

Literature Review on Technology–Oriented R&D Studies in Turkey

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Received: May 24, 2022

Accepted: June 12, 2022

Published: June 16, 2022

Abstract: In this study, it is aimed to compile academic studies on technology and research and Development (R&D) studies and to include information that will shed light on the future based on statistics data. It is aimed to evaluate the research method, dataset and the results of the articles and theses as a result of the literature review made in the Dergipark article database and YÖK thesis database. Of the scanning process, the keywords "R&D", "R&D expenditures", "technology", "advanced technology", "high technology" were used. Statistical data were got from Euromonitor, OECD, World Bank, TURKSTAT, Istanbul Chamber of Industry, the resulting indicators were presented to the reader in tables, the position and point of R&D studies in Turkey were tried to be pointed out.

Keywords: R&D, Research and Development, High Technology, Economics, Turkey

JEL Classification: A10

1. Introduction

In the 21st century, the economic and technological development of countries is closely related to whether they are adapted to obtaining and transforming information. In the competitive world, it is seen that the countries that take the top places and that produce technology, not consume, are developed countries. The existence of knowledge is a prerequisite for the production of technology. At this point, research and development studies emerge. R&D studies for the production of knowledge are productivity-oriented studies that adopt to explore the unknown and build new products, services and processes. The main goal of these studies is not only the discovery and dissemination of knowledge, but also the commercialization of knowledge and bringing it to the point where it can be applied and exported. Such activities will cause the country's economies to gain high returns in the long run, thus providing contributions to increase the welfare of the country.

Innovations and inventions in technology-intensive sectors such as Informatics, Space, Aviation and Pharmaceuticals are relatively compared to other sectors; provides higher returns and profits. When compared to the export price per kilogram, it is necessary to focus on high-tech products that provide high benefit. The way to this is through the studies carried out in the name of R&D studies, patent registration and technology transfer. As seen in the example of South Korea, it is primarily to realize the adaptation by providing information and technology transfer and to accelerate the transformation in the high technology intensive production industry. (TEPAV:2010)

Macroeconomic indicators such as economic growth of countries, per capita gross national product, foreign trade data in the field of advanced technology can give an idea about the welfare of the country and the dissemination of information. It would not be appropriate to see the general situation by looking at just a few indicators. There is a sharp distinction between the production or use of technology by decision makers and policy makers. Two questions can be asked at this point. First, should it be to transfer (import) and use technology? Secondly, should it be considered as an export good with high added value by producing technology within the borders of the country? Although both are important, the answer to the second question should be sought mainly.

Situations such as tensions between countries and unexpected diseases (COVID-19) can catch institutions and countries unprepared in product and service development. The information obtained as a result of R&D studies in high value-added and critical sectors such as high-technology-intensive defense, medicine and informatics is extremely valuable. Although the results of the studies that are not thought to be useful, they can be a solution at the point of despair. In terms of countries and institutions, R&D studies should be seen as an item that is far from periodic, continuous and needs to be allocated a budget.

In this study, articles and theses written on the basis of the keywords R&D, economics, advanced technology, high technology in the Dergipark article database and the YÖK thesis database were examined. Compilation article has been prepared. In addition, by supporting the study with statistical data, the point reached in R&D studies in Turkey has been tried to be pointed out.

2. Research and Development Definition, Purpose, Scope

According to the Turkish Language Association; "Research and development" is defined as detailed research conducted by experts to ensure the effectiveness, efficiency

and development of a product or a study. (TDK:2022) According to the OECD Frascati Guide (OECD:2015); It is the creative work carried out on a systematic basis to increase the knowledge of people, culture and society and to use this knowledge to design new applications.

OECD 's Frascati Guide; There are three types of R&D. (OECD:2015)

Basic Research: It is done to obtain new knowledge. The results are published in scientific journals. It is often carried out in public and academic circles.

Applied Research: It is done to obtain new knowledge for a specific purpose and goal. The information obtained is patented and can be kept confidential.

Experimental Development: It is the systematic studies aimed at producing new products, devices, materials, creating new processes, systems and services, and improving existing ones.

The aims of R&D studies can be listed as increasing the level of qualified knowledge, reducing production costs, increasing the quality of products and services, increasing profitability and productivity, maintaining competitiveness, providing economic growth and increasing qualified workforce.

R&D studies are prototype design, industrial design, algorithm development in computer science, image processing, geographic data presentation, and research in artificial intelligence.

OECD has grouped the sectors under four main headings according to the use of technology in the manufacturing industry sector. (Hatzichronoglou:1997)

High-Tech Industries: Aerospace, Pharmaceuticals, Computers and Equipment, Precision and optical devices used in medicine

Medium – High Technology Sectors: Electrical Machinery, Motor Vehicles, Chemistry, Machinery and Equipment

Medium Low Tech Industries: Metal, Shipbuilding, Plastics, Refined petroleum products

Low-Tech Industries: Food, Textile and General Manufacturing

Countries can increase their development by focusing their R&D investments on high-tech sectors, which is one of these four main sectors.

The expenditure on R&D studies, the number of personnel involved in these studies, the number of scientific articles and patent registrations are leading indicators in terms of countries' knowledge production, welfare and development levels.

The ratio of the budget allocated to R&D activities by countries to national income is known as R&D intensity. When the R&D intensities in 2020 are analyzed on the basis of countries, the ranking of the first 5 countries is shown in Table 1. way. (Euro Monitor) According to the ranking, it is seen that the first 5 countries are Israel, South Korea, Taiwan, Finland and Japan. Turkey is in the 38th place in this ranking. Considering Turkey's recent R&D statistics, it is seen that there has been an increase in R&D studies. The moves made in the last 20 years play an important role in reaching this level. While the R&D intensity in Turkey was 0.52% in 2001, it reached 1.0% in 2021.

Table 1. R&D Intensity (2020)

Order	Country	% Percentage
1	Israel	5.4
2	South Korea	4.1
3	Taiwan	3.3
4	Sweden	3.3
5	Japan	3.2
38	Turkey	1.0

Source: Euromonitor, 2020

Looking at the top 5 countries with the highest R&D Expenditures in 2020, it is seen that the USA, China, Japan, Germany and South Korea. Turkey is in the 28th place in this ranking.

Table 2. R&D Expenditures (2020)

Order	Country	Amount-Mio USD
1	USA	632,638
2	Chinese	309,601
3	Japan	162,467
4	Germany	117,690
5	South Korea	67,016
28	Turkey	7,340

Source: Euromonitor, 2020

According to the 2018 data of the World Bank, the ranking of the top 5 countries and Turkey in the number of scientific articles published as an output of R&D studies are as follows:

Table 3. Number of Scientific Publications (2018)

Order	Country	Piece
1	China	528,263
2	USA	422,808
3	Japan	135,788
4	Germany	104,396
5	South Korea	98,792
17	Turkey	33,535

Source: World Bank, 2018

The number of patent applications and registrations is another output of R&D studies, and the data for the last 5 years for Turkey are as follows:

Table 4. Patent Application and Patent Registration Numbers

Year	Patent Registration	Patent Application
2016	11,074	16,778
2017	12,424	19,283
2018	13,882	18,504
2019	13,720	19,916
2020	13,017	18,705
2021	12,566	17,566

Source: Turkish Patent Institute

The number of personnel involved in R&D studies is also a human capital criterion. According to OECD figures published in 2019; The ranking of the first 6 countries and Turkey is as follows:

Table 5. Number of R&D Personnel

Order	Country	Amount-Mio USD
1	Japan	942.180
2	Germany	667,394
3	Britain	548,398
4	South Korea	104,396
5	France*	429,959
6	Spain	241,372
7	Turkey	243,773

Source: OECD, 2019 *France listed as 2018

Table 6. R&D Spending Areas in Turkey (Million TL)

Year	R&D Personnel Expenditures	R&D Investment Expenditures	Other R&D Expenditures	Total Spending
2016	12,308	2,763	9,569	24,641
2017	15,167	3.101	11,586	29,855
2018	18,905	4.413	15,215	38,533
2019	23,692	3,989	18,271	45,953
2020	29.003	4.444	21.508	54,956

Source: Turkstat

When the foreign trade statistics between the EU and Turkey are analyzed, it is observed that Turkey ranks 18th in high technology exports to the EU and 7th in high technology exports to the EU. (Eurostat) It shows that Turkey is in an attractive market position for the EU.

According to the 2020 report created by the Istanbul Chamber of Industry with the data collected from Turkey's 500 largest industrial establishments, it is seen that 271 companies allocate resources to R&D studies. (ISO 500:2020) In addition, it is seen that the number of companies with added value and high technology intensity is relatively low.

Table 7. Number of Firms Making R&D Expenditures

Year	#ofFirms
2016	243
2017	239
2018	254
2019	276
2020	262
2021	271

Source: Istanbul Chamber of Industry

Table 8. Sector Groups by Technology Intensity

By Technology Intensity Sector Groups	Added Value Created - %	Number of Firms
Low Technology Intensive Industries (Food, Textile, Clothing)	37.3	205
Medium Low Technology Intensive Industries (Metal, Plastic, Shipbuilding)	31.5	134
Medium High Technology Intensive Industries (Chemistry, Defense, Automotive, Machinery Manufacturing)	24.8	122
High-Tech Intensive Industries (Pharmaceutical, Aviation/Space Vehicles, Computers, Electronics)	6,4	16

Source: Istanbul Chamber of Industry

The status of the number of R&D Centers, personnel and patents in Turkey as of April 2022 is shown in Table 9.

Table 9. Number of R&D Centers, personnel and patents

Year	Piece
Number of R&D Centers in Operation	1244
Total Number of Staff (including support staff)	72,911
Number of Patents	29,893
Number of Firms with Foreign/Foreign Partners with R&D Centers	194

Source: Ministry of Industry and Technology

The 11th Development Plan of the Ministry of Development for the period 2019–2023, published in 2018, includes the target of increasing the share of the private sector in R&D expenditures to 67 percent by 2023. (TCCB:2018)

Companies carrying out R&D activities in Turkey have the opportunity to benefit from different incentives and supports provided within the scope of R&D legislation and cash support programs. It is important for companies to benefit from the most appropriate support and incentive mechanism in order to reduce the costs of R&D and innovation activities. (PWC:2022) In this context, Law No. 5746 on Supporting R&D and Design Activities and Law No. 4691 on Technology Development Zones provide guidance.

The Ministry of Industry and Technology carries out the HAMLE project at the point of innovation and high-tech product production. The Ministry of Commerce offers public incentives for exports. KOSGEB, TUBITAK and Turkey Technology Development Foundation run R&D projects support programs. For companies operating in technoparks, income tax and SGK premium exemptions are also granted.

3. Literature Review

There are academic studies that deal with the contribution of R&D studies at company and country scale with different variables. In the literature review, articles and theses, which include the concepts of advanced technology and R&D studies, and which deal with economic growth, development, foreign trade, employment, and company profitability, were selected.

Baydilli (2019) examined the development of the IT sector in Turkey and the effects of the R&D incentives provided to this sector on the development of the sector. How the economic growth of 14 selected countries and Turkey was affected by R&D expenditures

and patent applications was analyzed by panel data analysis method, and according to the results obtained, it was seen that economic growth was positively affected by R&D and patent applications. It has been concluded that R&D expenditures affect economic growth more positively than patent applications. Among the suggestions of the author are the dissemination of the use and education of information and communication technologies, the orientation of our exports to high-tech products, the increase of public-university and industry collaborations, and the support of R&D and innovation studies. It focuses on the need for Turkey to focus on products and services with high added value that will increase its competitive power in order to achieve high economic growth figures. (Baydilli:2019)

Eryer (2021) points out the importance of following technological developments closely for a sustainable economic growth in his thesis. The author cites R&D studies as the source of this. The study aims to analyze the relationship between R&D expenditures, high technology product exports and economic growth for the Turkish economy. According to the results of the research, a long-term relationship was found between R&D expenditures and economic growth, high-tech product exports and R&D expenditures. The author emphasizes that in order to achieve sustainable economic growth and increase the welfare of the country, it should produce high technology products with high added value, and for this, more share should be allocated to R&D expenditures from the GDP. In addition, developing R&D and innovation programs and increasing the export of high-tech products are among the author's suggestions. (Eryer:2021)

Öğrü (2020); In his thesis, she aimed to reveal the effects of R&D expenditures and technology on economic growth and economic development. In the study, R&D expenditures, triple patent number, technology product export and import data of 25 OECD countries were used to examine this effect. The most important finding from the research confirms the positive and statistically significant effect of technology and R&D expenditures on the economy. Technology and R&D cause the country's economy to grow and develop at the same time. According to the results obtained, increasing technology and R&D expenditures is one of the ways to contribute to the economic performance and welfare of the country. The short-term growth of R&D expenditures in developing countries has a long-term effect. In upper-middle-income economies, the short-term beneficial effect of R&D expenditures can be seen. It points out the necessity of establishing policies related to R&D according to the economic structure of each country. The author predicts that grants, loans, tax and financial supports offered for R&D studies will increase R&D expenditures and thus support economic growth and

development. It focuses on investing heavily in universities, technoparks and research institutes in order to increase the number of patents, and attaching special importance to education policies. In particular, policies to be implemented to reduce foreign dependency should be carefully considered for the trade of technology products. (Öğrü:2020)

In his thesis study, Tüysüz (2020) states that the state should provide incentives and support systems, financing for R&D and innovation studies and create an ecosystem, and the roles that the state will assume are the main subject of his study. The data of 222 SMEs receiving R&D and innovation support from KOSGEB were obtained by the survey method, and as a result of the analysis, the adequacy of the entrepreneurial environment on the basis of the R&D and innovation ecosystem, R&D expenditures, regular, R&D activity, technology transfer, It has been determined that the age of the entrepreneur, the employment of university graduate personnel and government supports are very effective on the success of commercialization. The author explains the possibility of commercialization of the enterprises, the type of the enterprise, the age of the entrepreneur, the number of university personnel employed, whether it cooperates with international institutions, R&D and innovation expenditures, whether it receives non-KOSGEB R&D support, whether it carries out regular R&D activities, personnel and examined within the scope of consultancy supports and adequacy of the entrepreneurship environment. The author writes that Technoparks on the university campus are transformed into large technology development parks by increasing their physical capacity and competencies, meeting short-term qualified workforce needs of enterprises by establishing competence centers, providing enterprise-specific human resources solution and in-service training, competitive R&D, innovation and innovation at national and regional level. made recommendations to determine a technology strategy and prioritize investments in science, art and education. (Tüysüz:2020)

Gülsoy (2020) aimed to compare the R&D and innovation policies implemented in selected EU countries and Turkey, and the R&D and innovation performances of these countries with Turkey. For this, the position of Turkey among the selected EU countries between the years 2007–2017 has been tried to be determined using the R&D and innovation indicators cluster analysis method. As a result of the analysis, it is stated that although Turkey's R&D expenditures increased in GDP between 2007–2017, the allocated resources could not turn into enough patented output and commercial products. Despite the strategies and action plans prepared for R&D, innovation, science and technology, it has been observed that Turkey is not at the desired level. It is emphasized that the performance and results of these prepared strategies and action

plans should be discussed in detail. Another suggestion is that the most important condition for creating qualified human capital is to improve the education system and policies. It is pointed out that the dissemination of science, technology and innovation studies in schools throughout the country, and the provision of additional points for successful students in university entrance by organizing R&D competitions will contribute to the raising of future generations. The author's questioning why the resources allocated to R&D and innovation studies do not turn into sufficiently patented and branded products/services, the need to use resources more efficiently and performance-oriented, and the implementation of an incentive mechanism to prevent the brain drain of qualified researchers and R&D personnel recommended. In addition, the author's suggestions are to determine priority sectors that will create added value in order to have patents with brand value, to transfer resources to these sectors, to establish public-university and private sector collaborations, to consider scientific publications qualitatively (citation numbers) as well as quantitatively. (Gulsoy:2020)

Mehmet Akyol and Selim Demez (2020) aimed to analyze the effects of R&D studies on high-tech product exports in their articles. For this purpose, the authors discussed the variables of GDP, investment freedom, R&D expenditures, education level, human capital working in the field of science and technology between the years 2007-2017, including 10 selected EU member states and Turkey. They found that it affects the export of technological products positively. In addition, they concluded that the governments of the countries will contribute positively to the development of technology with structural reforms, and the increase in the export of high-tech products will have a positive effect on the level of economic development. It is emphasized that it is important to make controls to prevent abuse of R&D incentives and supports, to increase efficiency and to prevent waste of resources. Developing university-industry collaborations, solving structural problems that will minimize brain drain, and reviewing the curricula of educational institutions are among the suggestions of the authors. The importance of changing the investment climate and revising the political, legal and physical infrastructure is pointed out in order to attract foreign direct investments to Turkey for technology transfer. (Akyol, Demez:2020)

Deniz Dilara DERELİ and Uğur SALÇAR (2019) analyzed the relationship between Turkey's R&D expenditures and economic growth in their article. For this purpose, R&D expenditures and gross domestic product data in Turkey between 1990-2015 were examined. As a result of the analysis, a long-term bidirectional causality relationship was determined between R&D expenditures and gross domestic product. R&D expenditures in Turkey are below the average of OECD countries. Although there are

incentives and supports for R&D studies in Turkey, it is stated that there is not enough performance to provide an advantage in the international competitive environment. However, the increase in the number of patents and R&D personnel over the years is an indication that the policies implemented are not fruitless. In the study, it is pointed out that the share allocated to R&D in Turkey should be increased and R&D studies should be disseminated. As a result of R&D studies, it has been concluded that productivity and production will increase in Turkey thanks to innovative and advanced technologies, it will be possible to produce value-added products, and with the growth to be achieved, more resources will be allocated to R&D studies and a sustainable growth will be achieved. In addition, the importance of structuring R&D policies and finding application areas of incentives and supports is emphasized. (Dereli, Salğar:2019)

Habibe YAMAN – Assoc. Dr. Dilek ÇETİN – Prof. Dr. Murat Ali DULUPÇU (2019) They aim of articles is to determine the relationship between R&D expenditures in OECD countries and the share of advanced technology exports. The variables of R&D expenditures, the number of R&D researchers, real GDP per capita, general government total consumption expenditures, total government expenditures on education, net foreign direct investment inflow and real exchange rate are discussed as the determinants of high technology exports. According to the results of the analysis, it has been determined that there are variable general government total expenditures that reduce high technology exports. It has been observed that the share of advanced technology exports has increased with the economic growth of the countries. It has been determined that the increase in the share allocated to R&D expenditures also increases the exports of advanced technology in OECD countries. It has been observed that the effect of R&D expenditures on high technology exports is greater than the effect of the increase in the number of R&D researchers. For this reason, it has been concluded that increasing R&D expenditures will contribute more positively to the increase in advanced technology exports. (Yaman, Cetin, Dulupçu:2019)

Tiftik (2021) aimed to reveal how the literature on the relationship between R&D studies and employment and the contribution of R&D studies to employment has developed over the years. As a result of his examination, the author reached research findings showing that technological developments and R&D studies do not increase general employment, but increase unemployment, and stated that technology has a reducing effect instead of increasing employment. It points out that the data showing the effect of R&D studies on general employment is not collected, therefore the contribution of R&D expenditures and incentives to employment is uncertain. (Tiftik:2021)

In their article, Gemici and Öztürk (2020) mentioned the obstacles in conducting R&D studies, why the outputs could not turn into products and added value. The fact that R&D studies are an investment has been put forward as the driving force of development. There are three suggestions in the concluding part of the article. Firstly, R&D managers are trained on technology management, secondly, state supports are given not according to the size of the firm, but based on the added value it produces, and thirdly, R&D supports are continued until the product is commercialized, not until the prototype stage of the product. (Gemici, Öztürk:2020)

4. Conclusion

The results obtained from the reviewed articles and theses can be listed as follows:

- R&D activities are an inevitable necessity for the welfare of the country and economic growth.
- Academia, industry and public cooperation are required for high-tech product and service delivery.
- Incentives should be provided to increase qualified human resources and scientific publications, and financial support for R&D activities should be increased.
- In order to ensure technology transfer, supports and incentives for foreign direct investment should be reviewed.
- Inspections and standards should be brought to measure the effectiveness of R&D activities.
- In the long term, the educational infrastructure of R&D studies should be strengthened and the working conditions of qualified human resources should be reviewed.
- It should be focused on the realization of R&D activities by private companies and universities rather than the public sector in countries, and making their outputs convertible into commercial products/services.
- R&D studies also play an important role in the creation of new or existing products and services. Statistical indicators such as R&D intensity, number of scientific articles, number of registered patents that support this role provide important clues about the technological development level of a country. Intuitively, the diversity of R&D activities also
- R&D studies carried out only in universities will increase the number of scientific publications. However, serious efforts should be made in order for their industry, service and agricultural sectors to reach a level that will affect

the economic growth of a country. This only requires public–university and private sector collaborations.

- The quality of R&D studies, the financial resources to be allocated, and the transformation of the outputs to be obtained as a result of commercial products and services take a certain amount of time. Therefore, the return on investments made in R& D is longer–term compared to other budget items.

In addition, the quality and maturity of human capital also affects the orientation of R&D activities. Human capital leaving the country with brain drain should be prevented, therefore, the conditions of the country should be transformed into an environment suitable for R&D studies. Therefore, the existence of qualified human resources constitutes the input of these studies.

Access to qualified human capital, technology transfer, and foreign direct investments to the country, which are among the main inputs of R&D studies, may not always be possible. Tensions and embargoes between countries may affect the production and use of technology. For these reasons, activities should be focused on technology production rather than technology use, so that foreign dependency on technology will decrease to a minimum.

Bringing together resources at the right place and time will affect the size of the outputs. These sizes will result in the economic growth of the country, the decrease in the foreign trade deficit and the increase in the welfare of the country.

On the other hand, it is necessary to develop the R&D culture in the industrial sector of our country and to offer incentives to increase R&D activities. The establishment of R&D culture in the private sector and the regular measurement of the performance of R&D incentives and supports are topics open to research.

References

- Akyol, M. & Demez, S. (2020). The Effect of R&D Expenditures on High–Tech Product Exports: EU Transition Economies and Turkey Analysis . Gumushane University Journal of Social Sciences, 11 (3), 767–781. Retrieved from <https://dergipark.org.tr/tr/pub/gumus/issue/57505/670386>
- Baydilli, Y. (2019), Economic Impact of R&D Investments in the IT Sector Effect on Growth: The Case of Turkey (2006–2016), (Master's Thesis, Yalova University), Yalova

- Dereli, DD & Salğar, U. (2019). THE RELATIONSHIP BETWEEN R&D EXPENDITURES AND GROWTH: AN ASSESSMENT ON TURKEY. *Journal of Life Economics*, 6 (3), 345–360 . DOI: 10.15637/jlecon.6.021
- Economic Policy Research Foundation of Turkey– TEPAV (2010), To what does South Korea owe its success in innovation? Implications for Turkey,
- Eryer, S. (2021), R & D Expenditures, High–Tech Product Exports and the Relationship with GDP Turkey Example, (Master's Thesis, Kahramanmaraş Sütçü İmam University), Kahramanmaraş
- Gemici Z., Öztürk F. Correctly Interpreting R&D: Holistic R&D, Innovation and Technology Management. *Machine Design and Manufacturing Magazine*. 2020; 18(2): 82–91.
- Gülsoy, S. (2020), State Practices for Research, Development (R&D) and Innovation in Turkey and Comparison with Practices in European Union Countries, Policy Recommendations for Turkey, (Master's Thesis, Ankara University), Ankara
- Hatzichronoglou , T. (1997), "Revision of the High – Technology sector and Product Classification", *OECD Science , Technology and industry working Papers* , No. 1997/02. doi : 10.1787/134337307632
- Istanbul Chamber of Industry (ICI), Turkey's Top 500 Industrial Enterprises, 2020
- Ministry of Industry and Technology, R&D Centers, <https://www.sanayi.gov.tr/istatistikler/istatistiki-bilgiler/mi0203011502> , Access Date 15.04.2022
- Öğrü , G. (2020), The Spillover Effect of Technology and R&D Expenditures on Economic Growth and Development, (Master Thesis, Çukurova University), Adana
- PWC, R&D and design incentives in Turkey, <https://www.pwc.com.tr/turkiye-de-arge-ve-tasarim-tesvikleri>, Access Date 22.05.2022
- Presidency of the Republic of Turkey, Department of Strategy and Budget, Eleventh Development Plan (2019–2023), 2018,
- Tiftik, C. (2021). The Effect of Technology –Based Research and Development Activities on General Employment: A Systematic Compilation Study. *Istanbul Kent University Journal of Humanities and Social Sciences*, 2 (2), 95–111. Retrieved from <https://dergipark.org.tr/tr/pub/itbfkent/issue/64809/977128>
- Tüysüz, H. (2020), The Role of the State in Research–Development and Innovation Studies: The Case of Kosgeb , (PhD Thesis, Zonguldak Bülent Ecevit University), Zonguldak
- OECD (2015), Frascati Manual 2015: Guidelines for collecting and Reporting Data on Research and Experimental Development, The Measurement of Scientific , Technological and Innovation Activities , OECD Publishing, Paris.
DOI: <http://dx.doi.org/10.1787/9789264239012-en>
- Yaman, H., Cetin, D. & Dulupçu , MA (2020). R&D Expenditures and Exports of Advanced Technology in OECD Countries: A Panel Data Analysis. *Anadolu University Journal of Social Sciences*, 20 (3), 193–208. DOI: 10.18037/ausbd.801751