-RESEARCH ARTICLE-

THE EFFECT OF NATIONAL ENTREPRENEURSHIP ON NATIONAL COMPETITIVENESS: LINEAR AND NON-LINEAR REGRESSION ANALYSIS

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Abstract

National entrepreneurship and national competitiveness are two basic factors that affect the economic development of countries. In this study, the effect of national entrepreneurship on national competitiveness is examined. Linear and non-linear regression analyzes were applied as research method. Non-linear regression model estimates were obtained with the curve estimation model application. Obtained models are presented comparatively. The sample consists of 52 countries. The national entrepreneurship scores of the countries were obtained from the "Global Entrepreneurship Monitor (GEM)" reports. National competitiveness scores are derived from "Global Competitiveness Index (GCI)" reports. The research period is 2019 before the pandemic. According to the research findings, the model with the highest percentage of explanation among the non-linear models is determined as the "Qubic" estimation model. When the Qubic non-linear model and linear model are compared, both models are found to be significant. In addition, it is concluded that the percentage of explanation of the non-linear model is higher than the linear model. Based on the findings, it has been suggested to develop country-specific entrepreneurship strategies as well as general entrepreneurship strategies in determining national entrepreneurship strategies.

Keywords: *National Entrepreneurship, National Competitiveness, Non-linear Regression Models, Curve Estimation Models.*

JEL Codes: *M10, M16, L26.*

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ULUSAL GİRİŞİMCİLİĞİN ULUSAL REKABETÇİLİK ÜZERİNDEKİ ETKİSİ: DOĞRUSAL VE DOĞRUSAL OLMAYAN REGRESYON ANALİZİ[3]

Öz

Ulusal girişimcilik ve ulusal rekabetçilik, ülkelerin ekonomik kalkınmasını etkileyen iki temel faktördür. Bu çalışmada, ulusal girişimciliğin ulusal rekabetçilik üzerindeki etkisi incelenmiştir. Araştırma yöntemi olarak doğrusal ve doğrusal olmayan regresyon analizleri uygulanmıştır. Eğri tahmin modeli uygulamasıyla doğrusal olmayan regresyon model tahminleri elde edilmiştir. Elde edilen modeller karşılaştırmalı olarak sunulmuştur. Örneklem alan 52 ülkeden oluşmaktadır. Ülkelerin ulusal girişimcilik değerleri "Küresel Girişimcilik Monitörü (GEM)" raporlarından elde edilmiştir. Ulusal rekabetçilik puanları "Küresel Rekabetçilik Endeksi (GCI)" raporlarından elde edilmiştir. Araştırma dönemi pandemi öncesi 2019 yılıdır. Araştırma bulgularına göre doğrusal olmayan modeller arasında en yüksek açıklama yüzdesine sahip model "Kübik" tahmin modeli olarak belirlenmiştir. Kübik doğrusal olmayan model ile doğrusal model karşılaştırıldığında her iki modelin de anlamlı olduğu görülmüştür. Ayrıca doğrusal olmayan modelin açıklama yüzdesinin doğrusal modele göre daha yüksek olduğu sonucuna varılmıştır. Elde edilen bulgulara dayalı olarak, ulusal girişimcilik stratejilerinin belirlenmesinde genel girişimcilik stratejilerinin yanı sıra ülkeye özgü girişimcilik stratejilerinin geliştirilmesi önerilmiştir.

Anahtar Kelimeler: *Ulusal Girişimcilik, Ulusal Rekabetçilik, Doğrusal Olmayan Regresyon Modelleri, Eğri Tahmin Modelleri.*

JEL Kodları: *M10, M16, L26.*

"Bu çalışma Araştırma ve Yayın Etiğine uygun olarak hazırlanmıştır."

1. INTRODUCTION

The system that covers the emergence of the entrepreneurial idea, the realization of entrepreneurial initiatives and the implementation of entrepreneurial activities is called the "entrepreneurship ecosystem". In this ecosystem, there are institutions, organizations and other actors that affect the continuity of the ecosystem (Acs et al., 2017). The factors that motivate the ecosystem are policies, programs and initiatives based on entrepreneurship (Isenberg, 2011). At the macro level, ecosystem outputs contribute to the development of the national economy. As a natural result of this, the ability of countries to compete develops. Models on the effect of the relationship between entrepreneurship and competitiveness on economic growth have been developed in economics-based studies (Herman, 2018; Crecente-Romero et al., 2019; Pradhan et al., 2020). In this study, an effort has been made to explain the concepts of

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[3] Genişletilmiş Türkçe Özet, makalenin sonunda yer almaktadır.

entrepreneurship and competitiveness at the national level and with a relationship-based model.

In the relationship between entrepreneurship and economic performance, the competitiveness and innovation power that emerges through entrepreneurship play an active role in increasing economic performance (Wong et al., 2005). To increase entrepreneurial success, "public-private" should act jointly and an entrepreneurial environment should be created (Blanco-González et al., 2015). The economic conditions and opportunities of the countries are different, along with the different entrepreneurship levels of the countries (Angulo-Guerrero et al., 2017). Regardless of whether they are at the same level of economic development, differences in the entrepreneurship levels of countries have been identified (Carree et al., 2002; Wennekers et al., 2005; Acs and Amorós, 2008). In addition, the differentiation of entrepreneurship levels according to countries takes place in the literature (Bardasi et al., 2007). This differentiation highlights that a standard approach cannot be established in the determination of entrepreneurship policies, and that each entrepreneurship policy must be country-specific (Acs, 2006). Other differentiations of a country in the same region support that entrepreneurship does not occur according to a certain region or group of countries (Acs and Armington, 2004). Wennekers et al. (2010) explain that there are divergences in the economic development, competitiveness, and entrepreneurship relations of different countries in different periods.

When the development levels of the countries are taken into consideration, competitiveness is evaluated in three stages (Porter et al., 2002). These stages are (i) the "factor-driven stage" that adopts a low-cost effectiveness strategy, (ii) the "efficiency-driven stage" that adopts production efficiency and technological developments, (iii) the "innovation-driven stage" that adopts innovation. Acs and Amorós (2008) explained the competitiveness stage, in which entrepreneurial activities are brought to the fore, as the "efficiency-driven stage". Many different factors play a role in the development of competitiveness. Commitment to entrepreneurial activities is among these activities (Sapena et al., 2018). Considering entrepreneurship as a resource and talent explains its significant positive relationship with competitiveness (González-Pernía et al., 2012). At the same time, national entrepreneurship plays an important role in the development of national competitiveness of countries (Amorós et al., 2012). At this point, research questions have been developed to explain the relationship between entrepreneurship and competitiveness at the national level. The research questions are as follows.

- *Research Question 1:* Does national entrepreneurship have a positive linear effect on national competitiveness?
- *Research Question 2:* Does national entrepreneurship have a positive non-linear effect on national competitiveness?
- *Research Question 3:* When the linear effects model is compared with the nonlinear effects model, which model has a higher percentage of explanation?

The research questions identified above show that the main purpose of this study is to determine the relationship between entrepreneurship and competitiveness at the national level with linear regression and nonlinear regression models. In the rest of the article, the theoretical framework and literature review are presented in the ongoing part. In the second part, the methodology of the research is given. In the third part, the results are explained. Discussion is given in the fourth part and the conclusions are given in the last chapter.

1.1. National Entrepreneurship

Entrepreneurship is one concept whose importance has increased with the development of the industrial age. It is at the highest point in the political, social, and economic plans globally. The concept is also an important indicator of the economic and competitive power of countries. For this reason, there are many studies evaluating the economic, process, and characteristics of entrepreneurship in the literature theoretically. Schumpeter, the most cited author on entrepreneurship, defines entrepreneurship as comprising doing things that are not done in the ordinary course of business routine. Schumpeter, the most cited author on entrepreneurship, defines entrepreneurship as doing things that are not in the classical business routine (Schumpeter, 1934). Entrepreneurship often seeks opportunities beyond tangible resources that can be controlled. It means discovering, evaluating, and adopting opportunities, and it is the discovery and implementation of the previously undiscovered product, market, process, organizational structure, and strategy opportunities before competitors (Shane and Venkataraman, 2000). Reynolds et al. (2005), describe entrepreneurship as discovering opportunities, establishing organizational structure, and creating economic value.

The meaning of the word "entrepreneur" is also as follows "A person or persons who organize and manage a commercial enterprise to make a profit and assume the risks in the process." (Hull et al., 1980: 11). To assimilate entrepreneurship, it is necessary to have some basic criteria. These criteria include entrepreneurial personality, identifying opportunities, managing the process, and operating evaluation mechanisms (Cunningham and Lischeron, 1991). The entrepreneur avails himself to the creation and marketing of useful products while he is taking upon himself the management responsibility and coordination in uniting the other factors of production labor capital and land (Sæthera and Eriksen, 2014: 14). Entrepreneurs are widely known among organizations as perceptible, understandable, and predictable people.

Entrepreneurship is one of the key drivers of national economic development. Especially the economic success of developing countries depends on the increase in the number of entrepreneurs and their growth. For this reason, entrepreneurship has been discussed in a national context with strategies, programs, and action plans aimed at increasing the number of enterprises and strengthening existing enterprises. National entrepreneurship is taken up within the context of national entrepreneurship strategy, national entrepreneurship policy, or national entrepreneurship system. National entrepreneurship is about allocating the resources for the creation and operation of new ventures within an institutional structure and creating a dynamic

structure between entrepreneurs and entrepreneurial activities (Acs et al., 2014). The national entrepreneurship system guides the identification of entrepreneurs, the correct definition of entrepreneurial activities, the correct evaluation of the effects and results of entrepreneurship (Acs et al., 2015).

National entrepreneurship is based on long-term plans. The main aim of these plans is to bring together the public and private sectors, educational institutions, non-governmental organizations, and entrepreneurs. National entrepreneurship should be addressed within the framework of a national strategy. The focus of this strategy is to promote entrepreneurship and improve entrepreneurial attitudes. In addition, inclusive strategies should be created by displaying proactive attitudes in the application areas. National entrepreneurship is also one of the critical elements that show the competitive power of countries against other countries. There are various indexes developed by different international institutions to measure national entrepreneurship. These indexes allow the comparison of countries in terms of entrepreneurship. One of these indexes is "Global Entrepreneurship Index (GEI)". The GEDI Institute, which collects data on a country's entrepreneurial ecosystem, has developed GEI. It started in 2009, and its first issue was called the "Global Entrepreneurship and Development Index (GEDI)". In 2019, the GEI project finished, and the GEDI published a new entrepreneurship measure that is called as "Digital Entrepreneurship Index (DEI)" in 2020 (Acs et al., 2020).

OECD publishes the SME and Entrepreneurship Outlook Report. This report compares 38 OECD countries from an entrepreneurial perspective. The subjects of comparison are (i) SME and entrepreneurship structural vulnerability, (ii) SME and self-employed population, (iii) exposure to quarantines, (iv) disruptions in global value chains, (v) SME resources and entrepreneurial resilience, (vi) digital procurement, (vii) access to liquidity, (viii) promoting skills availability in the labor market, (ix) entrepreneurial regulation (OECD, 2014). Although these indices have common components to measure entrepreneurship, each index has tailor-made policy recommendations (Ali et al., 2021).

"Global Entrepreneurship Monitor (GEM)", which has been a worldwide entrepreneurship project published since 1997, is the most used entrepreneurship index. The GEM index is wider than other indices and its focus is especially on entrepreneurship. It also reports results based on measurable criteria. GEM aims to determine the entrepreneurial activities of any country and to determine the economic results by explaining the differences in entrepreneurship between countries and regions. GEM data are good for making national comparisons (Karadeniz and Ozdemir, 2009). Therefore, this study is conducted based on GEM report data. The GEM is reported by combining two different survey applications. The first of these surveys is the "Adult Population Survey (APS)". APS applies to adults aged 18-64. The main purpose of the APS is to identify adults' entrepreneurial attitudes, perceptions, motivations, and intentions towards entrepreneurship. The second survey is the "National Expert Survey (NES)". NES applies to people who are experts in

entrepreneurship. NES also allows the factors affecting entrepreneurship decisions to be evaluated on a national scale (GEM, 2019).

National entrepreneurship scores of countries are calculated based on the results of the NES survey application. These results are described as the "National Entrepreneurship Context Index (NECI)". It summarizes the average state of a country's economy for entrepreneurship. The NECI score for any economy is the arithmetic mean of that economy's "Entrepreneurial Framework Condition (EFC)" scores. EFC score consists of the evaluation of 54 countries in the GEM (2019) list by experts with an 11-point Likert scale according to the criteria. NECI comprises 12 criteria. These criteria are (i) access to entrepreneurial finance, (ii) government policy: support and relevance, (iii) government policy: taxes and bureaucracy; government entrepreneurship programs (iv) entrepreneurial education at school, (v) entrepreneurial education post-school, (vi) research and development transfer, (vii) commercial and professional infrastructure, (viii) commercial and professional infrastructure, (ix) ease of entry: market dynamics, (x) ease of entry: market burdens and regulations, (xi) physical infrastructure, (xii) social and cultural norms (GEM, 2019: 70). NECI scores of countries are calculated according to the weighted average of these criteria (Herrington and Coduras, 2022). These criteria are also evaluated over 10 points. According to Singer et al. (2015) the state of these conditions directly effects the existence of entrepreneurial opportunities, entrepreneurial activities, and preferences, which in turn determines dynamics of business.

There are two main reasons for taking country entrepreneurship scores from the NECI data set in this study. First, the entrepreneurship scores of the countries are determined based on expert opinions. The second is that the number of countries is higher when compared to other indices. In addition, the basic criteria presented above provide a subject-based idea for determining the entrepreneurship policies of the countries. Thus, it is possible to see the missing point of any country in determining the national entrepreneurship strategies. The information presented on the entrepreneurship criteria country basis allows the comparison of countries in the perspective of entrepreneurship. This situation supports NECI to be a useful resource for academic studies on entrepreneurship (Menshikov et al., 2021). Undoubtedly, NECI contributed significantly to the realization of this study.

1.2. National Competitiveness

Competition, which is used in every field, means to be superior to at least two people related to a person, city, sector, region, and country. Today, the rapid change in environmental conditions, the sharing of information produced in a short time, and the imitation of information-based goods and services affect the competitiveness of these elements. Schumpeter (1943) specifies that competition provides a significant advantage to the parties in terms of cost and quality (Naude et al., 2014). This situation makes competition permanent and therefore pushes them to be competitive. Competition is now a race between businesses operating in the market (Özgen and Yalçın, 2006: 23).

This situation is handled within the framework of competitiveness, and it has a lot of definitions. Some definitions associate competition with the ability of citizens to achieve certain general outcomes, such as achieving a high standard of living and the growth of the country's economy; other definitions focus on the ability to achieve specific national economic outcomes, such as reducing unemployment, increasing exports, stabilizing unit labor costs, and balancing the budget and exchange rate (Delgado et al., 2012: 6). OECD, by making a more general definition, deals with competitiveness at the macro level and stated that competitiveness is a measure of the advantage or disadvantage a country provides when selling its products in international markets (OECD, 2014). It is the capacity of a nation, region, or location to deliver the beyond Gross Domestic Product (GDP) targets for its citizens (Aiginger et al., 2013:1), and it involves all the vital microeconomic and macroeconomic foundations required for a nation to compete in the international market to produce goods or services that meet global demand and enhance domestic well-being (Idris et al., 2021:39). It is the ability to act and react in a competitive environment to provide the financial strength needed to make strategic investments in people and technology (Rainer and Kazem, 1994:50); and it is about the development in the standard of living, the increase and diversification of employment opportunities, and the extent to which the state fulfills its international obligations and commitments (Nababan, 2019).

Since a rising living standard means higher wages and less pollution, competitiveness requires that a country moves up the ladder of technology, gaining share in the high value-added sectors of tomorrow (Lodge, 2009:462). Because of that, Porter says that a state's competitiveness revolves around on its industry's power to innovate and promote innovation (Porter, 1990) and it can be measured by the fact that a country can export more than it imports abroad (Krugman, 1994:31). So, the concept of competitiveness emerges as a topic at the top of the world agenda with the term "national competitiveness". It is also a national economy strategy accomplished by creating an ecosystem for organizations to produce, practice, and sell products and services that satisfy needs of global competition with shifting social rules (Chikán, 2008:28).

For this reason, various methods have been developed to measure the competition of countries. National competitiveness indicators are key devices to develop national strategies and policies to strengthen national powers. Indicators can support policymakers in determining the behavior of their economies and can help organizations compare themselves to their strategy (Amaral and Salerno, 2019:336). There are some institutions that calculate the global competitiveness as an index with the methods they have created and publish the results in reports periodically, but the most used indexes are developed by World Economic Forum (WEF) and International Institute for Management Development (IMD). The IMD published the first report from 1989 to 1995. In 1995, it was separated into the IMD and the WEF and the two institutes have published separate reports since 1996. WEF and GCI measure competitiveness through a mixture of quantitative and qualitative techniques based on determining the nation's competitive position. These indices offer a highly

disaggregated and detailed insight into institutions and institutional quality, allowing the study of cross-country institutional disparities in several areas of the public, and private spheres closely related to business performance (Pérez-Moreno et al., 2021: 2).

Each year, IMD publishes World Competitiveness and ranks countries according to their competitiveness. According to IMD competitiveness is the capacity of a nation to form added value and so the growth of national wealth, and national competitiveness is the capacity of a nation to form and maintain an ecosystem that continues to create higher added value for its enterprises and more prosperity for its people (IMD, 2019). IMD includes 4 major titles: Economic performance, government efficiency, business efficiency, and infrastructure, and 342 criteria depending on these titles.

WEF also describes competitiveness as the set of organizations, programs, components, and factors that affect the productivity status of a nation (WEF, 2008: 3). The Global Competitiveness (GCI) 2019 comprises 103 indicators into 12 sub-factors. These factors are innovation capability, adoption of ICT, labor market, infrastructure, macroeconomic stability, institutions, health, skills, product market, financial system, market size, and business dynamism (Boikova et al., 2021) organized in 4 categories as business dynamism, human capital, markets, and innovation capacity. It is also a composite indicator that details the factors and attributes driving stakeholder's productivity, growth, and human development (WEF, 2015: 1-2). However, Jovan and Bradić-Martinović deduce that the highly aggregated data of the GCI are not highly precise in determining the variables with more significant impact on the national competitiveness of the selected countries (Jovan and Bradić-Martinović, 2014: 762). GCI's country rates are sensitive to changing the options when more defensible weights are put on to measure the GCI and its sub-indices (Squalli et al., 2008: 125).

GCI is an artificial ratio that shows the interaction between system, business and organizational aspects of the economy and competitive macro and micro factors (Amaral and Salerno, 2019: 336). The GCI reflects the stages of improvement by giving larger relative weights to the pillars where a country's economy is eligible (Babalola, 2021: 387). It aggregates the latest economic ideas for competitiveness and, regards the complexity of reaching economic growth, including calculating the average value of a vast number of different components, each of which is reflected in one or more aspects of competitiveness (Marikina, 2018: 129). Because of that, it is used in this study.

Although WEF and GCI are commonly used indexes, Ochel and Röhn specify that the choice of growth factors of the WEF and GCI is not at all comprehensive and are usually not scrutinized by econometric tests (Ochel and Röhn, 2006: 59). According to Cho and Moon, the ability of these reports to have a strong theoretical foundation depends on a rigorous theoretical explanation, and why some factors are more important than others is not clear (Cho and Moon, 2005: 2). Because of that, these

reports change their models frequently, however, they only give a general idea of the competitiveness type of any country and do not allow for predictions of trends in the economic development of the country (Fyliuk et al., 2019: 53).

1.3. Relationship between National Competitiveness and National Entrepreneurship

In this study, two main variables have been discussed. These are national competitiveness and national entrepreneurship. These concepts and the research questions determined within the scope of the study are given above in detail. In the literature, there are studies dealing with the relationships between the concepts of competitiveness and entrepreneurship at the national level. In this section, the studies discussed in the literature are presented. Studies in the literature are explained in order.

In a study conducted in the sample of European Union member countries, Herman (2018) has been found that the correlation relationship between "high innovation and productive entrepreneurship" and "national competitiveness" was significant at a high level. In the research, national entrepreneurship data of the countries were taken from the "The Global Entrepreneurship and Development Institute (GEDI)", and national competitiveness data were taken from the "Global Competitiveness Index (GCI)" report. In the data set obtained from the GCI and GEM reports published in 2015, Pawitan et al. (2017) examined the relationship among countries' "entrepreneurial attitudes" and "entrepreneurial activities" and "national competitiveness". According to the results of the research, it has been determined that there is a negative relationship between national competitiveness and all other entrepreneurship variables except "growth", "innovation" and "internationalization". Trying to explain the national development level of 36 countries based on 2001 and 2002 data, Van Stel et al. (2004) concluded that the model including "Total Entrepreneurial Activity (TEA)", "GCI" and "per capita income" variables of 36 countries is significant and explains the national development level of approximately 25% (adj.R^2 =0.257). Mrożewski and Kratzer (2017) examined the relationship between countries' innovation levels and entrepreneurship levels. In the research, the innovation scores of the countries were obtained from the GCI report, and the entrepreneurship scores were obtained from the GEM report. As a result of the research, it has been determined that "Opportunity entrepreneurship" within the scope of the model with the highest percentage of disclosure affects the GCI sub-dimensions at a significant level. It was explained by Schumpeter (1934) that innovative entrepreneurship also plays an active role in macroeconomic indicators of countries. Ferreira et al. (2017) determined the effect of countries' "Total early-stage Entrepreneurial Activity (TEA)" values on innovation and national competitiveness by using structural equation modeling. In the research, countries were evaluated in 3 different stages ("Stage 1: factor driven; Stage 2: efficiency driven; and Stage 3: innovation driven"). As a result of the research, TEA has a negative and significant effect on GCI in Stage 1 countries. It was determined that the direct effect of TEA on GCI was not significant in Stage 2 and Stage 3 countries. Amorós et al. (2012) examined the impact of entrepreneurial factors on competitiveness of their countries in the period of 2001-2006. In this study, countries were evaluated in 3 stages. According to the results of the research, the importance of

improving the competitiveness of Latin American countries and strengthening entrepreneurial dynamics was emphasized. Gautam and Lal (2021) explored the relationship between entrepreneurial dynamics measured by TEA and competitiveness measured by GCI for G-20 economies with an econometric model by combining cross-sections of countries with time-series data for each country during the 2001-2016 study period. They found a significant positive relationship between entrepreneurial activities with respect to GDP, GCI, respectively. Coduras and Autio (2013: 67) prove that NES data can explain 70.5% of the GCI, and NES on the national entrepreneurial conditions can classify the GEM participating nations in their respective GCI stages of competitiveness as factor-driven, efficiency-driven, and innovation-driven economies.

As seen in the literature, it is generally mentioned that there is a significant relationship between national entrepreneurship and national competitiveness. The main focus of this research is to explain linear and non-linear models of the impact of national entrepreneurship on national competitiveness. The hypotheses determined within the scope of the research are as follows:

- *H1: The level of national entrepreneurship has a positive linear effect on the level of national competitiveness.*
- *H2: The level of national entrepreneurship has a positive non-linear effect on the level of national competitiveness.*

2. METHODOLOGY

2.1. Curve Estimation

Data collected from the sample area are not always linear. Regression analyzes of the linearly distributed data set are tested with linear regression models. In the data set that does not show linear distribution, regression analyzes are tested with nonlinear regression models. Curve estimation models are models that try to explain the distribution of data in the data set with curves (Efromovich, 2008). There are 11 curve estimation models in SPSS. The algorithms for these models are as follows:

Linear: $E(Y_t) = \beta_0 + \beta_1 t$; Logarithmic: $E(Y_t) = \beta_0 + \beta_1 \ln(t)$; Inverse: $E(Y_t) = \beta_0 + \beta_1/t$; Quadratic: $E(Y_t) = \beta_0 + \beta_1 t + \beta_2 t^2$; Cubic: $E(Y_t) = \beta_0 + \beta_1 t + \beta_2 t^2 + \beta_3 t^3$; Compound: $E(Y_t) = \beta_0 \beta_1^t$; Power: $E(Y_t) = \beta_0 t^{\beta_1}$; S: $E(Y_t) = exp(\beta_0 + \beta_1/t)$; Growth: $E(Y_t) = exp(\beta_0 + \beta_1 t)$; Exponential: $E(Y_t) = \beta_0 e^{\beta_1 t}$; Logistic: $E(Y_t) = (\frac{1}{u} + \beta_0 \beta_1^t)^{-1}$

These models are used to determine the R^2 values describing the data set. It ensures that the model structure belonging to the highest R^2 value is preferred, and it provides the highest level of explanation of the relationship between the variables. In addition, examining the data distribution graph of the data set also helps in choosing the right curve estimation model.

2.2. Variables and Sampling

Two main variables considered in the conceptual framework were accepted for the research. These variables are national entrepreneurship (NE) and national competitiveness (NC). Parallel to the research question, "national entrepreneurship" is the independent variable, and "national competitiveness" is the dependent variable to measure the effect of the national entrepreneurship on the national competitiveness. The impact of the Covid-19 pandemic period on entrepreneurship and competitiveness levels is not yet measurable. For this reason, the entrepreneurship and competitiveness values of the countries in 2019 have been considered in the research.

The NE scores of the countries have been taken from the "GEM report (2019)". As a result of the evaluations made by the experts on entrepreneurship within the scope of the GEM report, the NECI scores of the countries were published. A total of 54 countries are included in this report. The NC scores of the countries have been taken from the "GCI report (2019)" published by the World Economic Forum. This report includes NC scores for a total of 141 countries. The dataset consists of 52 countries included in both reports. Table 1 includes the analysis, variables, sample size and period of the research. Table 2 shows the Pearson correlation relationship between the variables used in the research. The correlation between variables was 0.69 ($p<0.01$). This level of relationship explains that there is a strong correlation between the variables (Newbold, 2000).

Table 1: Variables and Sampling

Analysis	Variables		Period	Sampling	Database
Linear Regression	*Independent Variable*	National Entrepreneurship	2019	52 countries	GEM
	Dependent Variable	National Competitiveness			GCI
Curve Estimation	*Independent Variable*	National Entrepreneurship	2019	52 countries	GEM
	Dependent Variable	National Competitiveness			GCI
Non-Linear Regression	*Independent Variable*	National Entrepreneurship	2019	52 countries	GEM
	Dependent Variable	National Competitiveness			GCI

Table 2: Correlation of Variables

Variables	Mean	S.D.	National Entrepreneurship	National Competitiveness
National Entrepreneurship (NE)	4.66	0.7427	1	
National Competitiveness (NC)	68.25	9.8100	0.690[*]	1

Notes: [*] $p < 0.01$

3. RESULTS

3.1. Linear Regression Findings

To determine the effect of national entrepreneurship on national competitiveness, it is first necessary to determine whether the variables in the data set have a normal distribution. "The Kolmogorov and Smirnov normality test" was performed with the SPSS package program to determine whether the variables have a normal distribution. As a result of the test, it was determined that the data of the variables had normal distribution ($p>0.01$). Normality test results are given in Table 3. In addition, the kurtosis and skewness of the variables are presented. As seen in Figure 1, the Q-Q plot charts of the variables also support that the dataset have a normal distribution.

Table 3: One-Sample Kolmogorov-Smirnov normality test, Skewness and Kurtosis Values

Variables	N	Mean	SD	Kolmogorov-Smirnov Z	Asym .Sig.	Skew.	Kurt.
National Entrepreneurship (NE)	52	4.6635	0.74272	585	0.884	-0.743	0.650
National Competitiveness (NC)	52	68.251	9.81009	585	0.883	-0.570	0.650

The normal distribution of the data of the variables indicates that linear regression analysis can be performed. The basic assumptions of linear regression analysis include the existence of a significant correlation between the variables and the normal distribution of the data. At this point, two assumptions are met.
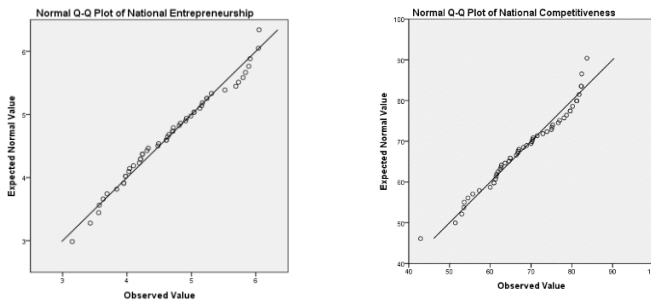

Figure 1: Q-Q Plot Charts

Linear regression model analysis findings have been determined with the SPSS package program. When the model summary was examined, it has been seen that $R^2=0.475$ and adjusted $R^2=0.465$. According to the results of the ANOVA table, it has

been determined that F=45,366, Sig.= 0.000. The coefficients of the variables are shown in Table 4. Thus, our linear regression model is as follows "NC=25.778+9.108*NE". This result explains that the *first hypothesis of the study is supported*.

Table 4: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
	(Constant)	25.778	6.387		4.036	.000
1	National Entrepreneurship	9.108	1.353	.690	6.732	.000

Note: Dependent Variable: National Competitiveness

3.2. Curve Estimation Models Findings

The effect of national entrepreneurship on national competitiveness was determined by linear regression model analysis in the previous section. However, it is aimed to determine whether the resulting model and the percentage of explanation of the model differ in different curve estimation models. Thus, by detecting R^2 values in different curve estimation models, it is possible to determine whether there is a curve estimation model with a higher percentage of explanation than the linear regression model (Jomnonkwao et al., 2020). At this point, 11 different curve estimation model results are determined with the help of SPSS program. The model summaries and parameters are presented in Table 5. The graphical representation of the models is presented in Figure 2. As the R^2 values in Table 5 can be seen, it is seen that the model structure that explains the relationship between the variables at the highest level is "Cubic" model (R^2=0.536, Sig.=0.000). In addition, all curve estimation models are found to be at a significant level.

Table 5: Model Summary and Parameter Estimates

Equation	Model Summary					Parameter Estimates			
	R Square	F	df1	df2	Sig.	Constant	b1	b2	b3
Linear	0.475	45.326	1	50	.000	25.778	9.108		
Logarithmic	0.500	49.945	1	50	.000	2.466	43.077		
Inverse	0.514	52.936	1	50	.000	111.376	-196.068		
Quadratic	0.533	28.013	2	49	.000	-60.279	46.496	-3.962	
Cubic	0.536	28.291	2	49	.000	-34.155	28.697	.001	-.288
Compound	0.471	44.482	1	50	.000	35.442	1.148		
Power	0.498	49.580	1	50	.000	24.803	.656		
S	0.516	53.233	1	50	.000	4.871	-2.995		
Growth	0.471	44.482	1	50	.000	3.568	.138		
Exponential	0.471	44.482	1	50	.000	35.442	.138		
Logistic	0.471	44.482	1	50	.000	.028	.871		

Notes: The independent variable is National Entrepreneurship. Dependent variable is National Competitiveness.

3.3. Non-Linear Regression Findings

In the Curve estimation model results, it has been determined that the "Cubic" model has the highest explanation rate (R^2). For this reason, it is aimed to determine the best model by performing nonlinear regression analysis with Cubic model. At this point, nonlinear regression analysis was performed with the SPSS package program. The first iteration model of the nonlinear regression analysis was determined as "NC=-34+28*NE+0.001*NE2-0.288* NE3". The number of iterations of the nonlinear regression analysis is shown in Table 6. The nonlinear regression model analysis reached the final model as a result of 5 model and 3 derivative evaluations. The parameter estimates at the final point are presented in Table 7. Considering the parameter estimates, the final nonlinear regression model is determined as "NC=144.449-89.951*NE+25.785*NE2-2.122* NE3". In the ANOVA results, the R^2 value of the final model is determined as 0.543. This result explains that *the second hypothesis of the study is supported*.

Table 6: Iteration History

Iteration Number	Residual Sum of Squares	Parameter			
		b0	b1	b2	b3
1.0	2777.371	-34.000	28.000	.001	-.288
1.1	2241.886	146.767	-91.505	26.126	-2.147
2.0	2241.886	146.767	-91.505	26.126	-2.147
2.1	2241.880	144.449	-89.951	25.785	-2.122
3.0	2241.880	144.449	-89.951	25.785	-2.122

Notes: Derivatives are calculated numerically. Major iteration number is displayed to the left of the decimal, and minor iteration number is to the right of the decimal. Run stopped after 5 model evaluations and 3 derivative evaluations because the relative reduction between successive parameter estimates is at most PCON = 1.000E-008.

Table 7: Parameter Estimates

Parameter	Estimate	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
b0	144.449	204.978	-267.687	556.586
b1	-89.951	135.418	-362.228	182.325
b2	25.785	29.379	-33.286	84.855
b3	-2.122	2.093	-6.330	2.086

4. DISCUSSION

In this research, it is aimed to explain the relationship between national entrepreneurship and national competitiveness. Therefore, three basic research questions and two hypotheses are formulated. There are three main points to be reached by testing the hypotheses. The first point is whether national entrepreneurship has a linear effect on national competitiveness. The second point is whether national entrepreneurship has a nonlinear effect on national competitiveness. The third point

is to determine which model (linear or non-linear) explains the impact of national entrepreneurship on national competitiveness at a higher level.

According to the first hypothesis finding, it is determined that national entrepreneurship has a positive linear effect on national competitiveness. In addition, the adjusted R^2 value of the model was determined as 0.465 (p<0.01). This showed that linear models explained 46.5% of the relationship between national entrepreneurship and national competitiveness. In the second hypothesis of the study, it is determined that there is a positive non-linear effect between the variables. In addition, the R^2 value of the model is determined as 0.543 (p<0.01). This indicates that the nonlinear model explaining the relationship between the variables is 54.3%. Thus, when the explanation percentages of linear and nonlinear models are compared, a difference of 7.8% between the two models is in favor of the nonlinear model.

In this study, which is based on the pre-pandemic conditions, namely the statistical data of 2019, it was determined that national entrepreneurship has a significant positive effect on national competitiveness and is also better explained by the non-linear model structure. Another point among the findings of this research is that the correlation relationship between the two variables is strong. This finding supports the finding of a high correlation between entrepreneurship and competitiveness (Herman, 2018). it can also be clearly mentioned that there is a mutually significant relationship between national entrepreneurship and national competitiveness variables.

In studies on national entrepreneurship, it has been emphasized that national entrepreneurship strategies and policies should be different because the regions, economic conditions, expectations, and opportunities of the countries are different (Angulo-Guerrero et al., 2017). The national entrepreneurship policies also affect the national competitiveness level. This situation explains that entrepreneurship policies developed to increase competitiveness at the national level cannot appeal to all countries. The relationship between entrepreneurship and competitiveness is explained by nonlinear model at high level. The non-linear model is based on the most appropriate level of relationship between the variables according to the competitiveness and entrepreneurship scores of the countries. It is suggested that countries should develop country-specific entrepreneurship strategies and policies in addition to generally accepted approaches in national entrepreneurship policies.

CONCLUSION

The most important result obtained in this study, in which the concepts of entrepreneurship and competitiveness are discussed on a national scale, is that it is more successful to explain the relations between the variables with a nonlinear model. In addition, it has been proven in all models that the effect of national entrepreneurship on national competitiveness is significant. These findings are a guide for government managers in determining entrepreneurship and competitiveness strategies on a national scale. At the same time, considering the effect of national entrepreneurship on national competitiveness, it has been understood that it would be appropriate to use

entrepreneurial strategies in increasing both national and international competitiveness. The development of applications that highlight technology entrepreneurship such as technofest, and the development of technoparks within universities will be beneficial in increasing national entrepreneurship. This benefit will also be effective in increasing the national competitiveness level.

Regardless of the stage of entrepreneurship activities, the level of national entrepreneurship can be increased by systematically monitoring and managing all stages. In addition, increasing the entrepreneurial activities of information technologies, which directly contribute to the development of competitiveness, will also contribute to the competitiveness power. Non-linear regression models give more flexible results than linear models in explaining real-life relationships. This situation helps to obtain realistic results in relationship analysis. This benefit also comes to the fore in this article. Considering the benefit provided by the curve estimation models, the determination of the optimum line slope that explains the relationships between the variables helps to explain the relationship model at a high level.

There are two main limitations of the research. These are time constraint and sample constraint. Due to the ongoing worldwide pandemic conditions, the impact of the pandemic on entrepreneurship and competitiveness has not yet been fully explained. After that, data from 2019 was used in the research. The sample area of the study consists of 52 countries. The reason for this is the creation of the data set for the countries included in both the GEM and GCI reports. Suggestions for researchers dealing with the relationship between national entrepreneurship and national competitiveness are as follows: (i) After the pandemic is over, the relationships between the variables can be examined and compared with the findings of this study. (ii) The relationship between national entrepreneurship and national competitiveness can be obtained from different reports, analyzed and the results compared with the findings of this research. (iii) Finally, it is considered that conducting studies examining the relationships between the sub-dimensions of national entrepreneurship and the sub-dimensions of national competitiveness will contribute to the literature.

ULUSAL GİRİŞİMCİLİĞİN ULUSAL REKABETÇİLİK ÜZERİNDEKİ ETKİSİ: DOĞRUSAL VE DOĞRUSAL OLMAYAN REGRESYON ANALİZİ

1. GİRİŞ

Girişimcilik fikrinin ortaya çıkması, girişimcilik teşebbüslerinin gerçekleştirilmesi ve girişimcilik faaliyetlerinin uygulanmasını kapsayan sisteme "girişimcilik ekosistemi" denir. Bu ekosistemde ekosistemin devamlılığını etkileyen kurum, kuruluş ve diğer aktörler bulunmaktadır (Acs vd., 2017). Ekosistemi motive eden unsurlar girişimciliğe dayalı politikalar, programlar ve teşebbüslerdir (Isenberg, 2011). Makro düzeyde, ekosistem çıktıları ülke ekonomisinin gelişimine katkıda bulunur. Bunun doğal bir sonucu olarak da ülkelerin rekabet edebilme yetenekleri gelişir. Ekonomi temelli çalışmalarda girişimcilik ve rekabet gücü arasındaki ilişkinin ekonomik

büyümeye etkisine ilişkin modeller geliştirilmiştir (Herman, 2018; Crecente-Romero vd., 2019; Pradhan vd., 2020). Bu çalışmada girişimcilik ve rekabetçilik kavramları ulusal düzeyde ve ilişki temelli bir modelle açıklanmaya çalışılmıştır.

Girişimciliği bir kaynak ve yetenek olarak düşünmek, girişimciliğin rekabet gücüyle olan önemli pozitif ilişkisini açıklamaktadır (González-Pernía ve diğerleri, 2012). Aynı zamanda ulusal girişimcilik, ülkelerin ulusal rekabet gücünün gelişmesinde önemli bir rol oynamaktadır (Amorós vd., 2012). Bu noktada ulusal düzeyde girişimcilik ve rekabet edebilirlik arasındaki ilişkiyi açıklamaya yönelik araştırma soruları geliştirilmiştir. Araştırma soruları aşağıdaki gibidir.

- Araştırma Sorusu 1: Ulusal girişimciliğin ulusal rekabet gücü üzerinde pozitif bir doğrusal etkisi var mıdır?
- Araştırma Sorusu 2: Ulusal girişimciliğin ulusal rekabet gücü üzerinde doğrusal olmayan pozitif bir etkisi var mıdır?
- Araştırma Sorusu 3: Doğrusal etkiler modeli ile doğrusal olmayan etkiler modeli karşılaştırıldığında, hangi modelin açıklama yüzdesi daha yüksektir?

2. YÖNTEM

Bu araştırmanın temel amacı ulusal girişimcilik ile ulusal rekabetçilik arasındaki ilişkiyi doğrusal ve doğrusal olmayan modellerle açıklamaktır. Doğrusal olmayan modeller için eğri tahmin modellerinden faydalanılmıştır. Kavramsal çerçevede ele alınan ulusal rekabetçilik değişkeni bağımlı değişken, ulusal girişimcilik değişkeni ise bağımsız değişken olarak kabul edilmiştir. Ayrıca doğrusal ve doğrusal olmayan modellerin değişkenler arasındaki ilişkiyi açıklama yüzdeleri karşılaştırılmıştır.

Ülkelerin ulusal girişimcilik puanları "GEM (2019)" raporundan alınmıştır. GEM raporu kapsamında girişimcilik uzmanların yaptığı değerlendirmeler sonucunda ülkelerin NECI puanları araştırmada kullanılmıştır. Bu raporda toplam 54 ülke bulunmaktadır. Ülkelerin ulusal rekabetçilik puanları Dünya Ekonomik Forumu tarafından yayınlanan "GCI (2019)" raporundan alınmıştır. Bu raporda toplam 141 ülkenin ulusal rekabetçilik puanları bulunmaktadır. Veri seti, her iki raporda da yer alan 52 ülkenin 2019 yılı verilerinden oluşmaktadır.

3. BULGULAR

Doğrusal regresyon modeli analiz bulguları SPSS paket programıyla belirlenmiştir. Model özeti incelendiğinde $R2=0.475$ ve düzeltilmiş $R2=0.465$ olduğu görülmüştür. ANOVA tablosunun sonuçlarına göre $F=45.366$, Sig.$= 0.000$ olduğu tespit edilmiştir. Dolayısıyla lineer regresyon modelimiz "$NC=25.778+9.108*NE$" şeklindedir. Bu bulgu, çalışmanın birinci hipotezinin desteklendiğini açıklamaktadır.

Farklı eğri tahmin modellerinde R^2 değerleri tespit edilerek, lineer regresyon modelinden daha yüksek açıklama yüzdesine sahip bir eğri tahmin modelinin olup olmadığını belirlemek mümkündür (Jomnonkwao vd., 2020). Bu noktada SPSS programı yardımıyla 11 farklı eğri tahmin modeli sonucu belirlenmiştir. R^2

değerlerine bakıldığında değişkenler arasındaki ilişkiyi açıklayan en iyi model "Kübik" modelidir (R2=0.536, Sig.=0.000). Ayrıca tüm eğri tahmin modellerinin anlamlı düzeyde olduğu tespit edilmiştir.

Kübik model ile doğrusal olmayan regresyon analizi yapılarak en iyi modelin belirlenmesi amaçlanmıştır. Bu noktada SPSS paket programı ile doğrusal olmayan regresyon analizi yapılmıştır. Doğrusal olmayan regresyon analizinin ilk iterasyon modeli "NC=-34+28*NE+0,001*NE2-0.288*NE3" olarak belirlenmiştir. Doğrusal olmayan regresyon analizinin iterasyon sayısı belirlenmiştir. Doğrusal olmayan regresyon modeli analizi, 5 model ve 3 türev değerlendirmesi sonucunda nihai modele ulaşmıştır. Parametre tahminleri dikkate alınarak nihai doğrusal olmayan regresyon modeli "NC=144.449-89.951*NE+25.785*NE2-2.122*NE3" olarak belirlenir. ANOVA sonuçlarında nihai modelin R^2 değeri 0,543 olarak.

4. TARTIŞMA

Bu araştırmada, ulusal girişimcilik ile ulusal rekabet gücü arasındaki ilişkinin açıklanması amaçlanmaktadır. Bu nedenle, üç temel araştırma sorusu ve iki hipotez formüle edilmiştir. Hipotezler test edilerek ulaşılması gereken üç ana nokta vardır. Birinci nokta, ulusal girişimciliğin ulusal rekabet gücü üzerinde doğrusal bir etkisinin olup olmadığıdır. İkinci nokta, ulusal girişimciliğin ulusal rekabet gücü üzerinde doğrusal olmayan bir etkisinin olup olmadığıdır. Üçüncü nokta, hangi modelin (doğrusal veya doğrusal olmayan) ulusal girişimciliğin ulusal rekabet gücü üzerindeki etkisini daha yüksek düzeyde açıkladığını belirlemektir.

Birinci hipotez bulgusuna göre, ulusal girişimciliğin ulusal rekabet gücü üzerinde pozitif doğrusal bir etkiye sahip olduğu belirlenmiştir. Ayrıca modelin düzeltilmiş R^2 değeri 0.465 (p<0.01) olarak belirlenmiştir. Bu, doğrusal modellerin ulusal girişimcilik ve ulusal rekabet gücü arasındaki ilişkinin %46,5'ini açıkladığını göstermiştir. Araştırmanın ikinci hipotezinde değişkenler arasında doğrusal olmayan pozitif bir etkinin olduğu tespit edilmiştir. Ayrıca modelin R^2 değeri 0,543 (p<0.01) olarak belirlenmiştir. Bu da değişkenler arasındaki ilişkiyi açıklayan doğrusal olmayan modelin %54,3 olduğunu göstermektedir. Dolayısıyla doğrusal ve doğrusal olmayan modellerin açıklama yüzdeleri karşılaştırıldığında, iki model arasında %7,8'lik bir fark doğrusal olmayan model lehindedir.

Ulusal girişimcilik üzerine yapılan çalışmalarda ülkelerin bölgeleri, ekonomik koşulları, beklentileri ve fırsatları farklı olduğu için ulusal girişimcilik strateji ve politikalarının farklı olması gerektiği vurgulanmıştır (Angulo-Guerrero vd., 2017). Ulusal girişimcilik politikaları, ulusal rekabet edebilirlik düzeyini de etkilemektedir. Bu durum, ulusal düzeyde rekabet gücünü artırmak için geliştirilen girişimcilik politikalarının tüm ülkelere hitap edemediğini açıklamaktadır. Girişimcilik ve rekabet gücü arasındaki ilişki, yüksek düzeyde doğrusal olmayan modelle açıklanmaktadır. Doğrusal olmayan model, ülkelerin rekabet edebilirlik ve girişimcilik puanlarına göre değişkenler arasındaki en uygun ilişki düzeyine dayanmaktadır. Ülkelerin ulusal

girişimcilik politikalarında genel kabul görmüş yaklaşımlara ek olarak ülkelere özgü girişimcilik strateji ve politikaları geliştirmeleri önerilmektedir.

SONUÇ

Girişimcilik ve rekabetçilik kavramlarının ulusal ölçekte tartışıldığı bu çalışmada elde edilen en önemli sonuç, değişkenler arasındaki ilişkilerin doğrusal olmayan bir modelle açıklanmasının daha başarılı olduğudur. Ayrıca ulusal girişimciliğin ulusal rekabet gücüne etkisinin önemli olduğu tüm modellerde kanıtlanmıştır. Bu bulgular, devlet yöneticilerine ulusal ölçekte girişimcilik ve rekabet edebilirlik stratejilerinin belirlenmesinde yol göstericidir. Aynı zamanda ulusal girişimciliğin ulusal rekabet gücüne etkisi göz önüne alındığında hem ulusal hem de uluslararası rekabet gücünün artırılmasında girişimcilik stratejilerinin kullanılmasının uygun olacağı anlaşılmıştır. Teknofest gibi teknoloji girişimciliğini öne çıkaran uygulamaların geliştirilmesi, üniversiteler bünyesinde teknoparkların geliştirilmesi ulusal girişimciliğin artırılmasında faydalı olacaktır. Bu fayda, ulusal rekabet gücünün artmasında da etkili olacaktır.

Araştırmanın iki temel kısıtı bulunmaktadır. Bunlar, zaman kısıtı ve örnek kısıtıdır. Dünya çapında devam eden pandemi koşulları nedeniyle, pandeminin girişimcilik ve rekabet gücü üzerindeki etkisi henüz tam olarak açıklanamamıştır. Bu nedenle 2019 yılına ait veriler kullanılmıştır. Araştırmanın örneklem alanı 52 ülkeden oluşmaktadır. Bunun nedeni hem GEM hem de GCI raporlarında yer alan ülkeler için veri setinin oluşturulmasıdır. Ayrıca ulusal girişimciliğin alt boyutları ile ulusal rekabet edebilirliğin alt boyutları arasındaki ilişkileri inceleyen çalışmaların yapılmasının literatüre katkı sağlayacağı değerlendirilmektedir
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