their importance is underlined by Audrestch&Belitski, (2014) in comparison with the knowledge spillovers. As the R&D is a multi-disciplinary topic in the literature, its "innovation indicator" characteristic and its effects on the market is researched by Coluccia et al., (2020) and firm scale dimension by Bauman&Kritkos, (2016). Second factor can be mentioned as the relation between design capability and innovation as mentioned by (Marsili&Santer, (2006).,Cautela et al, (2013) and Davern& Wilkin, (2008). At the similar token, the role of universities is also one of the topics that have been investigated especially on the basis of cooperation Scüzs, (2018), Lee &Miozzo, (2019) and as the actors of the triple helix (Lerman et al, (2021). Finally regarding the outputs of the innovation, the connection between innovation and patents are mentioned by Dachs&Pyka,(2009) and Clancy &Moschini, (2013).

When country-based innovation is in question, second group of studies concentrate on country evaluations in parallel to the indicators we used in the study. For example, knowledge investments and business R&D is researched by Hemert&Nijkamp (2010), knowledge transfer and higher education by Jackson et al, (2013) innovation and economic development by Ramadani et al, (2013), system of innovations Ferrera&Mavila, (2015), innovation and SME sector by Klonowski (2012), innovation and entrepreneurship policy by Dahlstrand& Stevenson, (2017).

Third group of studies use EIS indicators in order to assess the innovative and related performances. For example, Grupp& Schubert (2010) evaluate the national performance, Filipetti et al. (2011) relation between internalization and innovation; Ivanová&Čepel (2018) competitiveness and of Visegrad 4 countries; Russu (2014) Romania's creative and innovation potential; Paas&Poltimäe (2012) consistency between innovation indicators and national innovation performance in the case of small economies in their studies.

II. DATA AND METHODOLOGY

2.1. EIS Reports

The pilot version of EIS reports is firstly introduced in 2000 and provided information for the EU and selected countries that is used to track progress towards the EU's strategic goal of becoming a highly competitive and dynamic knowledge-based economy. The scoreboard is updated annually and based on a series of indicators (herein referred as "criteria"). Table 1 presents the EIS indicators for the selected years of the study.

For the purposes of the study, Turkey was compared with the EU 15-25-28 countries only, thus ignoring any other countries that were included in the EIS reports (e.g., US and Japan or associates wherever available).

Table 1. Number of EIS Indicators for Selected Years

Year	**Number of Indicators**
2003	28
2004	22
2005	26
2006	26
2007	26
2008	29
2009	29
2010	24
2011	24
2012	24

2013	24
2014	25
2015	25
2016	25
2017	27
2018	27
2019	27

Turkey has been listed as one of the acceding countries in EIS reports and have been assessed in the Scoreboard since 2003. Table 2 displays the number of countries included in EIS assessments.

Table 2. Number of Countries Included in EIS Assessments

Year	EU countries	Others
2003	15	10 AccedingcountriesBulgaria, RomaniaandTurkey, theassociatecountriesIceland, NorwayandSwitzerland, the US and Japan
2004-2005	25	Bulgaria, RomaniaandTurkey, theassociatecountriesIceland, NorwayandSwitzerlandthe US and Japan
2006-2014	27	CroatiaandTurkey, theassociatecountriesIceland, NorwayandSwitzerland, the US and Japan
2015-2018	28	Iceland, theFormer Yugoslav Republic of Macedonia, Norway, Serbia, Switzerland, Turkey, the US and Japan

2.2. Methodology

Based on the EIS reports for the selected years (EC, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2012, 2013, 2014, 2015, 2016, 2017, 2018) the scope of the data in this study cover a total of 17 years (2003-2019) divided into 7 periods according to changes in classification. When such changes occur, the pairwise comparisons that were made also change. All dimensions are therefore compared wherever data for Turkey was available; however, some significant differences are omitted for simplicity. Thus, it is generally only highlights that are considered. The 7 different time periods considered in this study are as follows:

- 2003 (1st period)
- 2004 (2nd period)
- 2005-2007 (3rd period) (criteria classifications are retrieved from the 2005 report as they do not change throughout the period)
- 2008-2009 (4th period) (criteria classifications are retrieved from the 2008 report and the 2008 methodology report as they do not change throughout the period)
- 2010-2013 (5th period) (criteria classifications are retrieved from the 2010 report as they do not change throughout the period)
- 2014-2016 (6th period) (criteria classifications are retrieved from the 2014 report as they do not change throughout the period)

- 2017-2019 (7th period) (criteria classifications are retrieved from the 2017 report as they do not change throughout the period)

Moreover, regarding different tabularizations in the EIS reports, only "current performance" tables were used to provide a clearer comparison between both countries' and periods' indicator scores.

2.3.Data Availability and Key Highlights

As noted previously, classifications as well as criteria changed from one period to another. Moreover, the number of countries included also changes. Throughout the 15 years, the data provided by Turkey varied; however, the overall amount gradually increased, especially from the 4th period onwards. Until then, Turkey provided data under the heading "knowledge creation" for the first two periods, and "innovation drivers" and "intellectual property" for the third period. It should also be noted that there were no data on venture capital, venture, and venture capital investments in the last 3 periods.

In the methodology section, the mean values for EU countries and Turkey are compared. In the first few periods (notably until the 4th period of 2008-2009) the amount of missing data for Turkey was quite high. However, after the 4th period, this problem was generally resolved.

It should also be noted that, when dealing with pairwise comparisons between groups of countries, "current performance" above 60% with trends toward a general increase were considered. The main areas selected and discussed in the text were those above 100%.

III. FINDINGS AND DISCUSSION

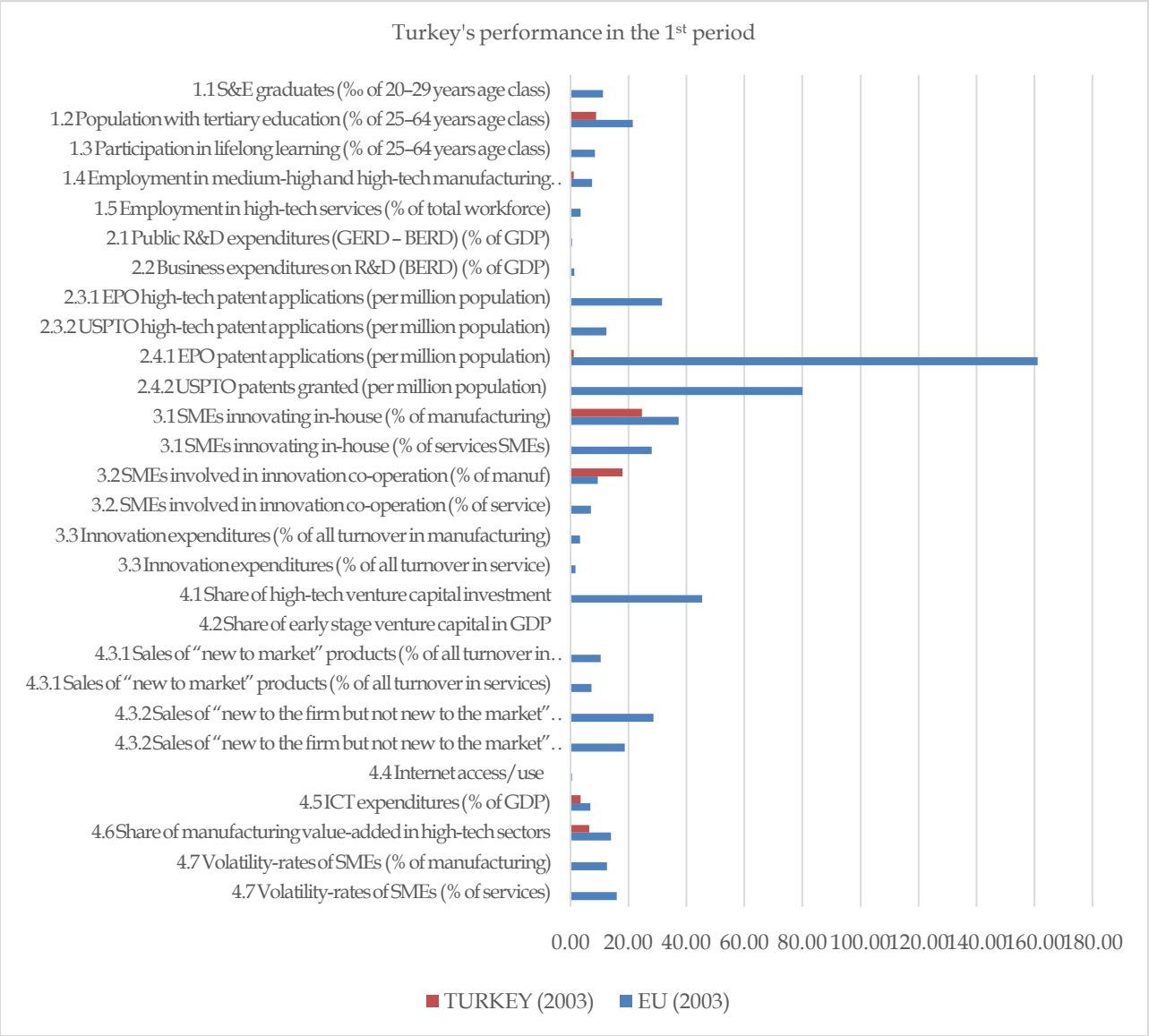
3.1.Findings: Data Comparison in Brief

1st period (2003)

In the 1st period, significant observations closer to or above the EU mean for Turkey were mainly in "Small and Medium Sized Enterprises (SMEs) innovating in-house"criteria. One significant finding was that SME's innovating in house criteria were around 65% of the EU 15 mean. On another important criteria, "SMEs involved in innovation co-operation with each other", Turkey exceeded the EU mean by 91%.

In this period, missing data with significant differences between the two groups of countries was the main issue. For instance, a meaningful difference was observed in the "knowledge creation" criteria. The weakest points for Turkey in this respect were USPTO and EPO patent applications. Other strong differences were between the share of "manufacturing value-added in high-tech sectors" and "ICT expenditures".

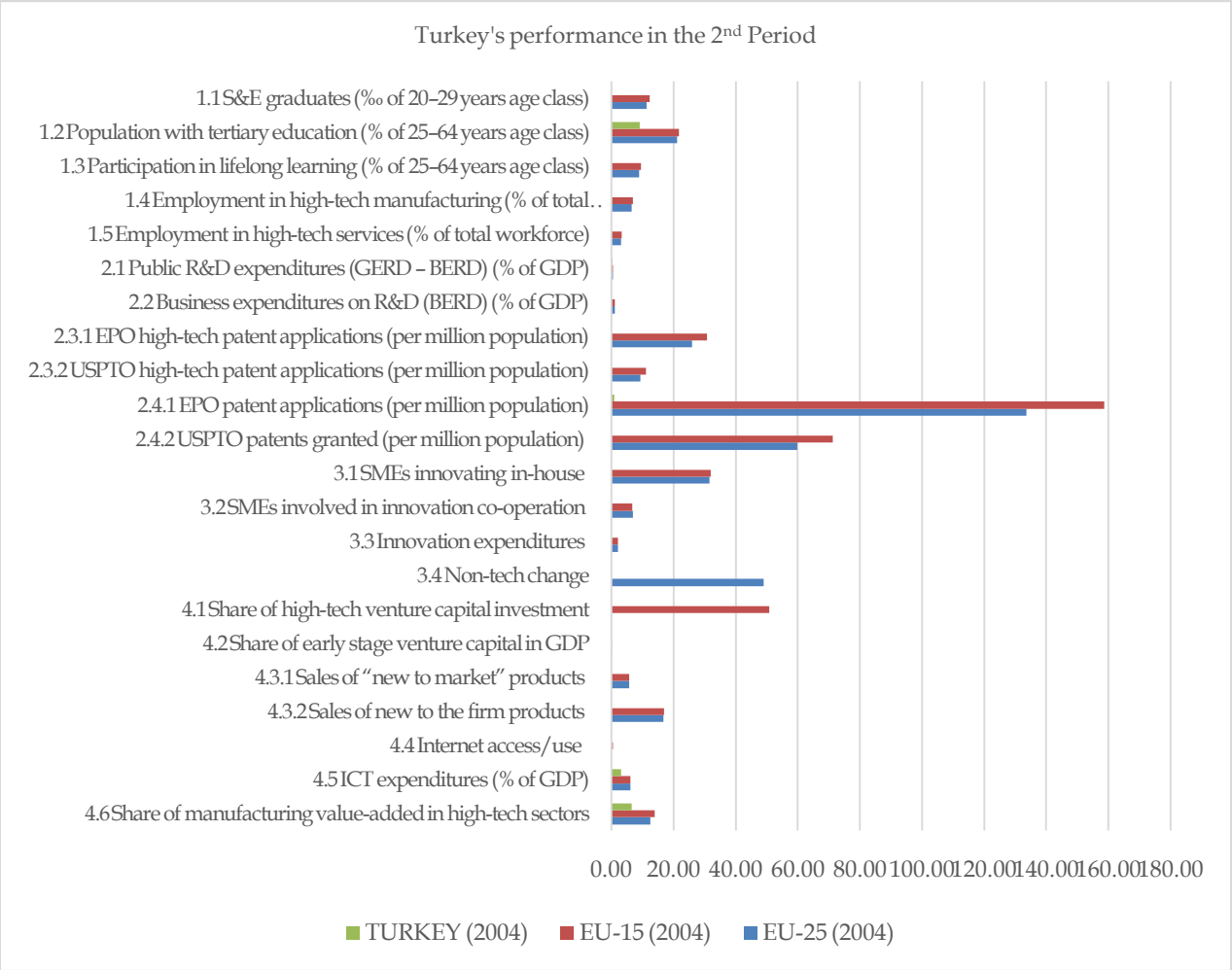
Fig. 1. Turkey's performance with comparison to the EU mean(s) in the 1st period



2nd period (2004)

In the 2nd period, the closest performing criteria to the EU mean was that of "knowledge creation". Because "transmission and application of knowledge" data along with "human resources" data were missing, there were significant differences between EU and Turkey in the "knowledge creation" criteria. The share of high tech value-added manufacturing and ICT expenditures remained stagnant for Turkey, constituting only about half of the EU-15 and 25 mean performances. In this period, only "public R&D expenditures" criteria performed well at about 64% of the level of the EU (for the remaining criteria, Turkey sometimes performed only about half as well). Finally, there was only a small improvement in "public R&D expenditures" performance.

Fig. 2. Turkey's performance with comparison to the EU mean(s) in the 2nd period



3rd period (2005-2007)

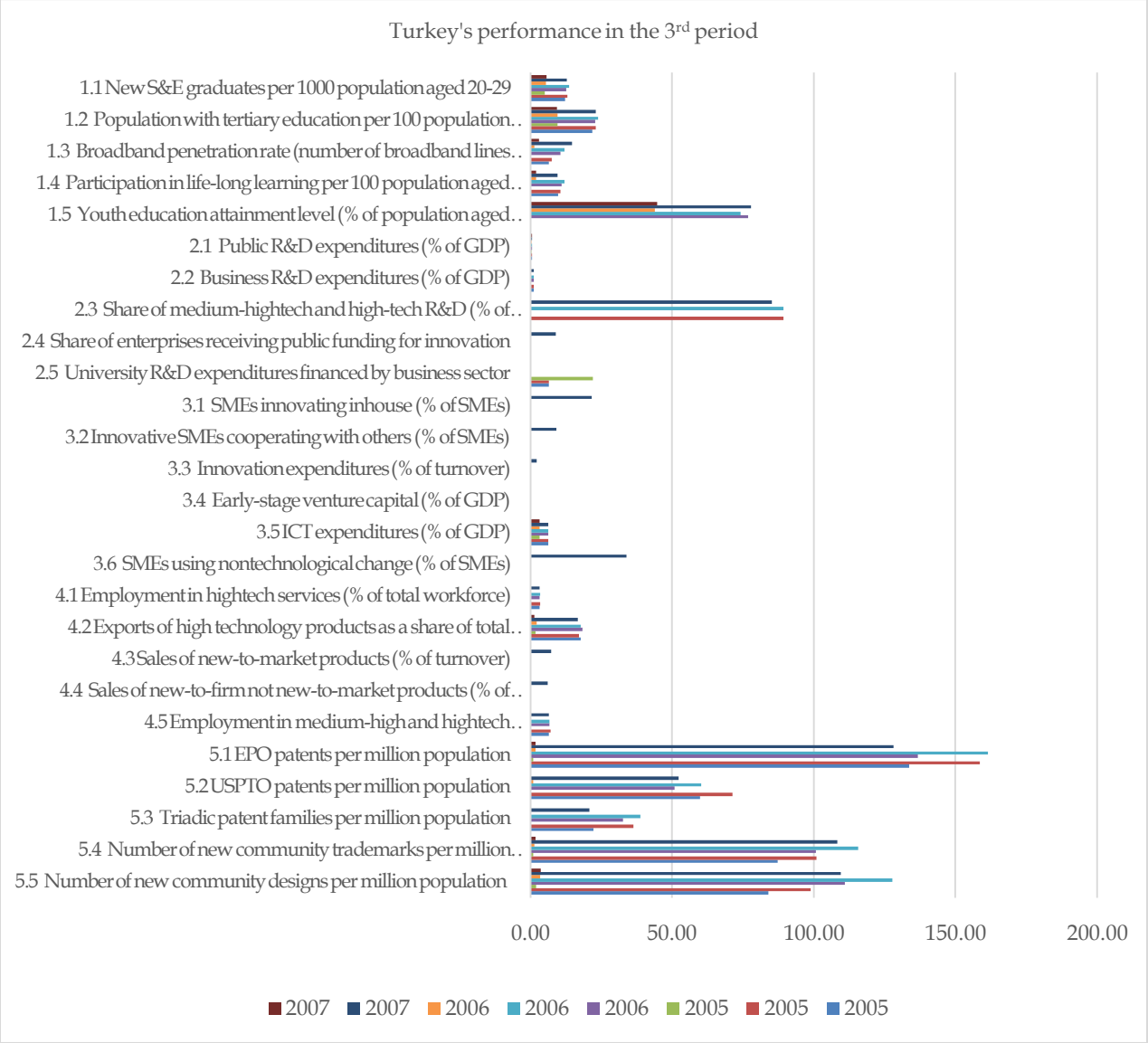
In the 3rd period, the closest or over performing criteria to the EU mean for Turkey were those under the "inputs" section: knowledge creation and innovation and entrepreneurship section.

In this period, the most significant data fell under the "human resources", section where, in the innovation drivers input data for Turkey in three years. Within three years, a small increase in "public R&D expenditures" was observed, although Turkey still lagged behind EU 15 and 27 performances. Again, a significant performance gap was observed in the "intellectual property" section.

When Turkey's performance is reassessed for the years in question, a slight increase in broadband penetration rate can be observed. In addition, very small increase/decreases and stagnancies were also evident. For example, "youth education attainment level" performance was almost half that of the EU-15 and 25 for the years 2006 and 2007, respectively.

Over the course of this period, public R&D expenditures performance gradually increased (68%, 73.8%, and, for 2007, 80% of the EU mean). Another significant increase in performance in 2005 was in "university R&D expenditures financed by business sector" which was 233% greater than the EU mean.

Fig. 3. Turkey's performance with comparison to the EU mean(s) in the 3rd period



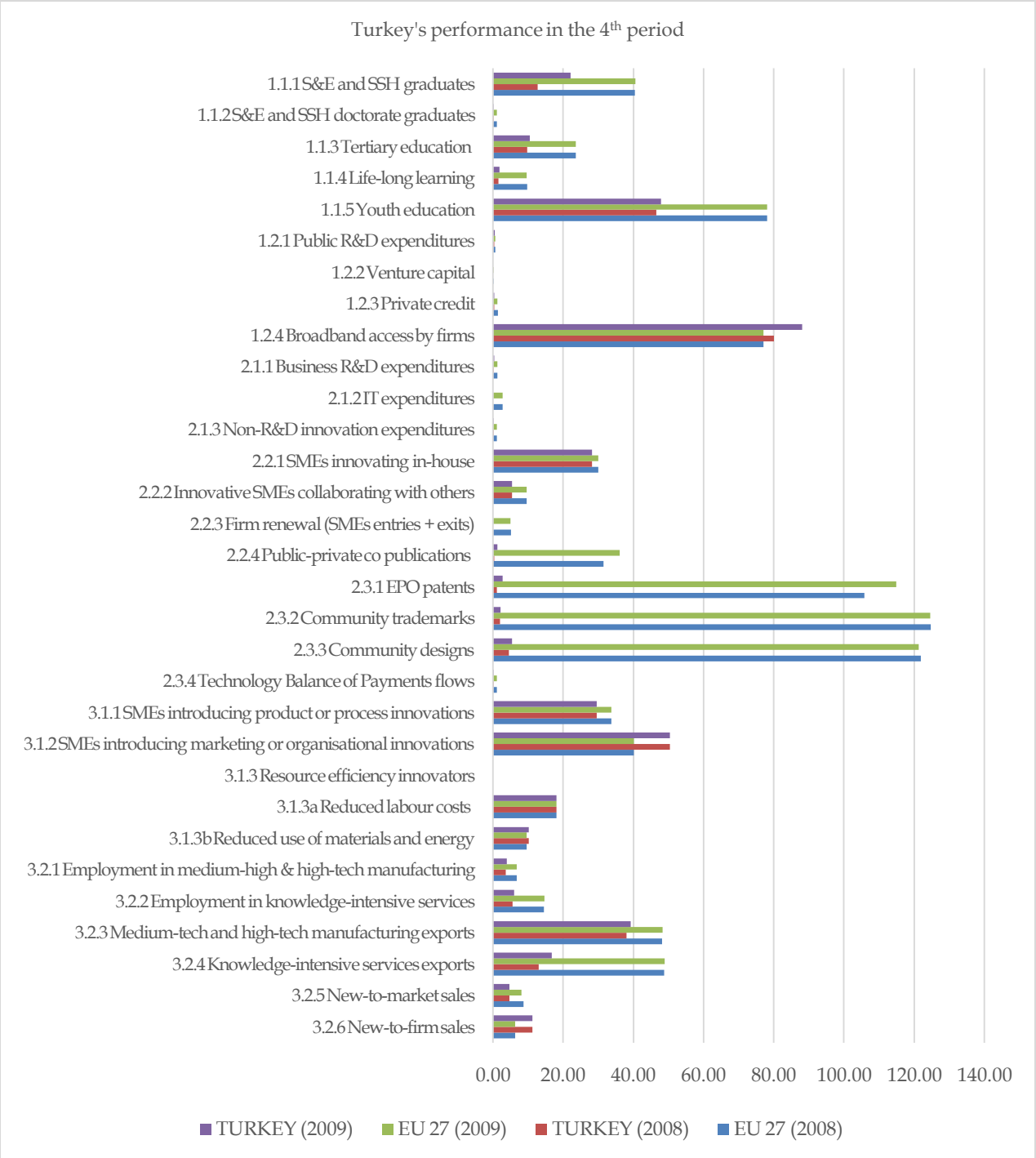
4thperiod (2008-2009)

In this period, the problem of data absence was almost resolved and therefore comparison is made solely between the EU-27 and Turkey. For this period, significant similarities are condensed on outputs under both "innovators" and "economic effects" sections. Similarities can also be observed under the "finance" section.

In the 4th period, the number of criteria for which Turkey performed or over performed in comparison with the EU mean gradually increased. For example, in 2009, public R&D expenditures (although slightly lower than the previous period) remained generally stable. Broadband access for firms was above the EU mean during this period (103% and 114%, respectively). Unlike previous periods, "SMEs introducing product or process innovations" criteria were approximately 87.5% of the EU mean, whereas "SMEs introducing marketing or organizational innovations" criteria outperformed the EU mean by approximately 25%. In both years, the performance of "medium-tech and high-tech manufacturing export" criteria were closer to the EU mean (79% and 81.1%, respectively). Another notable result was Turkey's performance for "new-to-firm sales" which was approximately 78% higher than the EU mean. Another significant increase within the two years occurred under the "enablers" section in criteria relating to S&E and SSH graduates in Turkey.

However, during this period, Turkey also lagged behind EU performance, especially under the "throughputs" and "firm activities" sections, except for "SMEs innovating in-house" criteria which was closer to the EU performance. One exception was "knowledge-intensive services exports" which slightly increased in 2009 compared to the previous year

Fig. 4. Turkey's performance with comparison to the EU mean(s) in the 4th period



5th period (2010-2013)

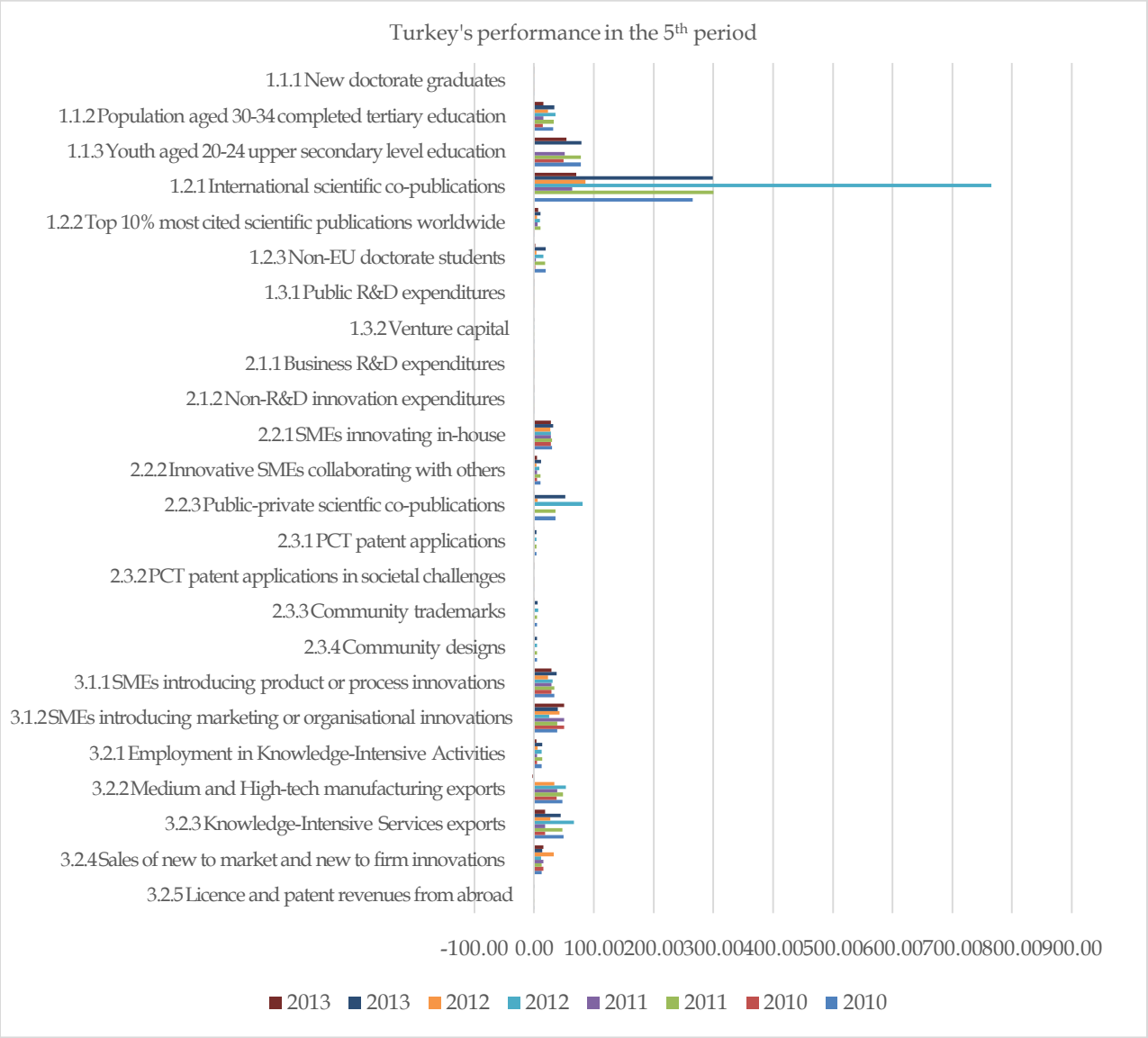
A similar picture can be seen in this period as, once again, there were similarities under the "innovators", "economic effects", and "linkages and entrepreneurship" sections.

Similarly, many criteria performed close to or above the EU mean. The first criteria "youth aged 20-24 upper secondary level education" showed a pattern of increasing performance for Turkey, culminating in a figure of 68.3% of the EU mean. This pattern resembles the "top 10% most cited scientific publications worldwide" for the year 2013.

Like the 3rd period, Turkey's performance on "public R&D expenditures" criteria showed an increase to 65.3% of the EU mean. This period is especially important for Turkey's SME related criteria performances. In house innovating SMEs along with those making product or process innovations, although slightly fluctuating, generally performed closer to the EU mean. In addition, Turkish SMEs introducing marketing or organizational innovations performed above the EU mean in all 3 years (128%, 126%, and 124.8%, respectively). A similar observation can be made for "sales of new to market and new to firm innovations" criteria, for which Turkey slightly exceeded the EU mean in all 3 years.

Turkey's remaining criteria performances were either significantly behind EU performance or very low for the years considered.

Fig. 5. Turkey's performance with comparison to the EU mean(s) in the 5th period



6th period (2014-2016)

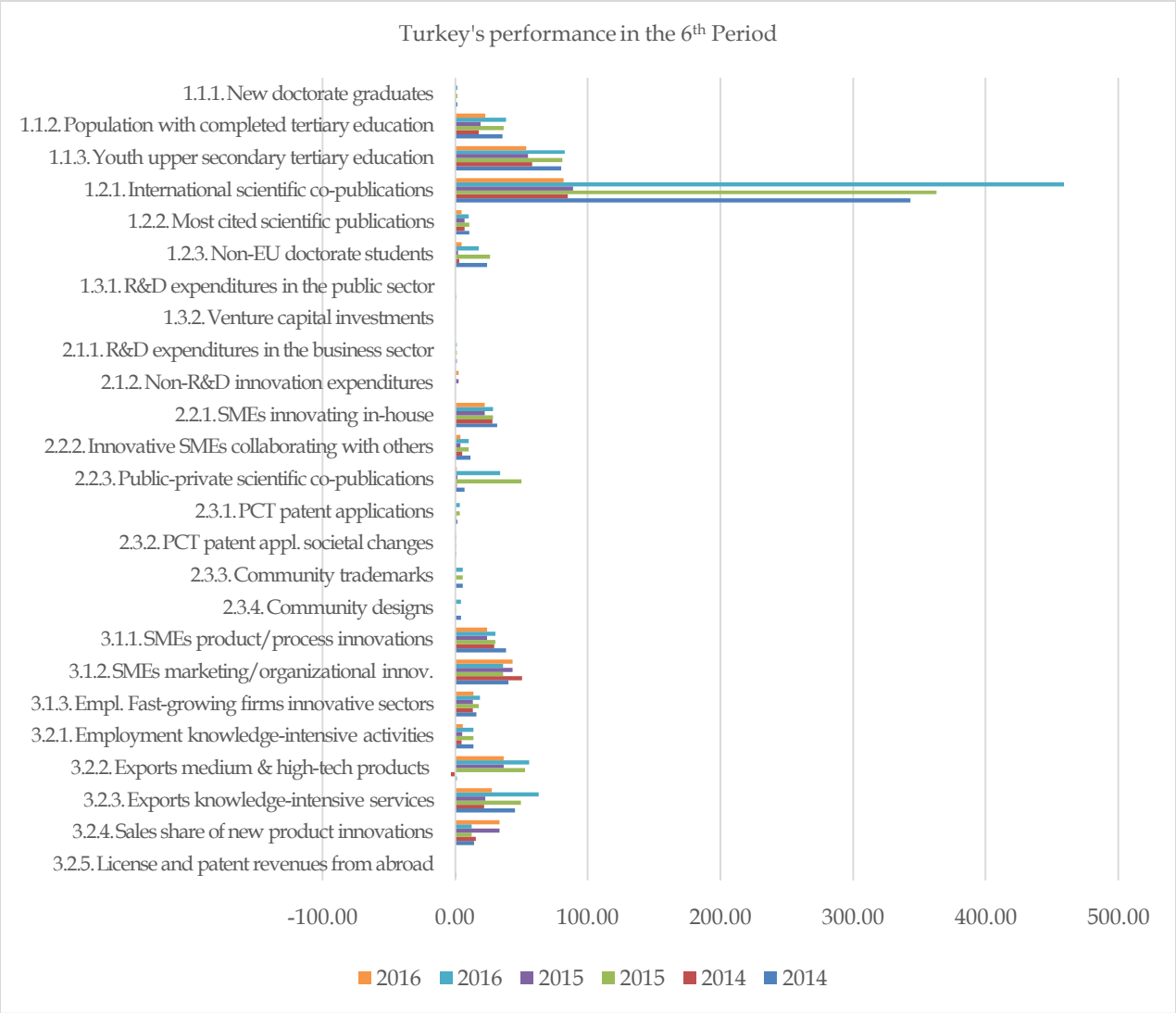
In this period, Turkey's over performing criteria fell under the sections "outputs/innovators", firm activities/firm investments" and "economic effects". Similarities were also evident under the "linkages and entrepreneurship" and "finance and support" sections.

Although fluctuating, "public R&D expenditures" shows a pattern similar to the previous period as does the "youth upper secondary tertiary education criteria" performance.

Again, similar to the previous period, firm performance related criteria were high for Turkey following the introduction of new criteria such as "non-innovation R&D expenditures" for which Turkey performed well above the EU mean. For the 3 criteria related to SME innovativeness (in house, product/process, and marketing/organizational), Turkey's performance remained approximately the same as in the previous period (fluctuating between 76% and 125%)

For the 2 remaining "new" criteria, Turkey's performance in this period was either close to the EU 27 mean (between 74.3%-82% for employment in fast growing innovative sectors) or above (between 109%- 270% in the "sales share of new product innovations" criteria).

Fig. 6. Turkey's performance with comparison to the EU mean(s) in the 6th period



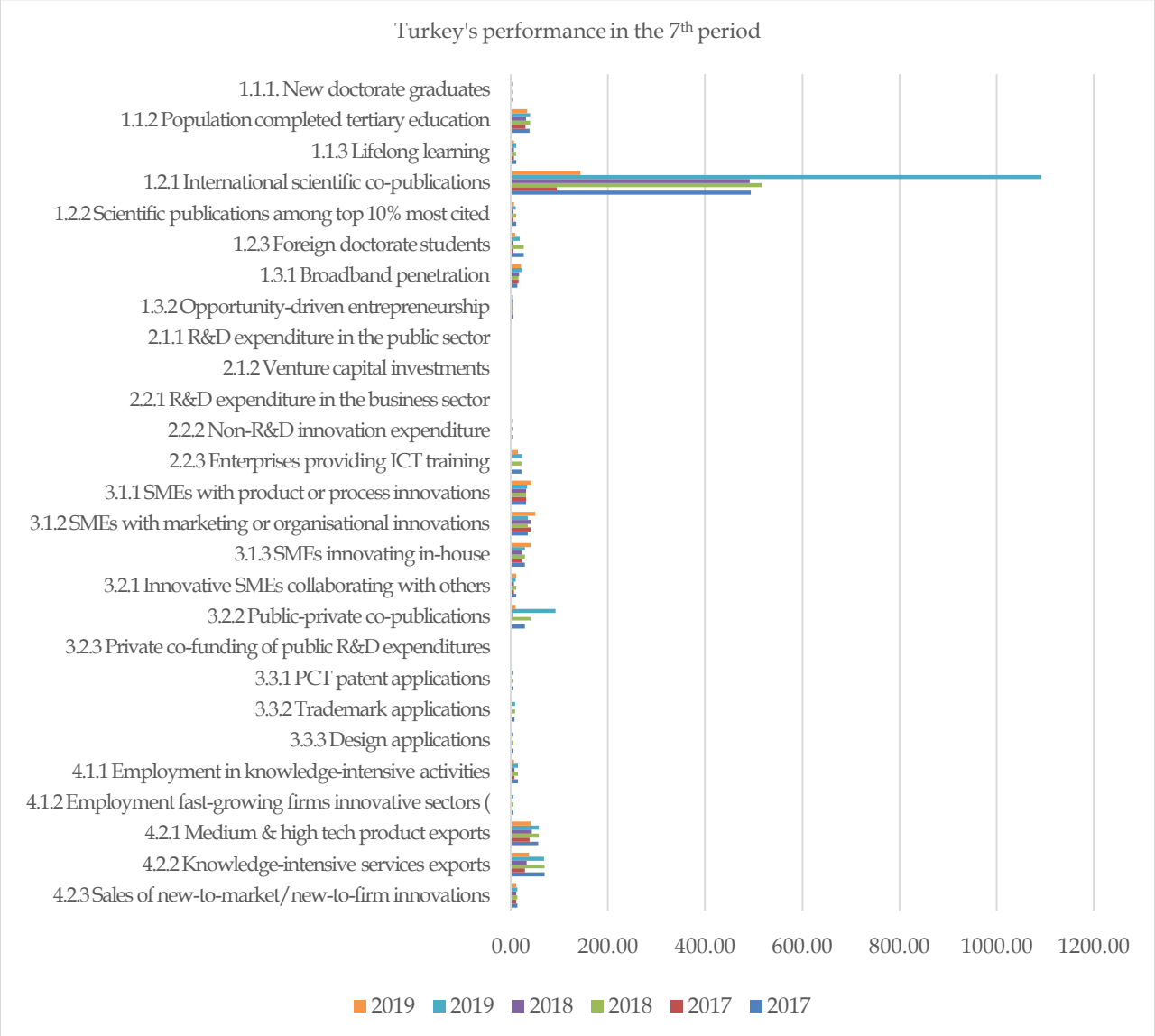
7th period (2017-2019)

In the final period, similarities in performance were observed under the impacts/economic effects and framework conditions/human resources sections, whereas higher performances were observed under the firm investments, innovators, and linkages section.

For "population completed tertiary education" criteria, scores similar to the previous period were observed. Similarly, Turkey's broadband penetration rate was also higher than the EU mean in both years (123%, 106% and respectively) however this ratio has slightly dropped in 2019.

For a criteria performance that was 60% or more of the EU mean, the 7th period resembles a compilation of all previous periods. In the case of generally over-performing criteria such as "non-R&D innovation expenditure" and "SMEs with product-process and marketing or organizational innovations", Turkey's performance was similar to previous periods, whereas for "SMEs in-house performance" (78.1%) and "sales of new-to-market/new-to-firm innovations" (78.6%), its performance was close to that of the EU. Finally, the performance of "private co-funding of public R&D expenditure" was also above the EU mean (20%, and 40% for the respective years) however this ratio has dramatically dropped in 2019.However, significant lags were observed between the two groups in all remaining criteria in which Turkey fell behind.

Fig. 7. Turkey's performance with comparison to the EU mean(s) in the 7th period



3.2.Discussion

The discussion in this section is limited to criteria for which related information is available. Throughout the periods the missing data problem of Turkey was resolved and this provided an opportunity to conduct a better analysis of the criteria.

As stated previously, although EIS criteria classifications changed throughout the periods, criteria indications generally remained the same and therefore the discussion is based on selected individual criteria rather than classifications.

Firstly, Turkey's performance generally lagged behind the EU mean in all areas of patent applications, including EPO and USTPO applications. According to patent application statistics published by the Turkish Patent Office (TPO), the ratio of Turkish oriented firms to foreign oriented firms in Turkey between years 2003 and 2018 was 60%. According to the same source, the ratio of Turkish oriented EPO patent applications was negligible(Turkpatent, 2018).

There are three reasons for the patent application problems. The first is stated as a failure to transform academic outputs (e.g., thesis studies' results) into patents in areas where, especially in engineering, an increase in outputs is necessary. The production of country originated patents depends on two factors: an increase in academia-industry collaboration to commercialize the results and an increase in related academic studies to create new/innovative products subject to patent application.

The second problem is related to the perceptions of firms. For instance, there is a lack of "patent awareness" as products subject to patent applications are generally made within the firms who also supply the equipment. An increase in related equipment, training, and facilities is required to increase firms' motivation to submit patent applications. One of the proposed solutions is industrial specialization. This entails an increasing focus by industries on their areas of interest, which will motivate them to create new and innovative products. Another solution is to increase the support provided to academics working in related disciplines.

The third problem is related to the awareness of firms themselves. Because the patent process is relatively lengthy, experience and knowledge regarding the process are required by firms.

One of the primary targets of the Turkish Patent Office (TPO) is to solve some of these problems (e.g., awareness). One of the solutions they have suggested is to implement a "Patent Incentive System". This will provide incentives for international applications such as the ones made for EPO patents. Similarly, a collaboration with The Scientific and Technological Research Council of Turkey's (TUBİTAK) "patent support program", which also has an international facet (e.g., EPO and USPTO evaluation process incentives), aims to increase the number of patent applications by firms in Turkey. To increase firm awareness, since 2006 the TPO has implemented training programs (e.g., establishment of the "Academy of Intellectual Property Rights" in Turkey) and various projects to increase firm innovativeness.

Similarly, to increase in-house innovation capabilities, the government has ratified the "Bylaw on Application and Auditing on Support of R&D activities" according to which firms are entitled to establish in-house R&D and Design Centers as separate departments. To support this venture, the government has provided incentives such as tax and insurance discounts to cover all firm-based R&D expenses.

To support academia-industry collaboration, a technology centers (TEKMER) program has been in progress since 1992. This program, which mainly targets parties that form part of the innovation ecosystem (universities and SMEs whose ratio to total firms is 99.8% as of 2018; Chambers of Industry and Commerce, Science Park management companies) to increase the number of technical entrepreneurs and innovative activities. By the same token, "business development centers" (İŞGEM) have been developed to provide support for SMEs in the areas of coaching, access to support networks, offices, and office equipment, and is headed by the Small and Medium Enterprises Development Organization of Turkey (KOSGEB)(KOSGEB, 2017:13). This initiative is under the responsibility of KOSGEB.

Another area in which Turkey remains below the EU mean is in business R&D expenditures. According to the OECD data from 2003 and 2018, the mean value of business expenditures to GDP in Turkey was 0.670% which remains behind the EU-28 mean (1.825%). It should also be noted here that Turkey's business expenditures share has significantly increased between years 2015-2018 (OECD, 2018). According to the 11th Development Plan 2019-2023, the target mean value for 2023 is 1.8%(Devplan 2019:102).

In general terms, significant R&D expenditures in the market are incurred by many industries, including the automotive, machinery production, defense, electronics and telecommunications, and household appliances industries. These industries are investing not only in R&D but also qualified human resources. Accordingly, these are the industries that can transform research results into products and services for which the export figures are better than in the remaining industries.

Although business R&D expenditures are continuing to increase, investments will have to be increased further to approach the EU mean. One of the important advantages in Turkey is the growth in the number of business R&D

centers (1240 centers as of 2020 (MIAT, 2020 (1)) and design centers (365 centers as of 2020)(MIAT, 2020 (2)). Again, it is important to re-emphasize the importance of university-industry collaboration.

Although fluctuating within periods (and close on some occasions to the EU mean), medium and high tech exports are another area in which Turkey remains below the EU mean. For example, between 2009-2019, exports of high–tech product exports constituted 2.3% on average of total product exports (fluctuating between 2% and 2.9% and finally 3,3% as of 2020 (Worldbank, 2020). This shows that the share of high-tech product exports among total exports is almost stagnant whereas the share of medium technology exports is much greater (Turkstat, 2019).The main reason for this is the shift from low technology product manufacturing towards middle level production. This especially applies to the production lines of SMEs in the context of investments and the number of workers. This increase is also reflected in revenues. The product groups most commonly exported are automotive spare parts, garment, machinery, jewelry and textile products. Therefore, Turkey aims to increase the percentage of middle and high-tech products as a share of total exports to 35% in the medium—term in 2023(GEKA, 2012:33).

To achieve this, one solution is to increase the incentives provided by government for high-tech product manufacturers. These incentives will mainly be provided to ensure that intensity and innovativeness of R&D in these firms is higher than in others. In this context, one of the KOSGEB's strategic goals is to improve production and management capabilities of the SMEs in order to manufacture innovative and value adding products/services and therefore increase their global competitiveness (KOSGEB, 2018:27). Besides, standard financial incentives such as "SME development support program" are also in progress(KOSGEB, 2016:18). In addition to these, supports are planned to be provided for the establishment of international incubation centers by KOSGEB (KOSGEB, 2017:77) and innovative start-ups by TUBİTAK (TUBİTAK, 2021). This can be seen a contributing factor to the SMEs due to the fact that commercialization of the R&D results along with lack of innovativeness and design remains as SMEs relatively weak points in Turkey(KSEP, 2018:49).

The government also plans to establish a system to track the needs of related firms and focus on territories (especially provinces) where the number of similar firms is higher. This approach, termed the "Producing Provinces Program", also aims to support related provinces in terms of institutionalization, marketing, and logistics infrastructure(Devplan, 2019:67). Another of the government's priorities is to attract foreign direct investment for technology transfer. Importantly, some of these incentives are also included in programs already in progress in Turkey.

One of the areas in which Turkey has lagged behind the EU mean over the years is in human resources and related educational activities. For example, performance in "new doctorate graduates" and "foreign doctorate students" was generally lower the EU mean in all periods. Furthermore, although fluctuating (with a general tendency to increase, especially in the 6th period), "most cited scientific publications" remains lower than the EU mean.

Based on available data the percentage of the doctoral or equivalent level graduates between the ages of 25-64 which is 0.302 and below the EU mean which is 0.813 as of 2018(OECD, 2018 (2)).When tertiary education is considered, the most popular subject areas for foreign students in Turkey were engineering, business and social sciences. However, regarding the ratios; the percentage of population is 35.33% (ages 25-34) and 10.97 (ages 55-64) in Turkey, whereas mean ratio of EU countries is 36.94% (ages 25-34) and 22.39% (OECD, 2018 (3)). In this regard, it can be deduced tertiary graduation is mostly popular among between young population, whereas the increase in number of total universities which is 207 as of 2020(YOK, 2020) can be assumed as a positive factor in order to support tertiary education.

Between 2002 and 2018 there were 376227 Turkish scientific publications in total, which mean is 295 per million members of the population (TUBİTAK, 2020). Although showing an increase, the ratio remains lower than the EU mean. Similarly, regarding the most cited publications, the total number of citations of Turkish publications between 1996 and 2019 was 639659 (SCIMAGOJR, 2020), which is very close of the EU mean and to the values given in the EIS documents.

When the parameters for which Turkey performs either close to the EU mean or over performs are considered, the most significant areas were related to "innovators" or "linkages and entrepreneurship". Although the data stream began in the 4th period, the performance of SMEs introducing product, process, marketing, and organizational innovations was quite high, being either close to or above the EU mean. A similar scenario applies to SMEs in-house innovation activities. In this section, although their ratios were above the EU mean, policies to increase SME innovativeness will be discussed along with some of the challenges that lie ahead for SMEs.

According to Turkish Statistical Institute (Turkstat), the status of innovative SMEs in Turkey is as follows. First, the number of innovative activities increases in parallel with the scale of the firm. Thus, as the firm grows, its tendency to innovate also increases. According to Turkstat, Innovation Survey, 2018 and classification made between 2016 and 2018 82% of product innovative enterprises are dealing with goods innovation, whereas 69,1% (double counts are omitted) of them are involved in service innovation.(Turkstat, 2018).

In this respect, product and process innovation are accepted as "technological innovation" while marketing and organizational innovation are accepted as "non-technological innovation". Closer to the EIS classification, according to Turkstat, Innovation Survey, 2016, the percentage of organizations which are involved in technological innovations are 47.3%, whereas, this ratio is 50,8% for non-technical innovation which is slightly higher (Turkstat, 2016). During the survey period which is between years 2014-2016, the percentage of innovative firms generally fluctuates, although there is a clear increase in the last year. The same pattern is evident for all types of innovations although, consistent with the EIS data, non-technical innovations are better than the technical innovations within firms. Importantly, although SMEs with technological and/or non-technological innovations are over performing with regard to the EU mean, their share within the total number of firms in Turkey will need to be improved further. In this way, the innovative activities of firms will acquire faster momentum.

Within this framework, the "Technological Product Demonstration and Marketing Incentive" element of KOSGEB mainly targets support for the exhibition and marketing of technological products or prototypes that are the R&D outputs, innovations, and design works for firms.

For the periods in question, the most innovative industries were as follows (names vary according to the change in NACE classification):

- Computer and related activities
- Scientific research and development
- Information and communication

As noted previously, constraints in financial and technological opportunities for technical entrepreneurship are pitfalls, especially for small-scale firms. New incentive models to tackle this problem are to be implemented by the government alongside R&D support. A similar policy, dealt with by KOSGEB, will be applied to firms that stay within the Industrial Zones. However, the establishment of marketing and technology tracking will be a future challenge for SMEs, as will financing for new investments in technology. Similar incentives aim to increase the ability of SMEs to create and market their own brands.

One of the institutions that specifically support "technology product" and "technological process innovation" is the Technology Development Foundation of Turkey (TTGV). This foundation supports R&D and commercialization activities at the level of technological development based on the fact that the manufacturing process fulfils eco-productivity, minimum energy, water, and raw material requirements.

IV. CONCLUSION

In this study, Turkey's performance in EIS reports was compared with the EU mean for the period 2003-2019. Although the results reveal that, in some areas, Turkey is above the EU mean, many areas still need to be improved.

Given that innovation is a multi-faceted concept, the most important improvement lies in the performance of SME innovation. This is in fact the case for both technological and non-technological innovations, areas in which Turkey over performs (or is close to) the EU mean. The ratio of firms introducing similar innovations is to be improved and many different tools have been devised by policymakers in this regard.

Implementation of similar policies is important as the degree of technological (or non-technological) innovation depends on the extent to which technology is used as an important input for the innovation. If a firm aims to increase its degree of technological innovation, it should also improve its levels of technological and organizational talents. In this context, the two are connected. In process innovations there are several stages, ranging from small process improvements to redesigning the industry value-chain in which R&D and human resources play a significant role. Compared with the technological innovation ratios, organizational innovation mainly involves transaction costs,

improvements to productivity, access to external information, and increasing firm performance by decreasing equipment costs. If properly implemented, organizational innovations will also make significant difference in strategic decisions with regard to other firms. Consequently, an increase in innovative performance of SMEs may be observed as a significant improvement of related markets in general.

Turkey also needs to advance in different areas, one of which is human resources. These will help provide firm-based continuity in order to integrate innovation activities into processes. Thus, qualified human resources are needed to transform research inputs into products that can be commercialized. This establishes one part of the "intellectual capital" required by firms. Related indicators, mainly based on human resource potential, are yet to be improved to support firm-based innovativeness in Turkey, especially in the areas of doctoral graduates.

The area of "patent application" is the second issue Turkey needs to address. Patent applications establish one of the most important criteria in national assessments. Currently, numerous interdisciplinary research studies are conducted and their focus is shifting to the realization of firm missions due to the increasing number of collaborative projects between academia and industry. This requires a "more elastic" relationship between two parties. Thus academia-industry partnership and patent production are connected and the results of planned policies in Turkey are to be reassessed.

A final challenging area is that of R&D expenses. These mainly serve to increase the knowledge stock to facilitate the design of new and innovative implementations. This has a catalyzing effect in economic growth. Research show that an increase in public R&D expenses leads to an increase in private expenses. In this context, one of the important duties of the government is to create a favorable environment for the private sector to increase R&D capability, related investments, and, consequently, growth opportunities for firms. Regarding R&D, there has been a shift from a temporary sponsorship to a permanent partnership model between government and industry. An increase in government expenses also means an increase in scientific, technological, and intellectual capital and its diffusion.

Therefore, in Turkey, the institutional infrastructure (e.g., TUBİTAK, KOSGEB, TTGV) and criteria required for innovation is present. For SMEs especially, the required legal support mechanisms have increased in the last decade. Similarly, an increasing focus on research via R&D centers is itself an advantage that will enable firms to create an innovation atmosphere. This can be also expressed as an increase in "firm-based innovation initiatives". In economic terms, this approach also motivates the government to create innovation-based structural reforms. The EU integration process undertaken by Turkey to integrate entrepreneurship and innovation is another advantage in this regard. It should also be emphasized that Information Technology investments by firms have followed a parallel trend over the last decade.

However, although they have already been mentioned as positive political initiatives, access to financing and gaps in academia-industry collaboration continue to present a challenge regarding the transformation of innovative inputs to products and services, and hence the commercialization of the innovation. To address this, several incentives and projects, some of which have already been mentioned in the previous section, are now in progress. In this regard, an increased demand for innovative products originating in Turkey, patent application awareness, and additional tools for increasing the innovative capability of the firms are the main priorities to be addressed to increase performance on the related criteria. One solution is the improvement in coordination between industry and government in markets where innovation should generally be at the forefront.

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