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The Impact of R&D Expenditures on High-Tech Product Exports

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Abstract. Increasing high-tech product exports in international markets to achieve sustainable economic growth goals is considered an important element in every country in the contemporary world, where globalization is experienced at the highest level. Although it is accepted that many factors affect high-tech product exports in the literature, it is emphasized that R&D expenditures have significant effects. In this research, the effect of R&D expenditures on high-tech product exports in 11 emerging market economies in the period of 1996–2018 was examined. In the context of explanatory variables that are thought to have an impact on high-tech product export, exchange rate, foreign demand, economic growth, and foreign direct investments were used in addition to R&D expenditures. To analyze the relationships, panel quantile regression analysis was applied. The results showed that each variable had different effects on high-tech product exports, and it was seen that R&D expenditures had a positive and very strong effect. In addition, it was determined that economic growth and foreign direct investment also had positive and significant effects on high-tech product exports. In the light of the findings, it is of great importance to allocate more share to R&D expenditures to increase high-tech product exports and benefit from international trade markets more effectively, especially in developing countries.

Key words: economic growth, high-tech products, panel quantile regression analysis, R&D expenditures.

Introduction

The mercantilist period, experienced since the 15th century, has been the scene of a capital accumulation race between western countries. In this process, which can also be expressed as trade capitalism, it has been accepted that wealth passes through the possession of precious metals, policies have been applied to increase exports and reduce imports. The industrial revolution that began in England with the influence of technological developments from the mid-18th century – industrial capitalism – brought about mass production and created high-level increases in the supply of manufactured goods. As in the mercantilist period, increasing exports was critical to meltdown this resulting supply surplus and prosperity. A significant level of development difference has emerged between the countries that have managed to achieve industrialization and those that have not. Countries have begun to be categorized as developed and underdeveloped countries according to the level of industrialization. Currently, developed countries are trying to achieve high economic growth rates to gain the upper hand over each other by increasing their wealth, while underdeveloped countries are trying to reach the level of developed countries. As in previous periods, export is considered the most effective tool that can be used for this purpose. Especially since the 1980s, countries have been pursuing export-based policies for sustainable growth goals.

In a world where competition in international markets is at the highest level, companies are constantly trying to maintain their activities and increase their profits by making changes in the nature of the products they produce. Since it is accepted that the most important source of production today is technology, increasing the added value of products by using higher technology in production allows standing out from the competition. In addition, the increase in sales of companies in international markets affects increasing the wealth of the country by increasing the exports of the country to which they are connected and gaining foreign currency. In this regard, governments in each country implement various policies that will ensure production and HTE. It has been observed that it has significant effects on the economy, and the number of studies conducted to determine the determinants of HTE is increasing day by day. Although it has been found that more than one factor is effective in many studies, it has been determined that R&D activities are of great importance in technological development, which provides benefits such as invention, innovation, and, effective use of resources. Therefore, it has been emphasized that the most effective factor on the HTE is R&D activities. Even (Gruber et al., 1967) said that "All roads lead to the relationship between export performance and R&D activities" regarding the achievement of competitive advantage. The fact that it has been stated many times in the literature that R&D activities have significant effects on HTE has aroused our curiosity about this subject and has also been the source of motivation for this study.

In the study, the effect of research and development expenditures on HTE in 11 selected emerging market economies is investigated. This study differs from other studies in 3 aspects. Firstly, the number of studies examining the impact of R&D expenditures on exports of high-tech products has decreased in recent years. In this respect, as a result of the analysis to be made using new data, it will be possible to determine in which direction the relationship between the variables has developed. Secondly, in the study, the literature examining the effect of R&D expenditures on exports of high-tech products has been researched more extensively than in other studies. This helps us to create a good working setup by enabling us to have a full grasp of all the details of the subject. Thirdly, in other studies, it has been determined that the relationships between variables are generally investigated by traditional empirical methods. In this study, panel quantile regression analysis, which has not been applied before, was used. The use of panel quantile regression analysis has provided the opportunity to see how the impact of R&D expenditures changes in countries with the high, medium, and low levels of high technology product exports in a single analysis. Therefore, in the study, more detailed information about the relationship between the variables was obtained and this information was useful when making policy recommendations.

This paper is organized as follows. Conceptual explanations are made about the issue in the next part of the study, and the theoretical literature is summarized. In the second part, the empirical literature is presented, and in the third part, a data set and an econometric method are introduced. In the fourth section, the results of the empirical analysis are reported, and in the conclusion section, the study is concluded with a general evaluation and policy recommendations. Thanks to the econometric method applied, more detailed information has been obtained about the relationship between the variables compared to other studies on this subject.

Conceptual and theoretical framework

According to the definition made by (Davis, 1982), a high-tech product is produced with a high R&D expenditure. It is also expressed as technology-intensive goods with high-income elasticity and complex production stages, which have a significant impact on the growth of a country's economy. Therefore, high-tech production refers to the provision of efficiency and quality improvement in production. Nowadays, when export-based growth policies are implemented, fast-growing countries are trying to increase the exports of high-tech products to protect and expand their share in export markets (Mani, 2000; Çolakoğlu, 2021; Sara, 2012).

According to Aghion et al. (Aghion et al., 2000), the main source of technological progress is innovation, which ensures the emergence of new products, production methods, production activities, and new organizations. Innovations, on the other hand, are created by R&D activities by profit-seeking firms, entrepreneurs, and researchers. Therefore, an important part of technological development is a product of companies' R&D activities aimed at creating new technologies. This aspect also constitutes the starting point of internal growth models (Jones, 2013). The internalization of technological development in the theory of economic growth was first made by the study of (Schumpeter, 1942). Later, (Romer, 1986) developed Arrow's learning by doing model and coined the R&D-based growth model. According to Romer, companies that want to maximize their profits reflect the knowledge they have obtained by making R&D expenditures for production and try to become a monopoly power. The increase in the production of companies encourages economic growth. In addition, the new information obtained by the companies is used in production by other companies operating in the same sector, creating a spillover effect and this situation positively affects economic growth. In studies conducted by Grossman and Helpman (Grossman, Helpman, 1989, 1990) and Aghion and Howitt (Aghion, Howitt, 1992), different opinions on the importance of R&D activities on economic growth have been put forward. According to the models, the increase in the number of people working in the R&D sector and the positive externalities created in this sector have positive effects on economic growth (Taban, Şengür, 2014). Based on this theoretical information, it is stated that R&D expenditures have a two-ways effect on technology. Firstly, R&D expenditures expand a country's capacity to develop new products, and secondly, the capacity to obtain information through R&D expenditures is increasing and the technology transfer between countries or sectors is accelerating (Griffith et al., 2004).

Aw et al. (Aw et al., 2009) developed a dynamic export model to examine the relationship between R&D activities and exports. In their model, they stated that productivity largely depended on the firm's R&D activities and participation in export markets. Therefore, they emphasized that research and development activities would have a positive effect on export revenues by increasing productivity (Harris, Moffat, 2011). As a general rule, the effects of R&D activities on exports are expressed in two different ways as input and output. In the input approach, the relationship between exports and factors such as R&D expenditures and research and development personnel used in the development of a new product or production technique is examined. In the output approach, the relationship between patents obtained as a result of R&D activities and exports is examined (Yıldırım, Kesikoğlu, 2012).

The products of the manufacturing industry of a country are classified by the OECD into four groups according to the level of technology. Accordingly, technology density is taken into account both the level of technology-specific to the sector (ratio of R&D expenditures to value-added) and R&D expenditures on intermediate and capital goods, as well as technology distinguished as low, medium-low, medium-high, and high. In this context, high-tech products include products with high R&D intensity, such as products produced in the computer, aerospace, pharmaceuticals, chemicals, electrical machinery, electronics, and telecommunications industries or produced through scientific research (Hatzichronoglou, 1997; OECD, 2011). In the light of these explanations, it can be stated that the way to high technology in production and therefore in exports passes through R&D activities. For this reason, it can be said that the countries that allocate more share to R&D expenditures are in a better position in terms of high-tech product exports. This situation is shown in *Table 1.*

Looking at Table 1, it can be seen that the highest R&D expenditure according to the income classification is made in high-income countries. The lowest R&D expenditures are made in lower-middle-income countries. It has been determined that HTE are mostly in upper-income countries and least in low-income countries. At this point, it can be said that both R&D expenditures and HTE are higher in upper-income country groups than in

Table 1. R&D expenditures and HTE in-country groups by income and region classification

Country groups	R&D expenditures, %[1] (2018)	Exports of high-tech products, %[2] (2019)
High-income countries	2.59	20.23
Upper-middle-income countries	1.64	23.60
Lower-middle-income countries	0.53 (2017)	16.92
Low-income countries	-	5.38
European Union	2.19	16.21
East Asia and the Pacific	2.44	33.85
Latin America and the Caribbean	0.67	14.09
The Middle East and North Africa	0.61 (2017)	4.61
Sub-Saharan Africa	0.48 (2007)	6.02
World	2.20	20.75

Note: [1] the share of R&D expenditures in GDP. [2] the share of HTE in manufacturing exports.
Source: World Bank (2022).

low-income countries. According to the regional classification, it has been determined that the East Asian and Pacific countries, which have become the production bases of multinational companies in recent years, especially due to low labor costs, are in the best position in terms of both variables. In addition, it has been determined that research and development expenditures and HTE are much higher in developed western countries compared to other regions consisting of developing countries.

Literature summary

Since the 1980s, it has been emphasized that R&D activities have significant effects on economic growth through technological developments in endogenous development theories. Therefore, it has become widespread to investigate the effects of R&D activities on economic growth, as well as other variables such as total exports, HTE, exports of industrial goods, exports of information and communication technologies. Studies examining the relationship of R&D activities with HTE have shown an increase since the 1990s. R&D activities are among the main determinants of HTE. As stated in the theoretical part, R&D activities are included in the analysis in the form of variables such as R&D expenditures, several researchers working in the R&D sector, and several patent applications or patents, depending on the input and output approach. In studies conducted mainly on the European Union, OECD countries, and Asian countries, it has been found that generally, research and development activities have positive effects on high-tech product exports. It is worth noting that the availability of data is also of great importance when choosing a country. Some of the studies conducted on this issue are presented in *Table 2*.

Data and econometric method

In this study, it is aimed to investigate the effects of R&D expenditures on high technology product exports in 11 Emerging Market Economies[1]; 11 Emerging Market Economies were determined according to the availability of data among the countries covered by the Morgan Stanley Capital International (MSCI) emerging markets index. In addition, Russia, which is considered as one of the emerging markets by many organizations, was included among the countries examined. The countries examined in the study are considered as economies that have shown rapid economic growth performance, attracted large amounts of foreign capital investment since the beginning of the 2000s, and whose impact on the global economy has increased rapidly with these characteristics. They are trying to increase the production of high technology products in order to reach the level of

[1] 11 Emerging Market Economies: Colombia, Mexico, Czech, Hungary, Kuwait, Poland, Russia, Turkey, China, India and South Korea.

Table 2. Summary of the literature

Authors	Period/Country	Variables	Method	Result
Le (1987)	1975, 1979, 1980, and 1983, OECD countries	HTE, R&D1	Regression Analysis	Positive impact
Fagerberg (1995)	1960–1980, 19 OECD countries	SI, R&D1, PATENT, SAL, POP, DEF, INV	Panel Regression Analysis	R&D expenditures have a positive effect on the specialization index in some products and a negative effect on some products.
Landesmann and Pfaffermayr (1997)	1967–1987, 7 OECD countries	EXP, ER, LABORC, R&D1	Panel Regression Analysis	Positive impact
Seyoum (2004)	1996–1998, 54 countries	HTE, FDI, R&D2, EDU1, UICL, ER, PINFS	Cross-Country Analysis	Positive impact
Gourlay et. al. (2005)	1988–2001, United Kingdom (1468 companies)	EXP, SALE, VPRO, R&D1, CAP1, ER	Cross-Country Data Analysis	Positive impact
Srholec (2007)	2001–2003, 111 countries	EPEXP, TECH, R&D1, POP, FPIMP, IGIMP	Panel Regression Analysis	Positive impact
Braunerhjelm and Thulin (2008)	1981–1999, 19 OECD countries	HTE, R&D1, GDP, EDU2, GOV1, FDI, MIDTECH, PCGDP	Panel Regression Analysis	Positive impact
Özer and Çiftçi (2009)	1990–2005, 30 OECD countries	HTE, ICTEXP, GEXP, R&D1	Panel Regression Analysis	Positive impact
Bojnec and Ferto (2011)	1995–2003, 18 OECD countries	IEXP, GDP, DIST, LANG, R&D1	Time Series analysis	R&D expenditures have a positive impact on industrial exports.
Alemu (2012)	1994–2010, 11 East Asian countries	HTE, R&D1, R&D2, PCGDP, PHONE, EDU3, CAP2, FDI	Panel Data Analysis	R&D activities have a positive impact on HTE.
Uzay et. al. (2012)	1995–2005, Turkey (25 sectors)	EXP, R&D1, ER, VOL, WGDP	Time Series Analysis	R&D expenditures have a positive impact on exports.
Yıldırım and Kesikoğlu (2012)	1996–2008, Turkey (25 sub-sectors of the manufacturing industry)	REXP, REER, R&D1	Panel Data Analysis	There is a one-way causality relationship between R&D expenditures and exports.
Göçer (2013)	1996–2012, 11 Asian countries	HTE, ICTEXP, EXP, FTBAL, GROWTH, R&D1	Panel Data analysis	R&D expenditures have a positive impact on HTE. In addition, there is a one-way causality relationship between R&D expenditures and HTE.
Ismail (2013)	2004–2009 (excluding 2007–2007), 10 Asian countries	HTE, R&D1, FDI, GDP, PCGDP.	Drawing Model	R&D expenditures have a positive impact on HTE.
Kılıç et al. (2014)	1996–2011, G8 countries	HTE, R&D1, REER	Panel Data Analysis	R&D expenditures have a positive impact on HTE. In addition, there is a one-way causality relationship between R&D expenditures and HTE.
Sandu and Ciocanel (2014)	2006–2010, 26 EU countries	HTE, R&D3, R&D4, INFEMP	Panel Data Analysis	R&D expenditures have a positive impact on HTE.
Şahbaz et al. (2014)	1996–2011, 17 EU countries and Turkey	HTE, R&D1	Panel Data Analysis	In addition, there is a one-way causality relationship between R&D expenditures and HTE.

End of Table 2

Authors	Period/Country	Variables	Method	Result
Özkan and Yılmaz (2017)	1996–2015, 12 EU countries and Turkey	HTE, GDP, R&D1	Panel Data Analysis	R&D expenditures have a positive impact on HTE. In addition, there is a one-way causality relationship between R&D expenditures and HTE.
Karasaç and Sağın (2018)	2008–2015, 35 EU countries	HTE, R&D3, R&D4, REER	Panel Data Analysis	Public and private sector R&D expenditures have a positive impact on HTE.
Gaberli (2018)	1996–2014, G-7 countries	HTE, R&D1, IPR, ECI	Panel Data Analysis	R&D expenditures have a positive impact on HTE.
Boz et al. (2019)	2000–2015, BRICS and MIST countries	HTE, R&D1	Panel Data Analysis	There is a bidirectional causality relationship between R&D expenditures and HTE in South Korea. There is a one-way causality relationship between HTE and R&D expenditures in China, Brazil, and Turkey.
Durmuş (2020)	2007–2017, 7 Emerging Market Economies	HTE, R&D1, PATENT, FRTRADE, FRINV	Panel Data Analysis	R&D expenditures have a positive impact on HTE.
Oğuz and Sökmen (2020)	1996–2016, 31 OECD countries	HTE, R&D1, PATENT, REER	Panel Data Analysis	R&D expenditures have a positive impact on HTE.
Yaman et al. (2020)	1998–2017, 35 OECD countries	HTE, R&D1, R&D2, GOV2, EDU4, FDI, RER, PCGDP	Panel Data Analysis	R&D expenditures have a positive impact on HTE.
Yavuz and Uysal (2020)	1991–2016, 15 OECD countries	HTE, R&D1, GROWTH, FDI	Panel Data Analysis	R&D expenditures have a positive impact on HTE.
Akay (2021)	2007-2018, 27 12 EU countries and Turkey	HTE, R&D1, PATENT, OPEN, FDI	Panel Data Analysis	R&D expenditures have a significant impact on HTE.
Aktaş and Gür (2021)	2010–2020, E7 and G7 countries	HTE, R&D1, ICT, FDI, GROWTH, GOV3, CAP3, ARTİCLE	Panel Data Analysis	Positive impact
Sey and Aydın (2021)	1990–2018, Turkey	HTE, R&D1, PATENT	Time Series Analysis	Positive impact

Note: HTE: The Share of High-Tech Product Exports in Manufacturing Industry Exports, EXP: Export, ICTEXP: Export of Information and Communication Technologies, GEXP: Export of Goods, IEXP: Industrial Exports, REXP: Real Exports, EPEXP: Electronic Product Export, R&D1: R&D Expenditures, R&D2: Number of Researchers in the R &D Sector, R&D3: Public R&D Expenditures, R&4: Private R&D Expenditures, PATENT: Total Number of Patent Applications, SI: Specialty Index, DEF: Defense Spending, ER: Exchange Rate, RER: Real Exchange Rate, REER: Real Effective Exchange Rate, VOL: Exchange Rate Volatility, LABORC: Cost of Labor, FDI: Foreign Direct Capital Investments, EDU1: Level of Education in Mathematics and Physics, EDU2: Total Education Expenditures, EDU3: The Rate of Participation in Secondary Education, EDU4: Public Sector Education Expenditures, UICL: University and Industry Cooperation Level, PINFS: Physical Infrastructure Level, SALE: Amount of Sales, VPRO: Variety of Products, TECH: The Level of Technology, FPIMP: Import of Final Products, IGIMP: Import Intermediate Goods, GOV1: Total Public Expenditures, GOV2: Public Consumption Expenditures, GOV3: Government Activity Index, MIDTECH: Mid-Level Technology Production, PCGDP: Real GDP per Capita, WGDP: World GDP, GDP: Real GDP, DIST: Distance, PHONE: The Number of Phones per 100 People, CAP1: Capital Intensity, CAP2: The Ratio of Total Fixed Capital of the Country, CAP3: Formation of Gross Capital, FTBAL: Foreign Trade Balance, INFEMP: The Number of Employees in Information-Intensive Sectors, IPR: Intellectual Property Rights Expenditures, ECI: Index of Economic Complexity, FRTRADE: Freedom of Trade, FRINV: Freedom of Investment, OPEN: The Ratio of Openness to the Outside, ICT: The Use of Information and Communication Technologies, ARTİCLE: The Ratio of Scientific and Technical Articles, GROWTH: Economic Growth., POP: Population, LANG: Language, SAL: Salary, INV: Investment.

developed countries by making their rapid economic growth sustainable. Therefore, in these countries, whose production and export potential is increasing every year, it is necessary to examine the effect of R&D expenditures, which is considered as the most important element for high-tech products, on HTE in terms of their economic development. In the research, annual data for the period 1996-2018 were used depending on the availability of the data.

As a result of the literature review, it is seen that R&D expenditures are used extensively to represent research and development activities, and R&D expenditures have been selected as the independent variable that constitutes the basis of the study. Because the dependent variable is an export variable, the exchange rate, which is considered to be the main determinant of exports in the literature, in addition to world income and domestic income variables, foreign direct investment variables as control variables are included in the model. The explanations of the variables are presented in *Table 3.*

The econometric model created based on this information is as follows:

$$HTE_{it} = \beta_{it} + \beta_1 R\&D_{it} + \beta_2 LREER_{it} + + \beta_3 LFGDP_{it} + \beta_4 LGDP_{it} + \beta_5 FDI_{it} + \varepsilon_{it} \quad . \quad (1)$$

Empirical analysis consists of 5 stages. In the first stage, the the Breusch – Pagan test $CDLM_1$ (Breusch, Pagan, 1980), which gives effective results when the time dimension (T) is larger than the cross-section dimension (N), was used to examine the cross-sectional dependence between the series and in the model. In addition, Pesaran's $CDLM_2$ test (Pesaran, 2004), which gives effective results when T and N goes to infinity, and the Pesaran et al. $CDLM_{adj}$ test (Pesaran et al., 2008), which gives effective results when T>N and N<T, were also used. In panel data analysis, it is assumed that the cross-section units (countries) are independent of each other, that is, they are not affected by each other. However, in today's globalized world, other countries may also be affected by the shocks experienced by one country. For this reason, the use of tests that do not take into account the dependence between cross-section units can lead to biased and inconsistent results. The application of cross-sectional dependence tests is also of great importance for the tests to be selected at later stages.

In the second stage, the second generation panel unit root test CADF (Cross-Sectional Augmented Dickey-Fuller) belonging to Pesaran (Pesaran, 2007), which can be used when there is a cross-section dependence, was applied. This test is an extended version of the lag levels and 1st difference values for each series with cross-sectional averages in the standard CADF regression. With the CADF test, the arithmetic average of the statistics of each cross-section can be taken to obtain the CIPS statistics valid for the entire panel. In this way, stationarity analysis can be performed for each cross-section as well as for the entire panel. If the CADF and CIPS statistics values are less than the

Table 3. Variable descriptions

Variable	Description	Resource
HTE	The Share of High-Tech Product Exports in Industrial Exports, %.	World Bank
R&D	The Share of R&D Expenditures in GDP, %.	World Bank
LREER	Real Effective Exchange Rate Index (2007=100). Logarithmic values were used.	Bruegel.org
LFGDP	World GDP. The Sum of the Real GDP of the countries where each country trades the most, is calculated according to the Fixed Prices for 2015. Logarithmic values were used.	World Bank
LGDP	Real GDP, Calculated based on Fixed Prices for 2015. Logarithmic Values values.	World Bank
FDI	The Share of Net Foreign Direct Capital Inflows in GDP, %.	World Bank

critical table values as an absolute value, it is stated that there is a unit root in the series, and if it is large, there is no unit root in the series, that is, the series has a stationary structure.

In the third stage, the premise in the light of information obtained from previous analysis, Westerlund's Durbin – Hausman cointegration test (Westerlund, 2008) was applied. According to the test, the null hypothesis shows that there is no cointegration for all units. However, one of the 2 sub-alternative hypotheses shows that there is a cointegration for the entire panel and the other for some of the cross-sectional units in the panel.

In the fourth stage, it is investigated whether the variables show a normal distribution to decide the estimating method. For this purpose, some statistical methods have been used. One of them is Skewness and Kurtosis statistics, which are evaluated within the scope of descriptive statistics. Skewness is used to measure the symmetry of the data distribution. The fact that the statistical values are equal to 0 indicates that the data are distributed normally. However, it is stated that there is a skewed distribution to the right if it is greater than 0, and there is a skewed distribution to the left if it is less than 0. Kurtosis, on the other hand, is used to measure the width of the distribution of data. A statistical value equal to 0 indicates that the data is normally distributed, but different from 0 indicates that it is not normally distributed. In addition to these two descriptive statistics, the Shapiro – Wilk and Shapiro – Francia tests are also widely used. According to these tests, the probability level is less than 5%, which means that the data are not distributed normally (Xu, Lin, 2018). Although the skewness and kurtosis statistics being different from 0 indicate that there is no normal distribution, in some studies, statistical values between -1 and +1, between -1.5 and +1.5, or between -2 and +2 are accepted as normal distribution.

At the final stage of the analysis, Panel Quantile Regression Analysis developed by Koenker and Basset Jr (Koenker, Basset, 1978) and widely used in statistical analyses of linear and nonlinear models in different fields was applied to estimate the coefficient, since it was found that the variables were not normally distributed. The quantile regression model performs a regression analysis between the conditional quantile of the dependent variable and the explanatory variables and allows obtaining a coefficient estimate for all the quantiles. This model allows stronger and more effective coefficient estimates to be made than the Ordinary Least Squares (OLS) estimator in the case where the variables are not normally distributed. Because in such a case, if the Ordinary method is used for regression estimation, the skewed distribution of economic variables can be ignored. When the variables are skewed to the left or to the right, the distribution can be fully characterized and comprehensive analysis can be obtained thanks to quantile regression. The mathematical representation of the panel quantile regression model is as follows:

$$y_i = x_i b_{\theta i} + \mu_{\theta i}, \quad 0 < \theta < 1$$
$$Quant_{i\theta}\left(\frac{y_i}{x_i}\right) = x_i \beta_\theta . \tag{2}$$

In equation (2), x is the explanatory variables vector, and y represents the dependent variable, μ is the accidental error for which the conditional quantile distribution is zero. $Quant_{i\theta}(y_i/x_i)$ – is the quantile value of the defined variable. β_θ is the θ-th quantile regression and it is solved by the following formula:

$$min \sum_{y_i \geq x_i' \beta} \theta |y_t - x_i'\beta| + \sum_{y_i < x_i'\beta} (1-\theta)|y_t - x_i'\beta|. \tag{3}$$

When θ is equal to different values, different parameter estimates are obtained. Mean regression is a special case of quantile regression under conditions where $\theta = 0.5$ (Xu, Lin, 2018; Salari et al. 2021). In addition to panel quantile regression, the OLS estimator was also applied to make comparisons.

Results of empirical analysis

In accordance with the ranking described in the Econometric method section, it was first examined whether there is cross-sectional dependence between the variables and in the model. The results are shown in *Table 4.*

According to the results of three separate tests, it was found that there was a cross-section dependence at the level of 1% significance in all variables and the model. To determine the level of stationary of variables, the CADF panel unit root test was applied, which is one of the second generation unit root tests that take into account the cross-section dependence. To determine the level of stationary for the entire panel, CIPS statistics were taken into account. The results are given in *Table 5.*

According to the results of the unit root test, it was determined that the HTE and R&D variables were stationary I(1) when the 1st difference was taken. In addition, it was observed that the other variables were stationary I(0) at the level values. Since there was a cross-sectional dependence and some of the variables were I(0) and some were I(1), the long-term relationship between the series was investigated by applying the Durbin-Hausman cointegration test, accordingly. The results are shown in *Table 6.*

Table 4. The cross-sectional dependence test results

	$CDLM_1$	$CDLM_2$	$CDLM_{adj}$
HTE	186.776*** (0.000)	12.564*** (0.000)	12.314*** (0.000)
R&D	400.587*** (0.000)	32.950*** (0.000)	32.700*** (0.000)
LREER	297.082*** (0.000)	23.082*** (0.000)	22.832*** (0.000)
LFGDP	1263.760*** (0.000)	115.251*** (0.000)	115.001*** (0.000)
LGDP	1174.721*** (0.000)	106.761*** (0.000)	106.511*** (0.000)
FDI	114.018*** (0.000)	5.627*** (0.000)	5.377*** (0.000)
Model	202.180*** (0.000)	14.033*** (0.000)	7.701*** (0.000)

Note: ***, ** and * denote a significance level of 1%, 5% and 10%, respectively. The values in parentheses indicate the probability values.

Table 5. Panel unit root (CADF) test results

Variables	CIPS Statistical Value	
	Level	1st difference
HTE	-2.032	-3.341***
R&D	-1.672	-4.292***
LREER	-2.333**	-
LFGDP	-2.443**	-
LGDP	-2.452**	-
FDI	-2.607**	-

Note: The table critical values for the significance levels of 1%, 5% and 10% are -2.57, -2.32 and -2.20, respectively. ***, ** and * denote the significance level of 1%, 5% and 10%, respectively.

Table 6. The results of the cointegration test

	Test Statistic	Probability
DH Group	61.531***	0.000
DH Panel	38.374***	0.000
Note: ***, ** and * denote a significance level of 1%, 5% and 10%, respectively.		

The results of the table above indicate that there is a cointegration relationship between the series both for the group and for the entire panel. In the light of all these findings, finally, to determine the coefficient estimation method, it was investigated whether the variables had a normal distribution. The results are shown in *Table 7*.

Based on the -1.5 and +1.5 range, the skewness values indicate that the R&D and FDI variables do not show a normal distribution, but other variables have a normal distribution. Kurtosis values indicate that none of the variables are distributed normally. Since it is not possible to reach a complete conclusion according to these results, 2 more different tests used in the literature were applied. According to the Shapiro – Wilk and Shapiro – Francia test results, it was determined that the variables were not distributed normally because the probability values of the variables were less than 0.05. As a result, it was decided that the variables were not normally distributed. This proves that it is appropriate to use the panel quantile regression model for empirical analysis. The results of the quantile regression are presented in *Table 8*.

Table 7. Normal distribution test results

Variables	Distortion	Skewness	Shapiro – Wilk test		Shapiro– Francia test		Observation
			Statistics	Probability	Statistics	Probability	
HTE	0.494	1.985	0.919	0.000	0.923	0.000	253
R&D	2.008	7.717	0.802	0.000	0.801	0.000	253
LREER	-0.442	3.536	0.984	0.006	0.983	0.005	253
LFGDP	-0.471	2.984	0.975	0.000	0.976	0.001	253
LGDP	0.336	2.622	0.962	0.000	0.964	0.000	253
FDI	3.491	41.283	0.446	0.000	0.433	0.000	253

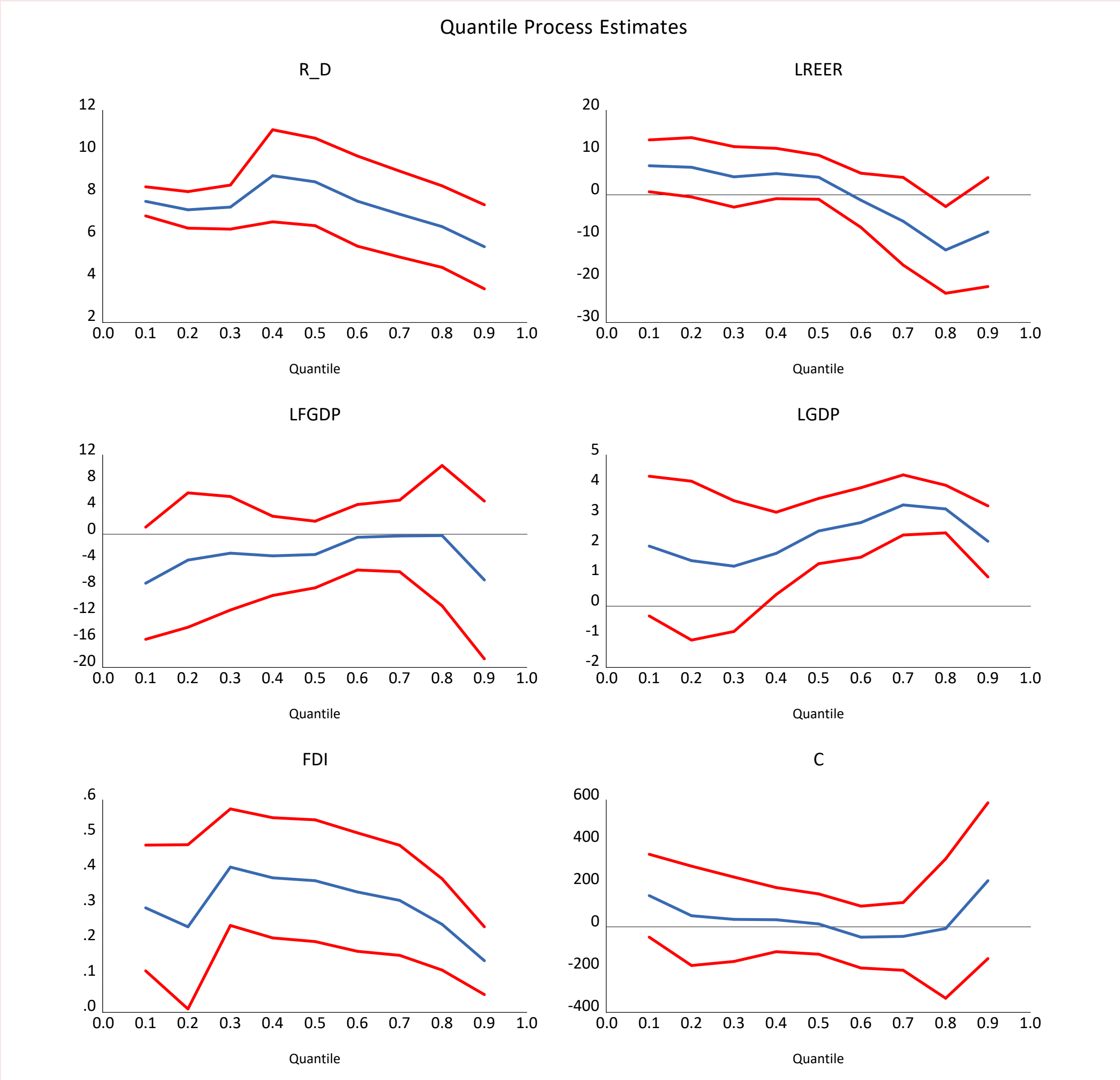
Table 8. Coefficient estimation results

Variables	QUANTILES					
	10	25	50	75	90	OLS
R&D	7.688*** (0.000)	7.439*** (0.000)	8.608*** (0.000)	6.325*** (0.000)	5.539*** (0.000)	7.332*** (0.000)
LREER	6.835** (0.029)	6.115* (0.075)	4.143 (0.119)	-11.283** (0.017)	-8.812 (0.181)	0.822 (0.765)
LFGDP	-7.405*** (0.000)	-3.285 (0.453)	-3.049 (0.236)	3.517 (0.163)	-6.909 (0.257)	-3.179 (0.147)
LGDP	1.985* (0.093)	1.341 (0.237)	2.481*** (0.000)	3.442*** (0.000)	2.141*** (0.000)	2.114*** (0.000)
FDI	0.294*** (0.000)	0.419*** (0.000)	0.371*** (0.000)	0.280*** (0.000)	0.144*** (0.003)	0.265*** (0.000)
Constant	147.087 (0.143)	39.311 (0.699)	13.257 (0.855)	-141.322* (0.075)	218.151 (0.247)	45.152 (0.483)
Note: ***, ** and * denote a significance level of 1%, 5% and 10%, respectively. The values in parentheses indicate the probability values.						

According to the table, it is seen that the effect of independent variables on HTE differs according to the quantiles. It was determined that the effect of R&D expenditures, which are included in the analysis as the main dependent variable, on HTE was significant and positive in all quantiles. It has also been observed that this variable has the strongest effect on HTE. However, in countries where the rate of HTE is higher than average, the positive effect of an increase in the ratio of R&D expenditures to GDP is lower. This result can be interpreted as the fact that in countries with a higher proportion of HTE in industrial exports than in other countries, R&D expenditures have also been directed to the production of products at different technology levels, since the range of products in exports is much wider in these countries. The effect of the real effective exchange rate represented by the LREER on the export of high-tech products is positive and significant, except for the 50th and 90th quantile indicators. The direction of the effect is positive on the 10th and 25th quantiles, while it is negative on the 75th quantiles. Accordingly, the valuation of the national currency in countries with lower-than-average exports of high-tech products positively affects the export of high-tech products, while the depreciation of the national currency in the group of countries in the 75th quantile, which is higher, positively affects the export of high-tech products. This situation reflects the impact of external dependence on production. With the appreciation of the national currency, an increase in production and exports can be achieved by supplying intermediate and investment goods in higher quantities at lower costs. It was determined that the LFGDP variable used to represent external demand did not have a significant effect on other quantiles other than the 10th quantile. Accordingly, it was observed that the impact of foreign demand was negative in the group of countries with the lowest level of exports of high-tech products compared to other countries. This result can be explained by the fact that the increase in world demand is shifting to other countries that are better at it, since countries with poor performance in exporting high-tech products have low competitiveness in international markets or are unable to demonstrate a brand value. Although the effect of the LGDP variable representing economic growth varies according to different quantiles, it has been found that it has positive and significant effects on the export of high-tech products. This finding shows that the increase in domestic production allows more exports to be made to meet overseas demand. Finally, it was concluded that the FDI variable representing foreign direct investment also has a significant and positive effect on the export of high-tech products in all quantile terms. This information can be interpreted as the fact that the increase in foreign direct investment accelerates the transfer of higher technologies to the group of countries, thereby allowing companies producing in the country to increase exports of high-tech products.

According to the OLS estimator used to compare the results of the panel quantile regression, the variables of R&D expenditures, economic growth, and foreign direct investment have significant effects on the export of high-tech products. Again, similar to the results of the panel quantile regression, the strongest impact on the export of high-tech products belongs to R&D expenditures. However, while the LREER and LFGDP variables are meaningless according to the OLS estimator, there are also situations where they have significant effects when examined under different quantiles according to panel quantile regression analysis. Therefore, as stated in the econometric method section, although there is a similarity at some points, it has been seen that the results of panel quantile regression analysis provide more information than classical regression analysis. Finally, *in Figure* below, the effects of explanatory variables on HTE at the 95% confidence interval are shown visually with the help of graphics.

Panel quantile estimation results



Discussion and conclusion

The effects of R&D expenditures on HTE in the 11 Emerging Market Economies have been examined within the framework of the period 1996–2018. For this purpose, panel quantile regression analysis was applied, and the coefficients of the explanatory variables were interpreted according to different degrees of quantile. In addition to R&D expenditures, which constitute the basis of the study as an explanatory variable, real effective exchange rate, world income, domestic income, and series of foreign direct investments as control variables were included in the model created for empirical analysis. As a result of the analysis, it was determined that the increase in R&D expenditures had a positive and significant effect on HTE in all quantiles. In addition, the effect of the real effective exchange rate on HTE varies according to different quantiles; world income has significant effects only on the country group with the lowest quantile; the variable used to represent domestic income has positive effects on all quantiles except the 25th quantile; On the other hand, it has been determined that foreign direct investments have positive effects on all quantiles. These findings have revealed that R&D expenditures, economic growth, and foreign direct investment are important indicators of HTE in terms of the period and country set under consideration. In particular, considering the strength of the effect, it has been seen that the increase in R&D expenditures has great positive results. It is because although they differ by quantiles, the 1% increase in the ratio of R&D expenditures to GDP provides an average increase of about 7.2% in the share of high-tech product exports in industrial product exports. In addition, this effect is higher in countries below the average in terms of high technology product export rate, and the contribution of the increase in R&D expenditures of these countries will be higher.

In the study, the results obtained on the effect of R&D expenditures on HTE are fully consistent with the studies in the literature. This situation allows us to generalize that R&D expenditures have a positive effect on HTE. It is important that more shares are allocated to R&D activities by countries as ensuring and maintaining competitive advantage depends on the increase in HTE. At this point, the power of the public and private sectors to make R&D expenditures comes to mind. Due to the lack of capital in almost all developing countries, such as most countries in the set of countries, the private sector cannot play a leading role in R&D activities. For this reason, sub-sectors of the manufacturing industry with high added value should be determined by the state by applying a selective industrialization policy, and support such as tax incentives, cheap input supply, and grants should be given to make more investments in these sectors by private entrepreneurs. In addition, using more shares from the budget for R&D activities by the state to selected sectors may make significant contributions to both the production and export of high-tech products. Finally, investments to be made by the state to increase the level of information infrastructure and human capital will have a complementary effect on R&D activities.

References

Aghion P., Howitt P. (1992). A model of growth through creative destruction. *NBER Working Paper Series,* 3223, 1–48. Available at: https://doi.org/10.3386/w3223

Aghion P., Garcia-Penalosa C., Howitt P. (2000). "Knowledge and Development: A Schumpeterian Approach", Paper presented at the World Bank ABCDE Conference, June 2000.

Akay Ö. (2021). Yüksek teknoloji ihracatında Türkiye'nin yeri ve belirleyicileri. *Düzce Üniversitesi Bilim ve Teknoloji Dergisi*, 9(4), 1128–1141. Available at: https://doi.org/10.29130/dubited.861464

Aktaş N., Gür B. (2021). E7 ve G7 ülkelerinin yüksek teknolojili ürün ihracatını belirleyen faktörler: panel eşbütünleşme analizi. *International Journal of Applied Economic and Finance Studies*, 6(2), 72–88. Available at: http://www.ijaefs.com/wp-content/uploads/2021/12/05_AKTAS-GUR.pdf (accessed: January 7, 2022).

Alemu A.M. (2012). The effect of R&D on high-tech product export competitiveness: Empirical evidence from panel data of East Asian economies. *STI Policy Review*, 3(1), 46–62. Available at: https://doi.org/10.22675/STIPR.2012.3.1.046.

Aw B.Y., Roberts M.J., Xu D.Y. (2009) R&D investment, exporting, and productivity dynamics. *NBER Working Paper Series, 14670.* Available at: https://www.nber.org/system/files/working_papers/w14670/w14670.pdf (accessed: 1 March 2022).

Bojnec Š., Fertő I. (2011). Impacts of research and development on manufacturing trade. *Zbornik radova Ekonomskog fakulteta u Rijeci: časopis za ekonomsku teoriju i praksu,* 29(1), 65–88. Available at: https://hrcak.srce.hr/69468 (accessed: December 25, 2021).

Boz F.Ç., Gültekin Ö.F. (2019). BRICS ve MIST Ülkelerinde Ar-Ge Harcamaları İle Yüksek Teknolojili Ürün İhracatı Arasındaki İlişki Üzerine Bir Araştırma. *Itobiad: Journal of the Human & Social Science Researches*, 8(2), 1111–1124. Available at: http://www.itobiad.com/issue/44987/533402, (accessed: January 6, 2022).

Braunerhjelm P., Thulin P. (2008). Can countries create comparative advantages? R&D expenditures, high-tech exports and country size in 19 OECD countries, 1981–1999. *International Economic Journal*, 22(1), 95–111. Available at: https://doi.org/10.1080/10168730801887026

Breusch T.S., Pagan A.R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies*, 47(1), 239–253. Available at: https://doi.org/10.2307/2297111

Çolakoğlu M. (2021). *OECD Ülkelerinde Beşeri Sermayenin Yüksek Teknolojili Ürün İhracatı ve Ekonomik Kompleksite Endeksi Üzerindeki Etkisi*. Pamukkale Üniversitesi Sosyal Bilimler Enstitüsü Yüksek Lisans Tezi, Denizli.

Davis L.A. (1982). *Technology intensity of US output and trade.* U.S Department of Commerce, International Trade Administration.

Durmuş S.M. (2020). *Ar-ge ve inovasyonun yüksek teknoloji ürün ihracatı üzerindeki etkisi: Yükselen piyasa ekonomileri örneği.* Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü İktisat Anabilim Dalı Yüksek Lisans Programı, Yüksek Lisans Tezi, Gümüşhane.

Fagerberg J. Is there a large-country advantage in high-tech? Available at: https://www.sv.uio.no/tik/InnoWP/archive/wpno526-1995.pdf (accessed: January 24, 2022).

Gaberli Ü. (2018). G7 ülkelerinde fikri mülkiyet haklarına yapılan ödemeler ve ar-ge harcamalarının yüksek teknoloji ihracatına etkisi: Bir panel veri analizi. *Finans Politik ve Ekonomik Yorumlar*, (641), 667–682 Available at: https://dergipark.org.tr/en/pub/fpeyd/issue/47981/607037 (accessed: January 6, 2022).

Gourlay A., Seaton J., Suppakitjarak J. (2005). The determinants of export behaviour in UK service firms. *The Service Industries Journal*, 25(7), 879–889. Available at: https://doi.org/10.1080/02642060500134154

Göçer İ. (2013). Ar-Ge harcamalarının yüksek teknolojili ürün ihracatı, dış ticaret dengesi ve ekonomik büyüme üzerindeki etkileri. *Maliye Dergisi*, 165(2), 215–240. Available at: https://www.acarindex.com/pdfler/3a556386-9a95.pdf (accessed: December 27, 2021).

Griffith R., Redding S., Reenen J.V. (2004). Mapping the two faces of R&D: Productivity growth in a panel of OECD industries. *Review of Economics and Statistics*, 86(4), 883–895. Available at: https://doi.org/10.1162/0034653043125194

Grossman G.M., Helpman E. (1989). Product development and international trade. *Journal of Political Economy*, 97(6), 1261–1283. Available at: https://doi.org/10.1086/261653

Grossman G.M., Helpman E. (1991). Quality ladders in the theory of growth. *The review of Economic Studies*, 58(1), 43–61. Available at: https://doi.org/10.2307/2298044

Gruber W., Mehta D., Vernon R. (1967). The R&D factor in international trade and international investment of United States industries. *Journal of Political Economy*, 75(1), 20–37. Available at: https://doi.org/10.1086/259235

Harris R., Moffat J. R&D, innovation and exporting. Available at: http://eprints.lse.ac.uk/33593/1/sercdp0073.pdf (accessed: February 15, 2022).

Hatzichronoglou T. Revision of the high-technology sector and product classification. Available at: https://doi.org/10.1787/050148678127

Ismail N.W. (2013). Innovation and high-tech trade in Asian countries. In: *Proceedings from International Conference on Recent Developments in Asian Trade Policy and Integration*. Available at: https://www.nottingham.ac.uk/gep/documents/conferences/2013/malaysia-conference/normaz-wana-ismail.pdf (accessed: January 14, 2022).

Jones C.I., Ateş S., Tuncer İ. (2001). *İktisadi büyümeye giriş.* Literatür Yayıncılık. Birinci Basım, İstanbul.

Karasaç F., Sağın A. (2018). Kamu ve özel kesim Ar-Ge harcamalarının yüksek teknolojili malların ihracatına etkisi: Avrupa ekonomileri analizi. *The Journal of European Theoretical and Applied Studies,* 6(1), 11–23. Available at: https://hdl.handle.net/20.500.11857/1129 (accessed: January 5, 2022).

Kılıç C., Bayar Y., Özekicioğlu H. (2014). Araştirma geliştirme harcamalarinin yüksek teknoloji ürün ihracati üzerindeki etkisi: G–8 ülkeleri için bir panel veri analizi. *Erciyes Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi,* (44), 115–130. Available at: https://doi.org/10.18070/euiibfd.62317

Koenker R., Basset Jr. G.S. (1978). Regression quantiles. *Econometrica*, 46, 33–50. Available at: https://doi.org/10.2307/1913643

Landesmann M., Pfaffermayr M. (1997). Technological competition and trade performance. *Applied Economics*, 29(2), 179–196. Available at: https://doi.org/10.1080/000368497327254

Le C.D. (1987). The role of R&D in high-technology trade: An empirical analysis. *Atlantic Economic Journal*, 15(4), 32–38. Available at: https://doi.org/10.1007/BF02304202

Mani S. (2000). *Exports of High Technology Products from Developing Countries: Is It Real or a Statistical Artifact*? New York: United Nations University, Institute for New Technologies.

ISIC Rev. 3 Technology Intensıty Definıtıon – Classification of manufacturing industries into categories based on R&D intensities. July 2011. Available at: https://www.oecd.org/sti/ind/48350231.pdf (accessed: January 1, 2022).

Oğuz S., Sökmen A.G. (2020). Araştırma geliştirme harcamalarının yüksek teknolojili ürün ihracatına etkisi: OECD ülkeleri üzerine bir panel veri analizi. *International Journal of Economic & Administrative Studies*, 27, 209–222. Available at: https://doi.org/10.18092/ulikidince.651992

Özer M., Çiftçi N. (2009). Ar-Ge harcamaları ve ihracat ilişkisi: OECD ülkeleri panel veri analizi. *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi*, 23(3), 39–50. Available at: https://dergipark.org.tr/en/pub/dpusbe/issue/4765/65481 (accessed: December 5, 2021).

Özkan G., Yılmaz H. (2017). Ar-ge harcamalarının yüksek teknoloji ürün ihracatı ve kişi başı gelir üzerindeki etkileri: 12 AB ülkesi ve Türkiye için uygulama (1996–2015). *Bilgi Ekonomisi ve Yönetimi Dergisi*, 12(1), 1–12. Available at: https://dergipark.org.tr/en/pub/beyder/issue/31845/318349, (accessed: January 25, 2022).

Pesaran M.H. (2004). General diagnostic test for cross section dependence in panels. *Cambridge Working Papers in Economics*, (0435), 1–39, Available at: https://doi.org/10.1007/s00181-020-01875-7

Pesaran M.H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, 22(2), 265–312. Available at: https://doi.org/10.1002/jae.951

Pesaran M.H., Ullah A., Yamagata T. (2008). A bias-adjusted LM test of error cross-section independence. *The Econometrics Journal*, 11(1), 105–127. Available at: https://doi.org/10.1111/j.1368-423X.2007.00227.x

Romer P.M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(5), 1002–1037. Available at: https://doi.org/10.1086/261420

Salari T.E., Roumiani A., Kazemzadeh E. (2021). Globalization, renewable energy consumption, and agricultural production impacts on ecological footprint in emerging countries: Using quantile regression approach. *Environmental Science and Pollution Research*, 28(36), 49627–49641. Available at: https://doi.org/10.1007/s11356-021-14204-x

Sandu S., Ciocanel B. (2014). Impact of R&D and innovation on high-tech export. *Procedia Economics and Finance*, 15, 80–90. Available at: https://doi.org/10.1016/S2212-5671(14)00450-X

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*, 7(7), 85–93. Available at: http://dx.doi.org/10.5539/ijbm.v7n7p85

Schumpeter J. (1942). Capitalism, socialism and democracy. *Social Science Electronic Publishing*, 27(4), 594–602.

Sey N., Aydın B. (2021). Türkiye'de Yüksek Teknoloji Ürün İhracatı ve İnovasyon İlişkisi Üzerine Ekonometrik Bir İnceleme. *Ordu Üniversitesi Sosyal Bilimler Enstitüsü Sosyal Bilimler Araştırmaları Dergisi*, 11(1), 238–252. Available at: https://doi.org/10.48146/odusobiad.785193

Seyoum B. (2004). The role of factor conditions in high-technology exports: An empirical examination. *The Journal of High Technology Management Research*, 15(1), 145–162. Available at: https://doi.org/10.1016/j.hitech.2003.09.007

Srholec M. (2007). High-tech exports from developing countries: A symptom of technology spurts or statistical illusion? *Review of World Economics*, 143(2), 227–255. Available at: https://doi.org/10.1007/s10290-007-0106-z

Şahbaz A., Yanar R., Adıgüzel U. (2014). Ar-Ge harcamaları ve ileri teknoloji mal ihracatı ilişkisi: panel nedensellik analizi. *Çukurova Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 23(1), 47–60. Available at: https://dergipark.org.tr/en/pub/cusosbil/issue/32277/353193 (accessed: January 11, 2022).

Taban S., Şengür M. (2014). Türkiye'de ar-ge ve ekonomik büyüme. *Abant İzzet Baysal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, 14(1), 355–376. Available at: https://app.trdizin.gov.tr/publication/paper/detail/TWpNMU5URTFOUT09 (accessed: February 2, 2022).

Uzay N., Demir M., Yıldırım E. (2012). İhracat performansı açısından teknolojik yeniliğin önemi: Türkiye imalat sanayi örneği. *Doğuş Üniversitesi Dergisi*, 13(1), 147–160. Available at: https://dergipark.org.tr/en/pub/doujournal/issue/66666/1043058 (accessed: December 13, 2021).

Westerlund J. (2008). Panel cointegration tests of the Fisher effect. *Journal of Applied Econometrics*, 23(2), 193–233. Available at: https://doi.org/10.1002/jae.967

Xu B., Lin B. (2018). What cause large regional differences in PM2. 5 pollutions in China? Evidence from quantile regression model. *Journal of Cleaner Production*, 174, 447–461. Available at: https://doi.org/10.1016/j.jclepro.2017.11.008

Yaman H., Çetin D., Dulupçu M.A. (2020). OECD ülkelerinde ar-ge harcamaları ve ileri teknoloji ihracatı: bir panel veri analizi. *Anadolu Üniversitesi Sosyal Bilimler Dergisi*, 20(3), 193–208. Available at: https://doi.org/10.18037/ausbd.801751

Yavuz G., Uysal Ö. (2020). Yüksek teknolojili ürün ihracatını etkileyen faktörlerin analizi: OECD örneği. *Uluslararası Ekonomi* İ*şletme ve Politika Dergisi*, 4(1), 205–220. Available at: https://doi.org/10.29216/ueip.673698

Yıldırım E., Kesikoğlu F. (2012). Ar-Ge harcamaları ile ihracat arasındaki nedensellik ilişkileri: Türkiye örneğinde panel nedensellik testi kanıtları. İ*ktisadi ve* İ*dari Bilimler Dergisi*, 32(1), 165–180. Available at: https://dergipark.org.tr/en/pub/muiibd/issue/495/4472 (accessed: January 10, 2022).

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