

## **“HIGH TECHNOLOGY EXPORT AND R&D EXPENDITURES” A STUDY FOR E7 COUNTRIES**

**Mehmet Alagöz**

Karamanoglu Mehmetbey University, Faculty of Economics and Administrative Sciences,  
Department of Economics, Karaman, Turkey  
malagoz@kmu.edu.tr

**Gökhan Akar**

Selçuk University, Hadim Vocational High School,  
Department of Foreign Trade, Konya, Turkey  
gakar@selcuk.edu.tr

**Tuba Akar** 

Karamanoglu Mehmetbey University, Faculty of Economics and Administrative Sciences,  
Department of Economics, Karaman, Turkey  
akartubaa@gmail.com

### **Abstract**

*The aim of this study is to evaluate the relationship between R&D expenditures and advanced technology export for E7 countries (Brazil, China, Indonesia, India, Mexico, Russia, and Turkey). Providing economic development of a country depends on many factors. Ability to have high technology sectors and export high added value are considered to be one of the most important factors in providing the advantage of sustainable economic development and global competitive advantage. In the study, examining R&D expenditures and advanced technology indicators of the country deal with, it is attempted to be observed the relationship between both of them. As a result of evaluation made, it was identified that both the share China allocates for R&D expenditures and its high technology product export are more, compared to the other countries.*

*Keywords: Human Capital, R&D expenditures, High Technology Exports, Innovation, E7 countries*

## INTRODUCTION

Liberalization of trade has contributed to globalization of world economy. Together with facilitation of goods and services flow among countries, some changes have been also experienced in production structures of countries as well (Gani, 2009: 34). Today, competitive advantage in international trade does not only depend on the natural resources of a country, it is based on innovative products and services. In the recent times, technology and innovation have become a driving force in positioning long term competition related to global markets (Sara et al. 2012: 86-88). At this point, the criteria such as the qualified labor force, technological infrastructure countries have, success and intensity in the activities of research and development (R&D) activities, and effective and extensive use of information and communication use become important. Developed countries reached these levels, increasing R&D expenditures, working on information production and commercializing this product, and giving importance to the activities improving the quality of labor force (Göçer, 2013a: 118). Technological developments, as a result of R&D activities carried out by the firms, emerge as the inventions and innovations. While technological development and innovation give rise to economic growth at the macro level, it results in increase of the profits and market shares of the firms at the micro level. Technological innovation i.e. product and process innovation has become an obligation in the world, in which the continuous developments and changes are experienced, in terms of keeping competitive power and becoming successful. In this context, it is impossible for the firms and countries, which do not showing necessary attention to R&D activities, to catch a sustainable growth trend. Since R&D activities are an important resource of economic growth, in today's world, it is unavoidable that there is a strong relationship between R&D expenditures and growth (Altın and Kaya, 2009: 252). Providing economic development of a country depends on many factors. Ability to have high technology sectors and export high technology and high technology products is considered to be one of the most important factors of an economy.

The competency of advanced technology is seen as one of economic development. Especially in the countries adopting export based growth, the increase of share of high technology products in total products and improvement of productivity are of the main aims of the rapidly growing countries of today to compete with the new and high technology sectors. Producing and exporting advanced technology products is the most fundamental indicator showing an innovation capacity of a country in global markets. (Gökmen and Türen, 2013: 217-218).

The aim of this study is to reveal the relationship between R&D expenditures and export of advanced technology product. In the study, this relationship was considered in terms of the developing E7 countries (Brazil, China, Indonesia, India, Mexico, Russia, and Turkey). In the study, the period of 1996-2014 is dealt with. The reason for choosing this period is to reach some data more healthily after this period. The study consists of three parts. Firstly, theoretical frame is given place. In the second part, literature review takes place. In the third part, the relationship between R&D expenditures and advanced technology export is examined with the necessary indicators for E7 countries. The study ends with the part of Conclusion, in which there are evaluations.

## **THEORETICAL FRAME**

Today, the contribution technology makes to economic growth and its important is a generally acceptable reality. Technological advance is locomotive of economic growth. While the contribution of technology to economic growth is examined, economic analysis are basically divided into two. The theory, divided as external and internal, agrees with that technology is one of the most important resources of long term growth but differs about modeling the technology process and technologic advance (Alan, 2008:14). The approach accepting the technology as external is neoclassic theories and, one these approach is Solow growth model putting forward that the growth rates of countries will approach to each other in time. In 1980s, internal growth theories emerged and internality of technology has begun to be used in accounting for the developedness differences between countries. According to this growth theory, technology is accepted as an internal variable and the effect of R&D activities on economic growth is studied. Romer (1990), Grossman and Helpman (1991), and Aghion and Howitt (1992) are the studies bringing R&D based growth internal growth models, which pay attention to innovation in long term growth, in the literature. Internal growth theories are based on the technologies and innovations, created by R&D activities (Yıldırım and Kesikoğlu, 2012:166).. According to internal growth models, new capital stock incorporate technological innovation. Economic growth forms as a result of dynamics in economic system. Internal growth models view the factors such as education, training, and new technology as the most important factors determining the growth rate of country (Alan, 2008: 23). Also Schumpeter, who introduced the theoretical foundations of R&D activities, puts forward a similar hypothesis. According to Schumpeter (1942), innovation developing within firms is one of the most important elements of capital development. R&D sector is the center of the new ideas and designs. The new designs and opinions developing in R&D sector are first sold to

intermediate goods sector. The firm, acquiring patent right, which becomes a monopolist power in this sector; later, sells final product sector. Thus, R&D sector becomes forms the dynamic of a sustainable growth (Yıldırım and Kesikoğlu, 2012:167). R&D expenditures have a great importance in the processes such as developing new product and/or production method, effectively using, adapting, and changing the existent or imported technology. Thus, not only the firms or countries but also firms and countries importing technology from the other countries are in the position to make largely R&D expenditure to obtain the highest productivity from the imported technology. In this scope, R&D expenditure is one of the main aims of gaining knowledge and experience, which have a great importance in the process of gaining technology ability (Saygılı, 2003: 70).

That technology internally comes into growth theory also created change in foreign trade theories. In describing the relationship between technology and foreign trade, two main schools stand out. The first of these is the one based on perfect competition markets, with which classic and neoclassic trade theories deal, and the other is the school based on imperfect competition market, which considers closer to the reality in contrast to classic and neoclassic theories. While classic and neoclassic trade theories deal with technology as an external factor, alternative trade theories regard to technology as an internal factor. Although classic and neoclassic schools consider technology as an external factor, they are aware of that technological innovation leads to saving in labor and capital. In contrast to the school based on perfect competition market, the school based on imperfect competition market, which accepts the technology as internal, includes “innovation model”, developed by Schumpeter, (1947) and “technologic deficit hypothesis”, developed by Posner (1961), and “product periods model” developed by Vernon (1966). Even though addition of innovation to the theoretical models begins with Schumpeter (1947), “technologic deficit hypothesis”, developed by Posner (1961) has become the first study giving place the technology in foreign trade theories (Uzay et al., 2012: 150). According to Posner (1961), export is a function of technology and widespread of technologies among countries takes time. Depending on labor and capital intensity, in time, the cost of goods of interest shifts the producing firms. In model, in case of supporting innovation ability and giving enough time, competitive advantage continues For complete advantage to continue, it is necessary to support innovations with investments. In summary, the continuity of export of a country depends on the continuity of production of new technology (Yıldırım and Kesikoğlu, 2012:166).

When developing countries and especially developed countries create innovation as a result of their R&D activities, they do not generate these innovations for presenting them to only domestic market and they also export them. Addressing to larger market than domestic market via export reduces the unit costs of R&D investments and this carries an encouraging quality interms of activities. Also, since these innovations, at least for certain times bring a monopolist power in the firms creating it, small number of worldwide firms makes a production on many products based on high technology (Özer and Çiftçi, 2009: 44).

That export structure shifts from low technology products to high technology products is an indicator of sustainability of competitive power and, of that national welfare will increase in time (Bayraktutan and Bıdırdı, 2015: 23). In today's world, in which global competition is intensive; countries can export only when they can produce the high quality products in a suitable price (Özer and Çiftçi, 2009: 42) At this point, the importance of the products produced with high technology and qualified labor that is necessary for this and R&D expenditures emerges (Göçer, 2013b:218). Advanced technology products are generally defined as R&D volunteered products. R&D and innovation intensity are the main factors of advanced technology export. Nowadays, every country, for being able to provide sustainable growth, should reserve time for the production of high technology product. R&D intensity can affect the export of high technology product, depending on that the firms produce high technology products, that national and intellectual capital increases and develops, and that patent appeals of innovative firms increase. In view of this, these can be considered as the most important determinants of the export level of advanced technology (Sandu, 2014: 82). For creating technology, the increase in technological competency enables for many country to improve and develop from many aspects. This increasing importance of technology and its role in affecting technological welfare and global economic growth carried it to another place. It directs investments allocated for research and development in large production sectors, because these investments lead advanced technology products to form. High technology export includes the products such as computers, drugs, scientific instruments, electronic products, software, transportation electronics, and military and civil aeration products. It is likely that the countries producing such electronic products have an important effect on economic welfare (Gani, 2009: 31-32).

In the recent times, the studies carried out by the researchers have transformed into the trade of high technology product. Especially, in the studies carried out on the innovation, high technology export, and effects of these on whole economic

performance, an increase is observed. The reason for the increase of this interest is that international trade of high technology products provides information about competitiveness and position of an economy in the technological global markets. In addition, another reason is it makes a contribution to accounting for how innovation affects the competitive advantage in a dynamic environment and the relative importance of high technology in international markets (Tebaldi, 2011: 343).

## LITERATURE

As in a country, the investments on high technology sectors and emerging products increase, product innovation and R&D activities gain more importance. The exporting firms are obliged to be innovative for maintaining their competitive power and being able to obtain profit. In the recent years, a number of studies testing the relationship of technological development – export have been carried out. There are two kinds of approach examining the relationship between technological innovation and export. First of these is patent model examining the relationship between patent data, accepted the output of R&D activities, and export. The second approach is the relationship between the variables such as R&D expenditures and R&D staff, accepted as the R&D activities; and export (Uzay et al., 2012: 151). While reviewing literature, the studies researching the relationship of R&D expenditures and export of high technology product were given weight.

Montobbio and Rampa (2005), using structural research analysis, examined the relationship between technological performance and export in 9 developing countries (Argentina, Brazil, China, Colombia, India, Malaysia, Mexico, Singapore, and Thailand) for the period of 1985-1998. As a result of the study, in case that the industries having the increasing technological opportunities increase, they identified that export gains were obtained in high technology sectors. Yoo (2008), in a study he carried out, analyzed the relationship between the export of high technology product and economic output in 91 countries, using the data of 1988-2000. As a result of the study, it was found that economic output had an important contribution to the export of high technology product export. Srholec (2007), analyzed the relationship of advanced technology export with national technology capacity by means of panel data method for 83 countries. The research results confirmed national technologic capacity, expressed through indicators such as R&D intensity, TIC patent per capita, gross tertiary enrolment, number of personnel computers, to be a predictive factor for the level of high-tech exports in total exports. Yet, he also noticed that this causal relation is often associated with some propensity for significant import of high-

tech components, which varies among countries. Braunerhjelm and Thulin (2008), using panel data analysis, 19 OECD countries, examined how R&D expenditures and market size affected the distribution of comparative advantage in the period of 1981-1999. As a result of the study, they identified that an increase of 1% in R&D expenditures led an increase of 3% in the export of high technology product. Özer and Çiftçi (2009), using panel data analysis, examined the relationship between R&D expenditures and general export, export of information -communication technologies, and advanced technology in 19 OECD countries for the period of 1993-2005. As a result of the study, they reached the conclusion that R&D expenditures had a positive effect on general export and advanced technology export. Sara et al. (2012), as a result of regression analysis they carried out on 120 countries, reached the conclusion that high technology export significantly affected innovation capacity of a country.

Tebaldi (2011), in the study he carried out, analyzed the determinants of export of high technology. In the study, in which the period of 1980-2008 was analyzed by the Panel data method, it was found that human capital, direct foreign capital inflows, and trade openness were the most important determinants of high technology industry of a country. It was found that the institutes affected high technology export through human capital and foreign direct investments not directly. Gokmen and Turen (2013), using the model of Tebaldi (2011), in the study they carried out on 15 European countries for the period of 1995-2001, found that in long term, human capital played an important role in the export of high technology product.

Göçer (2013b), in the period of 1996-2012, using the method of panel data analysis considering horizontal section dependency, 11 developing Asian countries, analyzed the effects of R&D expenditures on the export of high technology product, export of information and communication technologies, total export, and economic growth as well as the effects of export of high technology product export on foreign trade balances. As a result of the study, it was identified that increase of 1% in R&D expenditures increased the export of high technology product by 6.5%, the export of information-communication technologies by 0.6%, and economic growth by 0.43 %. Göçer (2013a), in the period of 1996-2012, using co-integration and causality tests, examined the determinants of technological improvements in the newly industrialized countries (South Africa, Mexico, Brazil, China, India, Indonesia, Malaysia, Thailand, and Turkey). As a result of the study, it was seen that there was a positive relationship between R&D expenditures and the export of high technology product. Ismail (2013), using pull model, in the period of 2004-2009 (except for the years 2007 and 2008), on 10 Asian

countries (Japan, China, Hong Kong, South Korea, India, Singapore, Malaysia, Indonesia, Philippines and Thailand ), examined the effect of innovation on high technology product. As a result of the study, he identified that innovation activities were important factors of export of high technology product. Kılıç et al. (2014), using panel data analysis, in the period of 1996-2011, for G8 countries, analyzed the relationship between R&D expenditures and export of advanced technology product. As a result of the study, it was identified R&D expenditures and real effective exchange rate had a positive effect on export of high technology product. In addition, it was identified that there were two directional causality between R&D expenditures and real effective exchange rate and one directional causality from the high technology product to real effective exchange rate.

Sandu and Ciocanel (2014), as a result of the econometric studies they carried out on 26 European countries for the period of 2006- 2010, they found that there was a positive directional relationship between R&D expenditures and advanced technology export and, in addition, that the effect of R&D expenditures made by private sector, was stronger than that of expenditures, made by public sector. Karahan (2015) examined the panel causality relationship applied by GMM method and, for the period of 2000-2013, the relationship between private sector R&D expenditures and the production of high technology product . In the analysis, carried out for Europe, it was introduced that private sector R&D expenditures increased the production of high technology products and that there was a strong correlation between these two data. Kızılkaya et al. (2016) examined the determinants of export of advanced technology product by FMOLS method for BRICS, (Brazil, Russia, India, China, South Africa,) countries, using the data of 2000-2011. In the study, it was concluded that R&D expenditures significantly affected the patent appeals, trade openness, and export of high technology product.

## DISCUSSION

In the presentation of the congress, titled "The World in 2050: Risk and Challenge's" hold in Zurich by The Geneva Association, it was claimed that the economic power in the world will change from G7 countries (US, Japan, Germany, UK, France, Italy and Canada) to E7 countries in 250 years and, according to purchasing power parity, total GDP of E7 countries would leave behind G7 countries (Larosiere, 2013). In this study, examining R&D expenditures and data on high technology export, the relationship between both of them was evaluated.

Table 1: Research and development expenditure (% of GDP)

Country- Years	1996	1999	2002	2005	2008	2011	2013
<b>Brazil</b>	-	-	0,98	1,00	1,13	1,14	-
<b>China</b>	0,57	0,75	1,06	1,32	1,46	1,79	2,01
<b>Indonesia</b>							0,08
<b>India</b>	0,63	0,71	0,71	0,81	0,84	0,82	-
<b>Mexico</b>	0,26	0,36	0,38	0,40	0,40	0,42	0,50
<b>Russian Federation</b>	0,97	1,00	1,25	1,07	1,04	1,09	1,13
<b>Turkey</b>	0,45	0,47	0,53	0,59	0,73	0,86	0,94

Source: Compiled from World Bank data

In Table 1, the share of R&D expenditures in GDP in Brazil, Indonesia, India, Russia, and Turkey is seen. According to this table, it is seen that the fastest increase is experienced in China. The data in this table has also a quality confirming these findings.

Table 2: High-Technology Export (current US 1000\$)

Country- Years	1990	1995	2000	2005	2010	2014
<b>Brazil</b>	1.053.130	1.207.552	5.990.406	8.031.342	8.121.872	8.228.775
<b>China</b>	-	13.057.348	41.735.539	215.928.412	406.089.687	558.605.991
<b>Indonesia</b>	144.306	1.685.982	5.774.419	6.671.058	5.742.569	4.980.582
<b>India</b>	497.829	1.351.219	2.062.488	4.139.238	10.086.626	17.315.676
<b>Mexico</b>	962.212	9.352.136	31.174.465	32.400.251	37.657.285	49.402.709
<b>Russian Federation</b>	-	-	3.907.958	3.820.368	5.075.117	9.842.669
<b>Turkey</b>	106.787	193.654	1.077.574	881.846	1.713.837	2.348.380

Source: Compiled from World Bank data

When we examine the data in Table 2, there are numerical values of advanced technology exports of countries in respect with years. In the direction of these data, with a general expression, it can be said that the countries have a positive tendency in respect with years and, that especially this acceleration increased along with the year 2000. Among the countries specified, China, standing out, is in the first rank in such a way that it has a significant export number against the other countries. Although Mexico is at the low level when compared to China, it is in the position of the second country. Turkey having a very low export figure takes place in the last rank.

Table 3: High-Technology Exports (% of manufactured exports)

Country- Years	1990	1995	2000	2005	2010	2014
<b>Brazil</b>	6,5	4,9	18,7	12,8	11,2	10,6
<b>China</b>	-	10,4	19,0	30,8	27,5	25,4
<b>Indonesia</b>	1,6	7,3	16,4	16,5	9,8	7,0
<b>India</b>	3,9	5,8	6,3	5,8	7,2	8,6
<b>Mexico</b>	8,4	15,2	22,5	19,6	16,9	16,0
<b>Russian Federation</b>	-	-	16,1	8,4	9,1	11,5
<b>Turkey</b>	1,2	1,2	4,8	1,5	1,9	1,9

Source: Compiled from World Bank data

In the export in manufacturing sector, the data containing the information belonging to the share of technology export are given in Table 3. China is in a position of country having the highest share. However, there is no tendency increasing in respect with years. It reached the highest value in 2005 with 30.8%. In the continuing years, there is a decreasing tendency in this rate. In Table 2, in the existing data in terms of all countries, it can be mentioned that a fluctuation was experienced in respect with years. For Turkey, this rate actualized as 4.8% in 2000. However, for the other years, this rate can be accepted as the range of 1.2-1.9%. Together with this level, Turkey takes place in the last rank.

If an evaluation is made for all tables, it is seen that China, Mexico, and India, and India take place in the first ranks in export of high technology product. Especially, China has an important difference between it itself and the other countries. In terms of R&D expenditures, since China is seen at the front compared to the other countries, it can be said that there is a positive relationship between R&D expenditures and export of high technology product. However, it reveals that it is necessary to empirically test the study. This study has prepared a ground for the further studies.

## CONCLUSION

In this study, the relationship between R&D expenditures and advanced technology export was evaluated in terms of E7 countries. In the study, it was aimed to reveal the importance of R&D expenditures and of export of high technology product in terms of country economies. In the part of Discussion of the study, the rates of R&D expenditures of the countries to GDP and data of High-technology exports (% of manufactured exports) were evaluated. As a result of evaluation, it is seen that China is at the relatively front

in R&D expenditures and export of high technology product. Setting out from these evaluations, when considered that the firms and countries do not pay necessary attention to R&D expenditures, it reveals that the countries should gain competitive advantage, spending the necessary time and effort to R&D and innovation. For the countries to be able to close the gap between them and developed countries and to have voice in the same global arena, it can be said that they should export the products with high value added. This depends on R&D expenditures of countries, their allocating more share from the national income, their paying attention to human capital, and their increasing national innovation capacity. Innovation has become the key determining factor in economic development. For example Ismail (2013), using pull model, in the period of 2004-2009 (except for the years 2007 and 2008), on 10 Asian countries (Japan, China, Hong Kong, South Korea, India, Singapore, Malaysia, Indonesia, Philippines and Thailand), examined the effect of innovation on high technology product. As a result of the study, he identified that innovation activities were important factors of export of high technology product. Also Tebaldi (2011), in the study he carried out, analyzed the determinants of export of high technology. In the study, in which the period of 1980-2008 was analyzed by the Panel data method, it was found that human capital, direct foreign capital inflows, and trade openness were the most important determinants of high technology industry of a country. It was found that the institutes affected high technology export through human capital and foreign direct investments not directly. Gokmen and Turen (2013), using the model of Tebaldi (2011), in the study they carried out on 15 European countries for the period of 1995-2001, found that in long term, human capital played an important role in the export of high technology product. Innovation and human capital has become the key determining factor in high technology product and economic development. We can say that the general determinants of high technology product and export include human capital, innovation, and R&D.

## REFERENCES

- Alan, Ş. (2008).Sinai Mülkiyet Haklarının Ekonomik Büyümeye Etkisi, Türk Patent Enstitüsü, Uzmanlık Tezi.
- Altın, O., Kaya, A. Ayşen, (2009). "Türkiye'de Ar-Ge Harcamaları Ve Ekonomik Büyüme Arasındaki Nedensel İlişkinin Analizi". Ege Akademik Bakış, 9(1) pp 251-259.
- Bayraktutan, Y. Bıdırdı H.(2015). Teknoloji Politikaları : Temel Göstergeler ve İhracata Yansımaları (Seçilmiş Ülke Örnekleri) , KOSDEB, 30, 1-30.
- Braunerhjelm , P.,Thulin P. (2008). "Can countries create comparative advantages? R&D expenditures, high-techexports and country size in 19 OECD countries, 1981–1999". International Economic Journal/Vol. 22, No. 1, 95–111.

- Gani, A. (2009). "Technological Achievement, High Technology Exports and Growth", *Journal of Comparative International Management*, Vol 12 (2), 31-47.
- Göçer, İ. (2013a). "Teknolojik İlerlemenin Belirleyicileri: NIC ülkeleri için Panel Eşbütünleşme ve Panel Nedensellik Analizleri". *Maliye Finans Yazıları*. Yıl 27. Sayı 100. 116-141, 2013a
- Göçer, İ. (2013b). "Ar-Ge Harcamalarının Yüksek Teknolojili Ürün İhracatı, Dış Ticaret Dengesi ve Ekonomik Büyüme Üzerindeki Etkileri" *Maliye Dergisi*, Sayı: 165. pp 215-240.
- Gökmen, Y., Turen, U. (2013). "The Determinants of High Technology Exports Volume: A Panel Data Analysis of EU-15 Countries". Vol 2(3). Pp 217-232.
- ISMAIL, NormazWana, (2013). "Innovation and High-Tech Trade in Asian Countries", *International Conference on Recent Developments in Asian Trade Policy and Integration*, 20-21 February, Kuala Lumpur, Malezya; <https://www.nottingham.ac.uk/gep/documents/conferences/2013/malaysiaconference/normaz-wana-ismail.pdf> Date of Access: 08.05.2016
- Karahan, O. (2015). "Intensity of Business Enterprise R&D Expenditure and High-Tech Specification In European Manufacturing Sector". *World Conference on Technology, Innovation and Entrepreneurship*, 195(3), 806–813.
- Karahan, O. (2015). "Intensity of Business Enterprise R&D Expenditure and High-Tech Specification in European Manufacturing Sector". *World Conference on Technology, Innovation & Entrepreneurship*, 195(3), 806–813.
- Kılıç, C., Bayar Y., Özekicioğlu H. (2014). "Araştırma Geliştirme Harcamalarının Yüksek Teknoloji Ürün İhracatı Üzerindeki Etkisi: G-8 Ülkeleri İçin Bir Panel Veri Analizi", *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, Sayı: 44, Temmuz-Aralık 2014 ss. 115-130.
- Kizilkaya, O., Ay, A. & Sofuoğlu, E. (2016). "The determinants of hightechnology product export in brict countries: An econometric approach", *Global Journal on Humanites & Social Sciences*, pp 112-117.
- Larosiere de J. (2013). "The World in 2050: Risk and Challenges" [https://www.genevaassociation.org/media/853749/ga\\_9th\\_cro\\_assembly\\_de-larosiere.pdf](https://www.genevaassociation.org/media/853749/ga_9th_cro_assembly_de-larosiere.pdf), Date of Access: 08.05.2016
- MONTOBBIO, Fabio and Francesco RAMPA (2005). "The Impact of Technology and Structural Change on Export Performance in Nine Developing Countries", *World Development*, 33(4), pp.527–547.
- Ozer, M., & Çiftçi, N. (2009). "Ar-Ge Harcamaları ve İhracat İlişkisi: OECD Ülkeleri Panel Veri Analizi". *Dumlupınar University Journal of Social Science*, (23), 39-49.
- Sandu, S. and Ciocanel, B. (2014). "Impact of R&D and Innovation on high – techexport" *Procedia Economics and Finance* 15, 80 – 90.
- Sara, T.S., Jackson F.H., Upchurch, L.T., 2012. "Role of Innovation in Hi-Tech-Exports of a Nation" *International Journal of Business and Management* Vol. 7, No. 7, pp 85-93.
- Saygılı, Ş. (2003). "Bilgi Ekonomisine Geçiş Sürecinde Türkiye Ekonomisinin Dünyadaki Konumu" DPT, Yayın No. DPT: 2675.
- Srholec, M. (2007). "High-Tech Exports from Developing Countries: A Symptom of Technology Spurts or Statistical Illusion?" *Review of World Economics*, Vol. 143 (2).
- Tebaldi, E. (2011). "The Determinants of High-Technology Exports: A Panel Data Analysis", *AtlEcon J* (2011) 39:343–353.
- Uzay N., Demir, M., Yıldırım E. (2012). "İhracat Performansı Açısından Teknolojik Yeniliğin Önemi: Türkiye İmalat Sanayi Örneği" *Doğuş Üniversitesi Dergisi*, 13 (1), 147-160.
- Yıldırım E., Kesikoğlu F. (2012). "Ar-Ge Harcamaları ve İhracat Arasındaki Nedensellik İlişkileri Marmara Üniversitesi İ.İ.B.F. Dergisi Cilt XXXII, SAYI I, S. 165-180.
- Yoo, S.H. (2008). "High-technology exports and economic output: an empirical investigation", *Applied Economics Letters*, 15. 523–525.