FRONT COVER AND SPINE

Yunus Emre KARAMAN

THE IMPACT OF R&D EXPENDITURES ON RESEARCH PERFORMANCE ON UNIVERSITIES

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A THESIS

SUBMITTED TO ABDULLAH GÜL UNIVERSITY

SOCIAL SCIENCES INSTITUTE

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF SCIENCE

By

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September, 2023

Kayseri, TURKEY

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SCIENTIFIC ETHICS COMPLIANCE

I hereby declare that all information in this document has been obtained in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all materials and results that are not original to this work.

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M.Sc. thesis titled “The Impact of R&D Expenditures on Research Performance on Universities” has been prepared in accordance with the Graduate Thesis Preparation Guidelines of the Abdullah Gül University, Social Sciences Institute.

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ACCEPTANCE AND APPROVAL

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ABSTRACT

The most significant factor showing that countries are economically developed is the level of technology they produce. Technology, on the other hand, is the application of knowledge produced theoretically through scientific research. In this context, there is a clear connection between the level of economic development and welfare and the point reached in science. The resources that countries allocate to science and research activities are increasing every year, and the effective use of these resources plays a critical role in increasing the welfare level of these countries. This study reveals the effect of the university investment budget, which constitutes an essential part of the financial resources allocated to research and development activities in Turkey, on the research performance of universities.

Multiple regression analysis was used to achieve the aim outlined in this thesis. The number of publications per lecturer published in AHCI, SSCI, SCI, and SCI-Expanded indexed journals and the number of Web of Science publications citations were used as dependent variables to represent research performance. The rate of investment budget spent on R&D was used as an independent variable to represent R&D expenditures. In addition, the number of lecturers and the number of YÖK 100/2000 Project doctoral scholars were included in the models as control variables. It was concluded that R&D expenditures affect research performance positively.

Keywords: R&D Expenditures, Research Performance, Multi-Regression Analysis

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ÖZET

Ülkelerin ekonomik olarak kalkınmış olduklarını gösteren en önemli etken ürettikleri teknoloji seviyesidir. Teknoloji ise bilimsel araştırmalarla teorik olarak üretilen bilginin uygulamaya aktarılmış halidir. Bu çerçevede ekonomik kalkınma ve refah seviyesi ile bilimde gelinen nokta arasında açık bir bağlantı vardır. Ülkelerin bilime ve araştırma faaliyetlerine ayırdıkları kaynaklar her geçen yıl artmakta ve bu kaynakların etkin bir şekilde kullanımı bu ülkelerin refah seviyesinin artmasında kritik rol oynamaktadır. Bu çalışma Türkiye'de araştırma-geliştirme faaliyetlerine ayrılan mali kaynağın önemli bir bölümünü oluşturan üniversite yatırım bütçesinin üniversitelerin araştırma performansına etkisini ortaya koymaktadır.

Bu tezde ortaya konan amaca ulaşabilmek için çoklu regresyon analizi kullanılmıştır. SCI, SCI-Expanded, SSCI ve AHCI endeksli dergilerde yayımlanmış öğretim elemanı başına düşen yayın sayısı ve Web of Science yayınlarının atıf sayısı araştırma performansını temsilen bağımlı değişkenler olarak kullanılmıştır. Ar-Ge'ye harcanan yatırım bütçesi oranı ise ar-ge harcamalarını temsilen bağımsız değişken olarak kullanılmıştır. Ayrıca öğretim elemanı sayısı ve YÖK 100/2000 Projesi doktora bursiyeri sayısı verileri kontrol değişkeni olarak modellerde yer almıştır. Ar-Ge harcamalarının araştırma performansını pozitif yönde etkilediği sonucuna varılmıştır.

Anahtar kelimeler: Ar-Ge Harcamaları, Araştırma Performansı, Çoklu Regresyon Analizi

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LIST OF ABBREVIATIONS

AHCI	Arts & Humanities Citation Index
ARDL	Autoregressive Distributed Lag
EKC	Environmental Kuznets Curve
FADL	Factor Augmented Autoregressive Distributed Lag
FADL	Fractional Frequency Fourier Autoregressive Distributive Lag
FMOLS	Fully Modified Ordinary Least Squares
GDP	Gross Domestic Product
ISI	Institute of Scientific Information
LCC	Load Capacity Curve
NRD	Nuclear Energy Research and Development
NSF	National Science Foundation
OECD	Organisation for Economic Co-operation and Development
PhD	Doctor of Philosophy
R&D	Research and Development
RRD	Renewable Energy Research and Development
SCI	Science Citation Index
SSCI	Social Science Citation Index
UGC	University Grants Committee
WoS	Web of Science
YÖK	Higher Education Institution

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1. INTRODUCTION

Changes in the world and our country after globalization and the transition to an information society have shown their effects on higher education institutions; especially in our country, the number of public and foundation universities has increased rapidly. As a result of this increase, the problems experienced in fulfilling the traditional functions of universities in a quality way become visible, making the measurement of academic performance a vital issue. However, the quality of scientific research outputs implemented in universities, which have an important function in the science and technology policies created by countries, has become necessary in terms of its contribution to social life and the world of science. Although it is not new in the field of management and organization, quality assurance system applications in higher education, which have been increasing in recent years, have made it necessary to perform higher education functions within the framework of specific standards (Sabır Taştan, 2020). Qualified universities, the most crucial locomotive of a country's economic development, must keep their academic performances at the highest level.

This master's thesis aims to reveal the effect of research and development (R&D) expenditures made by universities on the research performance of higher education institutions. According to Higher Education Institution (YÖK) data, there are 204 universities in Turkey. Four of these higher education institutions are foundation vocational schools. They are not included in this study because they only have associate degree programs, and their primary mission is to train intermediate staff. The study covers the years 2018-2021. During this period, 199 foundation and state universities operating in Turkey were included in the study (YÖK, 2022).

Multiple regression method was used in this study. The dependent variables used to represent research performance are the number of publications per lecturer published in AHCI, SCI, SCI-Expanded and SSCI-indexed journals and the number of citations of Web of Science publications. These data were obtained from the YÖK Monitoring and Evaluation Reports and the Web of Science (WoS) Core Collection database, respectively. In this study, the independent variables used to represent the R&D

expenditures of higher education institutions are the investment budget ratio spent on R&D. In addition, the number of teaching staff and the number of YÖK 100/2000 Project Ph.D. scholars were used as control variables. These data were obtained from YÖK University Monitoring and Evaluation Reports and YÖK Higher Education Information Management System.

The study begins with a literature review, including studies examining the R&D expenditures in universities, the research performance of universities, and the effect of R&D expenditures on research performance. Then, the study continues with a conceptual framework section in which university and R&D issues are discussed. And then, information about the data used in the study is given. The study's technique is described, followed by presenting the findings from the multiple regression analysis under the Analysis section. In the conclusion part, the inferences obtained from the analysis are given.

2. LITERATURE REVIEW

2.1. Research and Development Expenditures by Universities

R&D expenditures are a chief aspect of universities' activities, as they reflect the investment made by universities to improve knowledge and innovation in various fields. R&D expenditures can be defined as the funds allocated to research and development activities, which include the costs of conducting research, hiring researchers, purchasing equipment, and obtaining patents. Several studies have investigated the impact of R&D expenditures on universities, with a particular focus on their effects on research output, innovation, and economic growth.

Due to limited resources, the authors suggest that new firms often rely on spillovers from more prominent and established firms to drive their innovation. Consequently, they hypothesize that areas with high levels of higher education institution R&D expenditures are more likely to experience new firm establishment, leading to increased employment and growth in the local economy. The authors have found a positive relationship between higher education institution R&D expenditures and new firm formations using secondary data from diverse state sources from 1990 to 1999, which is also positively associated with employment level and growth. The results indicate that higher education R&D expenditures indirectly contribute to overall economic growth by promoting the establishment of new primary and secondary firms (Kirchhoff et al., 2007). In another similar study, Zhang and Ehrenberg approached universities' R&D expenditures from a different perspective in their research. This study employs panel data to explore the association between faculty recruitment and external research and development costs at research and doctoral universities for a term of 15 years. The study shows that an increase of 1% in the number of full-time faculty is related to a 0.2% rise in total R&D expenses. In addition, a %1-point increase in the share of non-tenure-track permanent faculty members leads to a decrease of around 0.6% in total external R&D expenditures; this indicates that tenured or tenure-track faculty members are primary contributors to external R&D financing. Additionally, given that the universities’ full-time faculty size is constant, and raises external R&D

expenses, their findings suggest that a growing dependence on part-time faculty members. A 0.44% increase in total external R&D expenditures is associated with an average 1%-point increase in the share of part-time faculty members. The study also demonstrates that increased graduate student enrollment is associated with increased external R&D expenditures. In conclusion, a university's external R&D expenditures are significantly influenced by both the amount of internally funded research expenses and the degree of government funding for research (Zhang & Ehrenberg, 2010).

Vitola and Erina's paper aim to examine the correlation between R&D performance indicators and R&D expenditures in universities and identify other factors that influence performance indicators in the Baltic States and Latvia. The study explores whether increased funding leads to better R&D performance indicators and compares universities' performance indicators and their relationship to R&D expenditures in the Baltic States. Vitola and Erina discovered that some performance indicators are linked to the level of expenditure in the higher education sector, while others are not. Additionally, they suggest that funding policies should focus more on performance (Vītola & Eriņa, 2015). There is another article published in the same year. The article examines the trends in research expenditures in South Africa since the implementation of the New Funding Formula in 2004. It compares South Africa's gross expenditures on R&D with other countries. The results show that the New Funding Formula has led to a remarkable increase in research expenditures in South African higher education. While South Africa has the highest total gross expenditure on R&D as a percentage of GDP among African countries, it still lags behind other economies such as Brazil, China, and Russia. Therefore, the research suggests additional investment in R&D in South Africa to become a knowledge-based economy (Odhiambo & Ntenga, 2015).

Although higher education R&D spending is essential in promoting economic growth through scientific advancements, innovation, and new ideas, its impact on environmental sustainability has yet to be thoroughly explored. Su and his colleagues' essay investigated the relationship between the R&D spending of universities and carbon dioxide emissions while also considering other variables, such as gross domestic product, electricity consumption, total population and foreign direct investment during

the period from Q1 of 2000 to Q4 of 2019. Several examinations were used to scrutinize the data, which comprise the cross-sectional dependence examination, the Westerlund error-correction-based panel cointegration test, the cross-sectionally augmented Dickey-Fuller unit root test, the mean group analysis, the common correlated effects mean group analysis, the augmented mean group analysis, and the Dumitrescu-Hurlin panel causality test. The results have shown that there is a cointegration relationship between higher education R&D expenditures, electricity consumption, gross domestic product, total population, foreign direct investment, and carbon dioxide emissions. The findings also revealed a significant long-term negative relationship between R&D of university spending and carbon dioxide emissions. Additionally, gross domestic product, electricity consumption, total population, and foreign direct investment were identified as significant parameters that exacerbate the comprehensive situation of carbon dioxide emissions. Finally, the study demonstrated bidirectional causality between carbon dioxide emissions and electricity consumption, carbon dioxide emissions and foreign direct investment, carbon dioxide emissions and gross domestic product, carbon dioxide emissions and population, and higher education R&D spending and carbon dioxide emissions. The results of this research suggest the need for policies that promote higher education for the development of green patents and increased financial support (Su et al., 2021).

Tanrıverdi and Öztürk's study examines the effects of R&D spendings, researcher numbers, patents and number of publications obtained on national income in Turkey between 2001-2016. The study uses Autoregressive Distributed Lag and Granger Causality analyses to produce different econometric models. The causality analysis shows that there is a unidirectional causality from number of patents to economic growth. The Autoregressive Distributed Lag analysis shows a positive and 2.5% relationship between economic growth and R&D, but no significant long-term relationship between economic growth and R&D was found (Tanrıverdi & Öztürk, 2023). Another research examines the impact of Germany's efforts to become carbon-neutral by 2045 by investigating the influence of nuclear energy research and development (NRD) and renewable energy research and development spendings on various environmental factors, including ecological footprint, CO2 emissions, and load capacity factor. The research uses annual data from 1974-2018 and applies the fractional

frequency Fourier autoregressive distributive lag (FADL) based FMOLS approach as the main model. Additionally, the study tests the validity of load capacity curve (LCC) and the environmental Kuznets curve (EKC) hypotheses. The results show that R&D spendings are efficient in reducing CO2 emissions, while R&D and NRD expenditures do not have a significant impact on ecological footprint. The EKC hypothesis is valid for Germany, while the LCC hypothesis is invalid. Based on these findings, policymakers could focus on implementing RRD to achieve the country's carbon-neutral goal and improve environmental quality. (Pata et al., 2023). Finally, Peng and colleagues' research investigates the relationship between a firm's implementation of intelligent manufacturing and the investment decisions of managers in research and R&D from the perspective of strategic transformation. The study also examines whether CEO tenure and government subsidies moderate this relationship. Using a sample of 7,522 observations of Chinese listed manufacturing firms from 2015-2019, the study utilizes a more detailed measurement of intelligent manufacturing strategy by analyzing Management Discussion and Analysis reports. The results indicate that implementing an intelligent manufacturing strategy is positively associated with R&D expenditures, even when controlling for other factors that impact R&D investment (Peng et al., 2023). Thus, it appears that the current literature on R&D expenditures of universities is quite limited. Researchers mainly focused on the R&D expenditures of companies and countries.

2.2. Research Performance of Universities

The research performance of universities has been the subject of extensive studies in the literature. One common way of measuring research performance is through publications, citations, and patents.

One of the early studies on the research performance of universities was published by Moed et al. This paper presents research on the potential use of bibliometric data, such as publication and citation records, as tools for higher education institute research policy. The research comprised computing bibliometric metrics for investigation teams

at the Faculty of Mathematics and Natural Sciences and Faculty of Medicine of Leiden University and conversing with scholars from these faculties about the findings. The study concludes that while there are challenges in collecting and interpreting bibliometric data, these can be overcome. When appropriately used, bibliometric measures can serve as a valuable tool for observing higher education research performance and informing science policy decisions. They allow policymakers to question researchers' scientific output and identify factors that may explain the bibliometric results (Moed et al., 1985). Another paper on the research performance of universities published in the eighties is by Johnes. The utilization of bibliometric instruments for assessing the research efficiency of academic divisions has become increasingly prevalent. This paper offers a thorough evaluation of these methods. It concludes that while they can help identify the most influential research environments for specific subject areas, their capacity to gauge performance accurately is considerably restricted (Johnes, 1988). One of the first papers on the research performance of universities was published by Phillimore. This research aims to analyze the challenges in measuring university research performance, focusing on the controversial evaluation exercise conducted by the University Grants Committee (UGC) in Britain in 1985-1986. The paper discusses the economic and political context surrounding universities in Britain, followed by a description of the technical, conceptual, and philosophical topics that emerged during the UGC exercise. The paper lists various research performance pointers proposed by the UGC and its critics and highlights weaknesses and inconsistencies in each indicator. The paper argues that "performance" is a multifaceted concept that cannot be measured by objective indicators alone. The context and process of developing performance indicators and their subsequent use are equally important. The paper also identifies policy issues arising from the UGC exercise and suggests strategies that governments and universities should consider avoiding similar mistakes. The paper concludes that this is especially crucial given recent government proposals for the higher education system and university research (Phillimore, 1989).

The other paper seeks to describe Spanish universities using various indicators, such as structural, output, and input factors. It aims to investigate the relationship between these factors and analyze higher education institution behavior across different

angles. The study considers the seniority of the universities, environmental factors, and indicators related to networks and connections. By doing so, it hopes to generate data that can aid in research management at the regional, institutional, and national grade and contribute to a better understanding of the university research system in Spain (Gómez et al., 2009).

Edgar and Gear published an article on this subject in 2013. This research aims to expand the knowledge of research productivity by analyzing the managerial practices and cultural aspects within university departments. The research design involves a comprehensive comparison of interview and survey data gathered from multiple stakeholders in universities of New Zealand, intending to identify factors contributing to high level research performance. The results indicate that high-performing departments share features such as autonomy, egalitarianism, and a strong cultural emphasis on achievement and individualism. These attributes are part of a commitment-oriented work environment, which is not present in the work environments of low-performing departments. This discrepancy prompts whether certain managerial practices and supportive cultural characteristics are essential to improving research performance outcomes. These findings should be of interest and benefit to academic and management professionals in higher education, particularly as universities around the world approach further rounds of research performance assessments (Edgar & Geare, 2013). Another study that was published next year focused on Chinese universities. This study aims to increase the research performance of Chinese higher education institutions between 2007 and 2010 using the Scopus database. Compared to top universities in the United States and Europe, this paper presents meaningful indicators to measure the research performance of Chinese universities. The study analyzes both the quality and quantity of research outcomes and the internationalization of research through international partnerships, citations, and impact measurements. A general score called the research performance score is given to measure universities' comprehensive research capability for selected subject categories. The study identifies gaps in research performance by comparing Chinese higher education institutions with best universities from selected regions across different subject areas. Results indicate that Chinese higher education institutions publish many papers but receive fewer citations than their counterparts. The study also shows that universities in China have a

low publication percentage in highly influential venues, which may be why they receive fewer citations. Selecting prestigious publication venues could help Chinese universities increase their research internationalization and compete with top universities worldwide (Zhu et al., 2014).

According to another essay, lately, there has been an accelerating interest among researchers in the competition in higher education. It has been suggested that universities compete to increase their student numbers, research performance, research support, quality of teaching staff, and financial contributions. This paper focuses on research performance as a significant aspect of this competition. In order to achieve this goal, a thorough literature review on higher education research performance has been conducted. The review begins by examining the definition of research performance, its indicators, and measures. It then provides a comprehensive discussion of the factors affecting research performance. Finally, the essay proposes a conceptual framework that can be useful for all higher education institution staff. By gaining a deeper understanding of research performance and the elements that influence it, relevant authorities can take steps to improve their positions in this highly competitive environment (Tamtekin Aydın, 2017).

Another study examines the factors affecting higher education institution research performance by analyzing the number of highly cited publications, publications with international cooperations, and publications with university-industry cooperations. These three factors measure different aspects of research and innovation, including research excellence and internationalization. Using regression analysis, the essay investigates the impact of structural variables such as age, size, location in a capital city, city size, disciplinary orientation, and country location on research performance. The findings reveal that differences in research performance among universities are primarily due to their size, country location, and disciplinary orientation. As a result, global benchmarking may not provide an accurate comparison between universities, and benchmarking should be conducted between institutions of a similar size and with consideration of their specific mission, orientation, and national institutions (Frenken et al., 2017).

More can be mentioned in the literature on the research performance of universities. There has been a widespread body of work on this subject. However, this thesis will focus on the institutional research performance of higher education institutions, not the individual research performances of academics.

2.3. The Effect of University R&D Expenditures on Research Performance

The number of articles showing the effect of universities' R&D expenditures on research performance is quite limited. Looking at the literature, two publications that deal directly with this subject could be found.

The first study is the 1981 article by McAllister and Wagner. This all-encompassing investigation makes use of two significant and unconnected data sources, the NSF's database for Integrated Science Statistics Program and bibliometric data from CHI Research, to scrutinize the correlation between research inputs, quantified by R&D expenditures and outputs, quantified by quantity, and the prominence of scientific journal articles. The study examines around 500 higher education institutions in the United States and analyzes 11 different fields of science. The findings suggest a linear relationship between the number of papers published in every field and R&D expenditures. Additionally, there is proof of a favorable connection between the quantity of citations per publication and the quantity of published papers, but this applies solely to basic research periodicals in biology, physics, and chemistry (McAllister & Wagner, 1981). The other study on the subject belongs to Meo and Usmani. This research aims to evaluate and contrast the effect of R&D spending on scientific publications, high-tech exports, and patents within various European countries. The research included 47 European countries and collected info on their per capita GDP, number of universities, R&D spending, high technology exports, patents and indexed scientific journals. The study recorded the total amount of research papers published in different social science and science subjects from 1996 to 2011. The

primary data sources utilized were WoS, World Bank, Thomson Reuters, and Scopus. The results showed that the mean GDP per capita for all European countries was 23372.64 ± 3588.42 US $, while the annual per capita spending on research and development was 1.14 ± 0.13 US$. The average number of Institute of Scientific Information (ISI) indexed journals per country was 90.72 ± 38.47, and the average number of research papers published in different science and social science subjects was 213405.70 ± 56493.04. The research discovered a favorable association between the spending on research and development, the count of universities, documented publications in different scientific and social science fields, indexed journals, high-tech exports, and the number of patents. Additionally, there was a positive correlation between high-tech exports and patent applications. Nevertheless, there was no significant contribution between research products and GDP per capita (Meo & Usmani, 2014).

3. CONCEPTUAL FRAMEWORK

In this section, the concepts related to universities and higher education systems in the world are examined. The historical development of universities is explained by referring to the concepts of globalization, digitalization, and the entrepreneurial university.

3.1. Universities and Higher Education System in Turkey

3.1.1. Historical Development of Universities

The name of university given to higher education institutions has a history dating back to BC. Plato's Academy, Aristotle's Lyceum, and Alexandria School were the first educational institutions that were founded on free thought and formed the foundations of the university. In the period after Christ, the schools established to train religious officials and lawyers in Rome and China, and the madrasahs established in the regions where Islam became widespread were accepted as critical educational institutions (Gürüz, 2003). Educational institutions established in ancient times are not the direct precursors of today's universities. However, these institutions played an important role in the development of university education. The concepts of "stadium generale" and "stadium particulare" that emerged in medieval Europe are concepts that define university education in a similar way to its current meaning. Stadium means an institution organized for education. Generale, type of institution that accepts students from outside the local area; Particulare means the type of institution for the students of a particular region. The structures of these institutions changed in parallel with the developments in the city, trade, and profession towards the end of the 12th century (Kenan, 2015). Although this situation was not a direct precursor to today's universities, it played an important role in the development of the concept of the university.

The development of universities in Europe started with the Paris and Bologna models in the 12th century. These two models form the foundations of today's universities (Bingöl, 2014). The concept at a university in the Middle Ages is derived

from the Medieval Latin word "universus" meaning "whole, monolithic.". This concept refers to societies and professional groups in cities (Kenan, 2015). The first universities established in medieval Europe were run by guilds in students or teachers (Gürüz, 2003). Universities have become an important power of their regions over time. This situation caused the political authorities to want to have more control over the universities (Kenan, 2015). The desire of the political authorities to have more control over the universities also caused changes in the management styles of the universities. For example, the student rectorate at the University of Bologna became symbolic with the financial support of the city administration. In the University of Paris, on the other hand, the administration began to need the approval of the pope or king, unlike the first periods when universities were established. This situation led to the emergence of the papacy and kingdoms as the protectors of the universities against the local powers in the Middle Ages (Bingöl, 2014). As the universities came under the influence of political and religious authorities in the Middle Ages, the interventions of local governments on universities were limited, but the academic autonomy of universities was also damaged. Although some privileges were given to universities in this period, the pressure on universities increased with the financial support of civil authorities, scholastic thought began to be accepted in universities, and universities began to lose their secular character (Gürüz, 2003). Humanist movements such as the Renaissance, Reform, and Enlightenment played an important role in changing the way of thinking in universities in the 18th century (Stone, 1964). The understanding of science created by humanist movements such as the Renaissance, Reformation, and Enlightenment paved the way for scientific revolutions (Ekinci et al., 2018). The efforts of Erasmus and Martin Luther contributed to the reform of Christianity and the decline of religious authority. This situation increased the academic autonomy of universities and encouraged their expansion in different geographies (Gürüz, 2003). These developments have helped universities to get rid of the pressure of religious and political authorities and to ensure academic autonomy.

The sudden Revolution accelerated the developments in higher education. The revolution led to the independence of universities from religious and political authorities, the acceptance of science as a fundamental field of education, and the increase in the quality of education. (Gürüz, 2003). Religious and political authorities,

aristocrats, and bourgeois supported universities to produce academic and scientific knowledge. This support has contributed to the strengthening of universities and to play an important role in society. Students and teachers have come to universities to access knowledge and benefit society. Those living in cities where universities are located expect universities to contribute to economic and cultural development (Ekinci et al., 2018). In this context, universities were established to meet the needs of society and to serve practical purposes. Until the 19th century, universities generally served as vocational schools such as medicine, law, and theology. In addition, higher education institutions were established in technical fields such as engineering and architecture (Gürüz, 2003). The primary function of medieval universities was to preserve and transmit knowledge. Social changes in the late 19th century led to significant changes in the functions of universities. One of the most important of these changes is that research has become one of the main functions of the university under the leadership of Humboldt University (Antalyali, 2007).

The 20th century is a period in which World Wars took place and the functions of universities diversified. In this period, Humboldt's research-based approach led to the organization of functions such as education and community service separately. As scientific research increased, specialization in a particular field also increased. Scientific developments have been used for different purposes to gain superiority in war. In the late 20th and early 21st centuries, the functions of universities began to evolve towards the American model of higher education. In addition to these functions, new roles such as providing service to the society and gaining citizenship identity have been added. Large-scale studies have been designed so that these roles can contribute more to the increase of welfare in American society. The financial support of these research was not limited to the state, but also the industry's contribution to universities was paved. While this situation facilitated the support of important research on the one hand, it also dragged the universities into competition (Bingöl, 2014). As a result, in the 20th century, the function of universities diversified and became competitive and market oriented.

Today, globalization and neoliberal policies impose new roles on universities. In the information society, the production forms of knowledge have changed and become the primary source of the economy. This situation has increased the importance of education for individuals to develop their cognitive and general skills. In this context, important roles are attributed to universities in terms of academic development and economic development. As a result of these roles, all variables, from the structure of universities to their roles and management styles, are transforming in line with the market (Ekinci et al., 2018).

3.1.2. Higher Education System in Turkey

The Turkish higher education system is regulated by the Higher Education Law No. 2547, which entered into force in 1981. With this law, the higher education system and higher education institutions in our country are under the responsibility of the Council of Higher Education (YÖK) (Akbulut Yıldırmış & Seggie, 2018). Currently, in the Turkish higher education system, associate degree education is provided in addition to undergraduate, graduate, and doctorate degrees. Associate degree education is also called short-term education (Şenay et al., 2020).

In the Turkish higher education system, approximately 7.7 million students study in 206 higher education institutions. Approximately 3.7 million of these students are women, and 4.07 million are men. 2.8 million students at the associate degree level, 4.4 million students at the undergraduate level, 400 thousand students at the graduate level, and 97 thousand students at the doctorate level. The ratio of female students to males is ahead of most developed countries in Europe (https://istatistik.yok.gov.tr).

In the Turkish higher education system, the management of universities is carried out by the Council of Higher Education (YÖK). YÖK consists of 21 members elected by the president, the council of ministers, and the interuniversity board. YÖK is an autonomous and public legal entity that regulates all higher education and directs the

activities of universities. Management and control mechanisms in universities consist of the rector, the senate, and board of directors. In 2016, with the Decree-Law No. 676, the re-appointment procedure was adopted for the determination of the Rector. According to this arrangement, the Rector will be appointed by the President from among three candidates to be proposed by YÖK. Persons to be proposed as rectors are required to work as a professor for at least three years. If the President fails to appoint one of the proposed candidates within one month, two weeks will be given to YÖK to propose new candidates. The President will be able to appoint directly if no new candidates are proposed at the end of the two-week period. The Rector of foundation universities will be appointed by the president upon the proposal of the board of trustees and the positive opinion of YÖK (Erat, 2019). Under the presidency of the rector, the Senate consists of vice-rectors, deans, a faculty member from each faculty to be elected for three years by the faculty boards, and the directors of institutes and colleges affiliated to the rectorate (Üniversitelerde Akademik Teşkilat Yönetmeliği, 1982). The University Executive Board consists of three professors elected by the deans and the senate under the presidency of the Rector. The board assists the Rector in the execution of the administrative activities of the university (Çankaya & Töremen, 2010).

Income sources of higher education institutions consist of appropriations to be put into the budget every year, aids to be made by institutions, fees, and fees to be collected, publication and sales revenues, revenues of movable and immovable property, profits to be obtained from revolving fund enterprises, donations, wills and other incomes (Yükseköğretim Kanunu, n.d.). Budgets of public universities are made in parallel with the state budget. The Republic of Turkey Strategy and Budget Presidency issues a budget call every 2 years and collects budget requests from all public institutions. Public universities, which are public institutions with a private budget, also create their own budget drafts and submit them to the Republic of Turkey Strategy and Budget Presidency. When universities make their own budgets, they ensure that all their units prepare the budget drafts for the relevant plans. While preparing university budgets, upper scale plans, regional plans, strategic plan of the university, performance indicators, and inflation are taken into consideration. The budgets submitted to the Strategy and Budget Presidency are finalized and implemented after the approval of the Turkish Grand National Assembly. In foundation universities, budget preparation is similar to that of public universities. However, in foundation universities, the budget is

approved by the board of trustees. A copy of the detailed budget of the foundation higher education institution approved by the board of trustees and the decisions of the board of trustees showing the principles regarding the implementation of the budget and the authorities regarding expenditure are sent to the Higher Education Council (Vakıf Yükseköğretim Kurumları Yönetmeliği, n.d.).

To understand the position of Turkish universities on a global scale, it is essential to consider university ranking systems. According to the 2023 data from Times Higher Education, one of the most prominent university ranking systems worldwide, three Turkish universities are ranked in the 401-500 range. (Times Higher Educaiton, 2023). According to the same system, there is one university ranked between 501-600, and three universities in the 601-800 range. According to the latest report from QS, another momentous ranking system, there are three Turkish universities in the top 500 and eight in the top 100. (QS, 2023). Additionally, according to the 2022 Highly Cited Researchers data published by Clarivate Analytics, there are six academics from Turkish universities among the world's most cited researchers (Clarivate Analytics, 2023).

3.2. Research and Development

R&D is a significant determinative of technological change, leading to the development of new goods, processes, and knowledge. According to the Frascati Manual (OECD, 1993, p. 29), R&D encompasses systematically conducted creative work to expand knowledge and design new applications. There are various kinds of R&D, and their impact on productivity can occur through different channels. To understand the relationship between productivity and R&D, it is essential to consider these views. It is important to mention that R&D is only one of the origins of novel technology in contemporary industrial economies. Other undertakings, like learning through experience or designing, frequently rely on innovative technology produced through R&D (for instance, modifications in business structure linked to communication technology and the utilization of information). The relationship

between R&D and innovation is nonlinear and complicated. However, it is widely acknowledged that substantial technological advancements are unlikely to happen without systematic efforts (even serendipity tends to arise in such a context), and R&D serves as a reliable sign of this wider phenomenon (Guellec & Van Pottelsberghe De La Potterie 2001).

The 2015 version of the R&D Frascati Manual defines it as "R&D comprise creative and systematic work undertaken to increase the stock of knowledge –including knowledge of humankind, culture, and society– and to devise new applications of available knowledge" (OECD, 2015). There are several key points to note in this definition. Firstly, the definition of R&D is comprehensive, encompassing various kinds of basic research, applied research, and experimental development in the process of knowledge creation. Secondly, the activities described should be conducted systematically. Lastly, three different types of R&D activities can be briefly outlined. Primary research involves obtaining information about fundamental facts and observable phenomena without any specific application area. Applied research encompasses original work, including research and experimentation, aimed at achieving concrete results for a specific purpose. Experimental development, on the other hand, refers to systematic efforts to develop new products, services, processes, and systems based on the knowledge generated from basic and applied research (Semih & Akçomak Kalaycı, 2016). Guilds are communities of people with common goals. In the guilds, the students came together and took lessons from the teachers for a fee and prepared for a higher school. Guilds are communities of students or teachers (Ekinci et al., 2018). The University of Bologna was established in the form of a student guild. In these guilds, the teachers' wages were paid by the students and their management was carried out by a representative rector elected by the students. The student rector was responsible for administrative, financial and disciplinary matters outside of education and training. Education and training, on the other hand, was determined as a field specific to teachers only. The University of Paris was established in the form of a teachers' guild. Although the wages were paid by the students in these guilds, the administration was among the duties of the teachers. In this context, the management of the university was carried out through the rector and faculty deans selected by the teachers (Doğramacı, 2007).

As mentioned before, per the guidelines presented in the Frascati Manual, R&D encompasses three distinct types of endeavors: fundamental research, practical research, and empirical experimentation. This is basic research; It is described as a systematic investigation, either experimental or theoretical, that is primarily conducted to gain a new understanding of the underlying principles of phenomena and observable facts without any specific application or utilization in mind. Applied research is defined as original research conducted to obtain new knowledge and is carried out to provide benefits for a specific applicable purpose or goal. On the other hand, experimental development is defined as a systematic study aimed at producing new products or processes or improving existing products or processes by utilizing new knowledge obtained because of research and applied experience and producing additional knowledge. In this context, the term "product" refers to a commodity or a facility offered, whereas "process" signifies the process of transforming inputs into outputs and their distribution, as well as organizational structures or practices (OECD, 2015).

Furthermore, the Frascati Manual defines R&D workings as the total of actions intentionally undertaken by R&D practitioners to create new knowledge. Conversely, an R&D project is formed by grouping R&D activities. An R&D project can be described as a collection of R&D activities that are organized and managed for a particular goal, with their purpose and expected outcomes (OECD, 2015).

R&D is also defined by specific legal regulations in Turkey. According to the Technology Development Zones Law No. 4691, R&D is defined as systematic creative work aimed at expanding the knowledge of culture, individuals, and society and utilizing this knowledge to design new systems, processes, and applications, including software. This definition is aligned with the sixth edition of the Frascati Manual from 2002 (Technology Development Zones Law, 2001). The definition of R&D activity in Law No. 5746 on Supporting Research, Development, and Design Activities goes beyond the definition in Law No. 4691. It includes environmentally compatible product design or software activities, which contribute to scientific and technological development in the field and focus on scientific and technological uncertainties, with

original, experimental, scientific, and technical content in a broader sense (Supporting Research, Development and Design Activities Law, 2008).

The concept of R & D and innovation/innovation are frequently mentioned in theoretical and practical studies, and there is a cause-effect relationship between these concepts. While most R&D activities can be seen as a prerequisite for creating an innovation, when innovation is considered a process in a broad sense, R&D can be described as the first stage of this process. In other words, R&D activities are one of the activities that can be used for innovation (Dikici, 2021).

3.3. Research Performance

In the literature, many concepts, such as academic performance, scientific performance, scientific productivity, academic productivity, and academic research performance, are used to evaluate the research outputs of academicians (Creswell, 1985).

In the scientific world, new information produced by research is distributed in the form of "publication"; Thus, it is ensured that formal scientific communication is maintained. Understandably, publications are evaluated as a measurable scientific production activity as an output of scientific research activity because of new information, scientific publications, patents, and tangible products. Although scientific publications include monographs and conference proceedings, reports, slides, and others, peer-reviewed journal articles are mainly used as a productivity measure despite disciplinary differences (Civelek Uzun, 2022).

Assessing a university's performance often involves considering research performance as one of the critical factors. With the rapid changes in the higher education sector and technological advancements, higher education institutions are increasingly being compelled to enhance their productivity and research capabilities. Higher

education institutions now recognize that establishing a solid scientific reputation requires being at the forefront of fostering innovation, knowledge production, and attracting reputable researchers. Administrations acknowledge the significance of supporting universities that can provide various kinds of services, such as training, education, disseminating information on current matters, consulting, and engaging in R&D workings. These activities are acknowledged to produce beneficial external effects for the community. Among these activities, R&D plays a crucial part in enabling other activities to be carried out at the desired level and quality, as they make it easier to keep up with the technological and social changes taking place in local and global settings (Deniz Tekneci, 2014) (Edgar & Geare, 2010).

4. DATA

The data used in this study were taken from the University Monitoring and Evaluation Reports compiled and published by YÖK from all universities in Turkey since 2018. These reports consist of four titles: education, research and development, internationalization, and service to society. The number of lecturers was obtained from the statistics portal of YÖK. 199 public and foundation universities were included in the study.

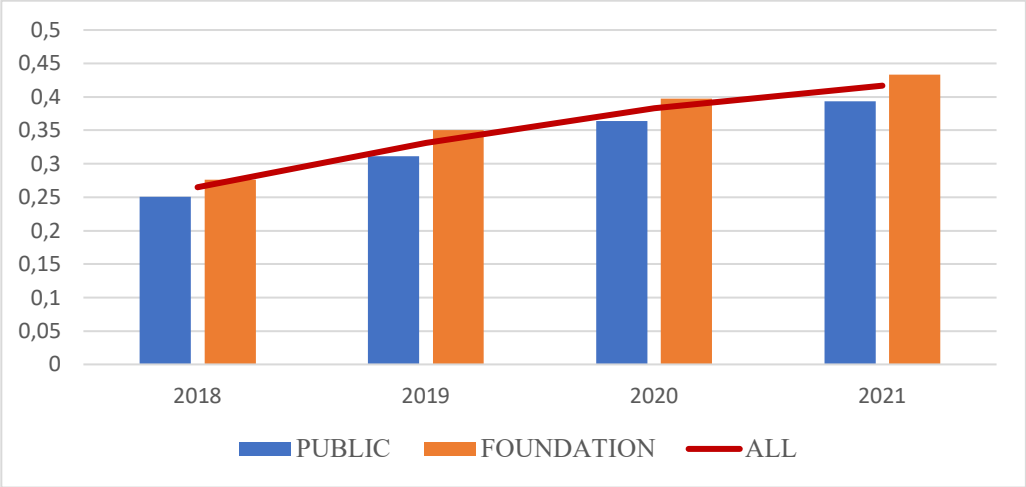
Table 1: Description of Variables

Dependent Variables	**Source**	**Description**
Number of Publications per Lecturer Published in AHCI, SSCI SCI and SCI-Expanded Indexed Journals	YÖK	• The ratio of the total amount of publications with an institution address published in AHCI, SSCI SCI and SCI-Expanded indexed journals (including ESCI) refers to the total amount of academicians in the relevant year. • Publications that were jointly authored by faculty members from the identical university were regarded as a unified publication. • The joint publications published by academic staff from different universities were evaluated separately for each university. • Only articles and reviews were included in the evaluation.

Citation Number of WoS Publications	WoS Core Collection	• It is the number of articles and reviews published in journals with the address of the institution in the relevant year and scanned in the WoS indexes.
Independent Variables	**Source**	**Description**
Investment Budget Ratio Spent on R&D	YÖK	• In the relevant year, the ratio of the investment budget used within the scope of R&D workings to the annual investment budget of the university (laboratory infrastructure, machinery and equipment purchase expenditures, etc. investment expenditures) • Participated R&D portfolio is not included in the calculation. • The ratio is expressed as a percentage.
Number of Instructors	YÖK	• It represents the number of research assistants, lecturers, assistant professors, associate professors, and professors employed at universities in the relevant year.
The number of YÖK 100/2000 Project Ph.D. Scholarship Holders	YÖK	• In the relevant year, the total amount of students studying at higher education institutions and receiving scholarships within the scope of the YÖK 100/2000 Doctorate Program

The number of publications per academician published in AHCI, SSCI SCI and SCI-Expanded indexed journals, one of the dependent variables used in the study, was found by dividing the number of publications in the journals scanned in the indexes in the relevant year by the total number of lecturers. Co-authored papers published by faculty members from the same higher education institute were considered as a single paper. Joint publications published by faculty members from different universities were evaluated separately for each university. Only articles and reviews are considered. YÖK automatically pulled data from the Web of Science index while calculating this data. When this data set is examined, it is seen that an increasing trend has been captured for both public and foundation universities since 2018 (Graph 1). Among 199 universities, the number of universities that could not increase the number of publications per academic staff is 29. The mean of this data for 2018 is 0.26, the mean for 2019 is 0.31, the mean for 2020 is 0.38, and the mean for 2021 is 0.41.

Graph 1: Number of Publications

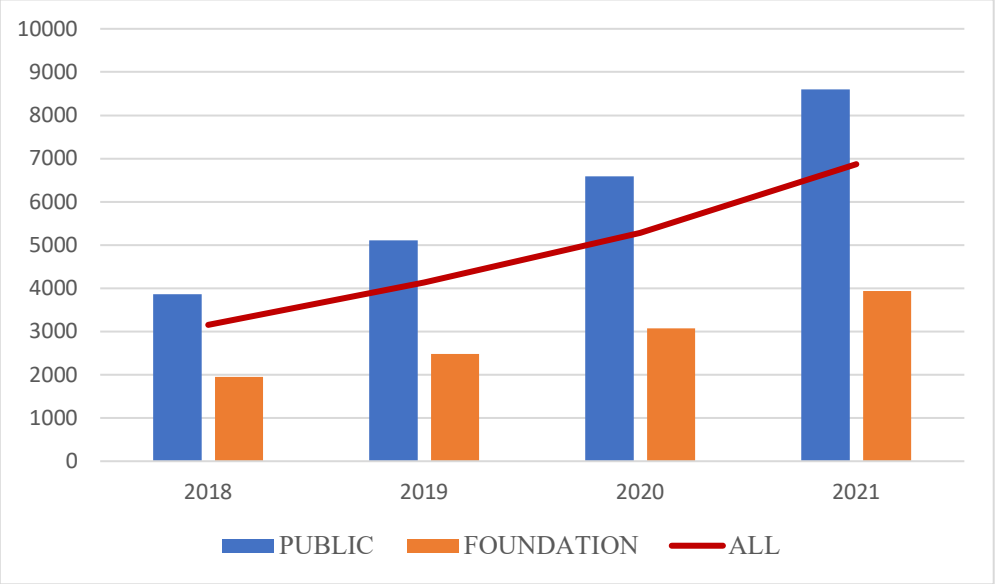


Notes: *1) YÖK University monitoring and evaluation reports (2023). https://www.yok.gov.tr/universiteler/izleme-ve-degerlendirme-raporlari*

Another parameter used as a dependent variable in the study is the Citation Number of Web of Science Publications. The data is taken from the WoS database. This variable represents the number of citations received by the studies published by universities in Turkey between 2018 and 2021. The total number of observations is 199. When the data is examined, the citations received by the universities in Turkey from the Web of Science indexed publications are 627519 in total. In contrast, the average

per university is calculated as 3153.36. In 2019, this number of citations totaled 822764. In the same year, the number of citations per university was calculated as 4134.49. The increasing trend continued in 2020 and 2021 as well. The total number of citations in these years was 1051346 and 1367035, respectively, and the average number of citations was again 5283.14 and 6869.52, respectively. When the data set is examined, it is seen that public universities receive more citations than foundation universities (Graph 2).

Graph 2: Number of Citations

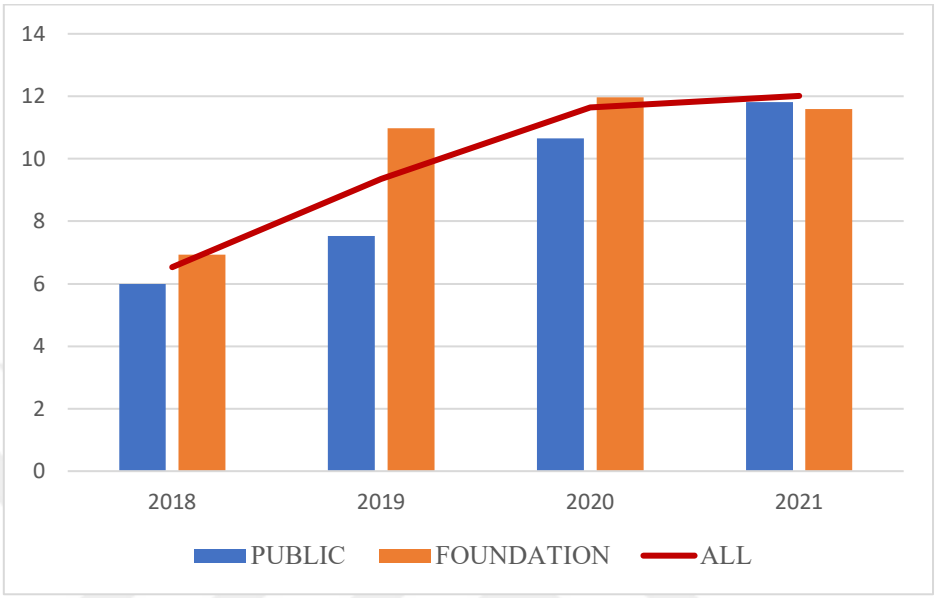


Notes: *1) Web of Science Core Collection (2023). https://www.webofknowledge.com*

The first data used as the study's independent variable is the investment budget ratio spent on R&D. This rate is obtained from all universities annually by YÖK and published in the University Monitoring and Evaluation Reports. This data is calculated by dividing the total budget used within the scope of R&D workings in universities by the actual annual investment budget of the university. The investment budget consists of developing the laboratory infrastructure and purchasing various machinery and equipment. When analyzed by years, it is seen that the ratio of investment budget allocated to R&D is in an increasing trend. This rate, calculated as 6.5% in 2018, was realized as 9.34% in 2019. It was calculated as 11.64% in 2020 and finally 12.01% in 21. When the investment budget rates spent on R&D are examined, it is understood that

foundation universities have higher rates than state universities until 2021. However, in 2021, state universities seem to have caught up with foundation universities (Graph 3).

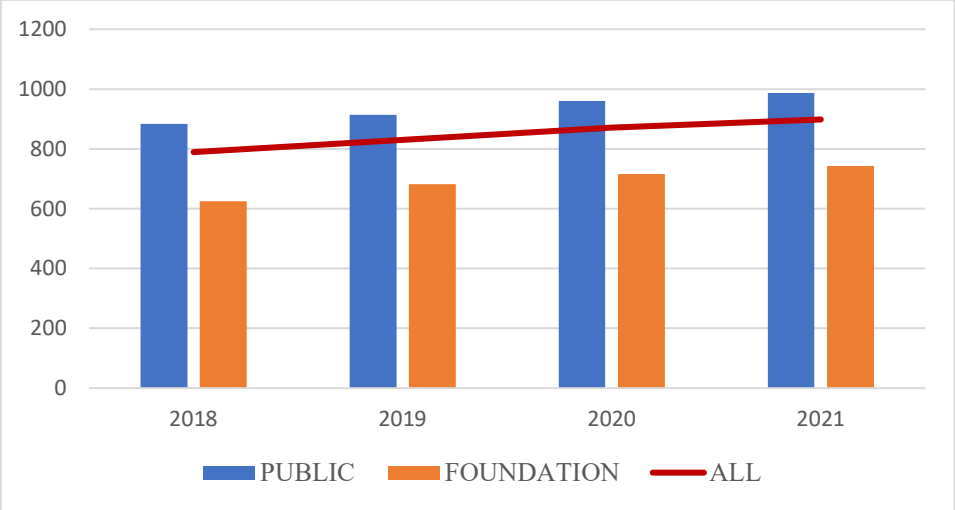
Graph 3: R&D Expenditures



Notes: *1) YÖK University monitoring and evaluation reports (2023). https://www.yok.gov.tr/universiteler/izleme-ve-degerlendirme-raporlari*

Another independent variable included as a control variable in the study is the number of instructors. These numbers are taken from the statistics portal of YÖK. The number of teaching staff in Turkey was 156732 in 2017-2018, 164653 in 2018-2019, 173027 in 2019-2020, and 178478 in 2020-2021. When the data is examined, it is understood that the number of instructors has increased from the academic year of 2017-2018 to the year 2020-2021. In all the academic years examined, approximately 70% of the total lecturers are in public universities (Graph 4).

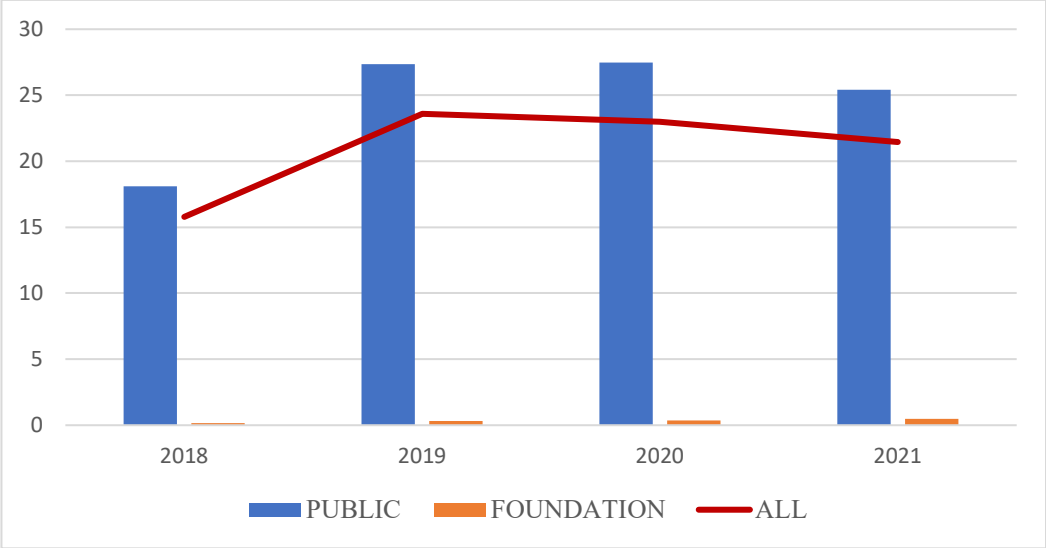
Graph 4: Number of Instructors



Notes: *1) Higher Education Information Management System (2023).* https://istatistik.yok.gov.tr

The last independent variable included in the study is the number of YÖK 100/2000 Project Ph.D. scholarship holders. This data consists of the total number of students studying at higher education institutions and receiving scholarships within the YÖK 100/2000 Doctorate Program scope. The data set was obtained from the University Monitoring and Evaluation Reports of YÖK. According to the data, there were 3128 scholarship holders in Turkey in 2018, 4677 in 2019, 4565 in 2020, and 4259 in 2021. The average number of. scholarship holders at state universities is 18.01 in 2018, 27.36 in 2019, 27.72 in 2020, and 25.41 in 2021. 99% of these students' study at public universities (Graph 5).

Graph 5: Scholarship Holders



Notes: *1) YÖK University monitoring and evaluation reports (2023). https://www.yok.gov.tr/universiteler/izleme-ve-degerlendirme-raporlari*

5. METHODOLOGY

In this study, we have utilized multiple regression analysis. In the realms of economics and business administration, it is not viable to explain a dependent variable using only a single independent variable. Economic models typically result from a multitude of contributing factors, where various variables can converge and mutually influence one another. Furthermore, these variables may interact among themselves. Therefore, when dealing with scenarios that require the use of multiple variables, performing a single regression analysis is not feasible. The practice of employing more than one independent variable in regression analysis is known as multiple regression analysis. The general form of the equation is as follows:

$$\boldsymbol{Y = B_0 + B_1X_1 + B_2X_2 + .. + B_nX_n + u}$$

The dependent variables of the multiple regression models established in the research are the number of publications and the number of citations. The independent variables of these models are R&D expenditures, the number of instructors, and the number of scholarship holders.

The fixed effect regression method was used in this study. In panel data analysis, the models in which the coefficients are believed to vary according to units or units and time are referred to as fixed effects models (Judge et al., 1991). The general formula for this model is based on the premise that differences among units can be explained by variations in the constant term. Therefore, in these models, only the constant term changes, not with respect to time but on a cross-sectional basis. In other words, while the time dimension is preserved by the constant variable, changes in behaviors among individuals become evident (Wooldridge, 2012). The fixed effect regression model is employed to control for unobserved variables that differ between events but remain constant over time (Collischon & Eberl, 2020). The fixed effects model can be shown as:

$$\boldsymbol{Y_{it} = (a_{it} + \mu_{it}) + \beta_{1it}X_{1it} + .. + \beta_{kit}X_{kit} + e_{it}}$$

The fixed effects model assigns a unique constant value to each cross-sectional unit. Within the fixed effects model, it is assumed that the slope coefficients, represented as β, remain constant, while the fixed coefficients change exclusively among cross-sectional data, solely within time data, or across both datasets. To elaborate, when variations exist between the sections within the panel dataset, and there is no time-based fluctuation, this regression model is referred to as a one-way fixed effects model dependent on the cross-section. If differentiation occurs solely over time, these models are termed as one-way time-dependent fixed effects models. In instances where differentiation arises in panel data across both time and cross-sectional dimensions, these models are denoted as two-way fixed effects models. However, it's important to note that panel data models are primarily one-way models, as they typically examine cross-sectional effects rather than temporal effects in panel data analysis (Allison, 2009).

In this model, it is assumed that the error terms are independently and identically distributed, ensuring that their variance is equal to zero. In addition, each $\boldsymbol{X_{it}}$ value is independent of $\boldsymbol{e_{it}}$. In the fixed-effects model, the fixed-effects estimator calculates distinct constants for each cross-section, resulting in varying constant coefficients across cross-sectional units (Hsiao, 2014).

6. ANALYSIS

In this study, the data of a total of 199 universities in Turkey between 2018-2021 were analyzed by multiple regression method. Firstly, the number of publications was used to represent the research performance. The results of the regression analysis performed in the STATA software are given in the table below (Table 2).

Table 2: First Multiple Regression Analysis Results

	Number of Publications (SCI)					
	Coeff.	**t-statistics**	**Prob.**	**Coeff.**	**t-statistics**	**Prob.**
R&D Expenditures (R&D)	0,0018	4,2100	0,000	0,0016	3,9700	0,000
Number of Instructors (instructors)				0,0003	9,1800	0,000
The number of Scholarship Holders (students)				0,0023	5,2300	0,000
cons	0,3407	56,7300	0,000	0,0502	1,8000	0,072
R_square	0,030			0,197		
Hausman (Prob.)	0,000			0,000		

As seen in Table 2, the multiple regression model was found as follows:

$$\boldsymbol{SCI = 0,0502 + 0,0016 R\&D + 0,0003 instructors + 0,0023 students}$$

The explanatory variables in the multiple regression model can explain the dependent variable with a margin of error of 0.05. The results are statistically significant. The constant of the model turned out to be 0.3407. In other words, even if no R&D expenditure is made, Turkey's average of WoS-indexed publications per academician is 0.3407. When the results are examined, it is seen that the number of publications per academic staff published in AHCI, SSCI SCI and SCI-Expanded indexed journals of universities increases by 0.0018 when the investment budget spent

on R&D is increased by 1%. In addition, as the number of lecturers increases, the number of publications with the WoS index increases only by 0.0003. The one-unit increase in the number of YÖK 100/2000 Project doctoral scholars increases the number of publications per academic staff member published in SCI, SCI-Expanded, SSCI, and AHCI-indexed journals by 0.0023. Therefore, it can be said that the independent variable that affects research performance the most is the number scholarship holders. In general, it can be concluded that the rate of investment budget spent on R&D, which is selected as the independent variable, the number of teaching staff, and the number of scholarship holders make a weak but positive contribution to the research performance. Since the p-value of all 3 explanatory variables was calculated as 0.000, it is statistically significant at the 95% confidence interval.

The H_0 hypothesis is rejected. In other words, all explanatory variables in the model can explain the dependent variable with a margin of error of 0.05. The probability value for the F statistic was found to be p = 0.0000. If this probability value is less than 0.05, the H_0 hypothesis that all coefficients in the model are equal to zero is rejected. Again, it can be said that all the explanatory variables in the model can explain the dependent variable.

$$\mathbf{0,05} > \boldsymbol{p} = \mathbf{0,000}$$

R^2 is calculated as 0,197. This means that 19,70% of the model is explained by explanatory variables.

The dependent variable of the second multiple regression model created is the number of citations with university addresses. This data representing research performance was taken from the WoS Core Collection for 199 universities. The explanatory variables in this model are the same as in the previous model.

Table 3: Second Multiple Regression Analysis Results

	Number of Citation (WOS)					
	Coeff.	**t-statistics**	**Prob.**	**Coeff.**	**t-statistics**	**Prob.**
R&D Expenditures (R&D)	45,8033	4,8100	0,000	41,7527	4,5800	0,000
Number of Instructors (instructors)				4,3131	6,1500	0,000
Scholarship Holders (students)				37,6899	3,7900	0,000
_cons	4539,4570	34,4300	0,000	-2,5894	0,0000	0,9970
R_square	0,038			0,124		
Hausman (Prob.)	0,000			0,000		

As seen in Table 3, the multiple regression model was found as follows:

$$\boldsymbol{WOS = -2,5894 + 41,7527R\&D + 4,3131instructors + 37,6899students}$$

According to the information obtained from the second multiple regression model, there is a positive relationship between the ratio of investment budget spent on R&D, the number of teaching staff and the number of scholarship holders, and the number of citations. The model is statistically significant. The fixed value of the model was calculated as 4539.45. In other words, even if the variables representing R&D expenditures are zero, the number of citations received by universities from WoS publications is approximately 4539. To express the situation separately for the explanatory variables, an increase of 1% in the budget allocated to R&D from the investment budget increases the number of citations by 45.80. In addition, one personality in the number of instructors now increases the dependent variable by approximately 4. Finally, when the number of Ph.D. scholarship holders increases by one, the number of citations increases by 37.68. In parallel with the results in the first model, the number of scholarship holders is much more effective than the number of lecturers in increasing research performance. Since the p-value of all 3 explanatory

variables was calculated as 0.000, it is statistically significant at the 95% confidence interval.

The H_0 hypothesis is rejected. In other words, all explanatory variables in the model can explain the dependent variable with a margin of error of 0.05. The probability value for the F statistic was found to be p = 0.0000. If this probability value is less than 0.05, the H_0 hypothesis that all coefficients in the model are equal to zero is rejected. Again, it can be said that all the explanatory variables in the model can explain the dependent variable.

$$\mathbf{0,05} > \boldsymbol{p} = \mathbf{0,000}$$

R^2 is calculated as 0,124. This means that 12,40% of the model is explained by explanatory variables.

7. CONCLUSIONS

Today, the level of technological production that countries reach determines the welfare level. While the countries that produce high-tech products are getting stronger economically, the countries that cannot achieve this cannot be the only consumers of this technology and increase their welfare levels. Technology is actually the application of science. Science, on the other hand, mainly progresses through research activities in universities. This situation forces countries that aim to have a say in the world to allocate significant budgets to research activities.

The increase in the welfare of all humanity depends on technological progress, and technological progress depends on the development of science. The development of science is possible with the practical realization of research activities. In this context, determining the extent to which the resources allocated for research have turned into output is one of the most important ways to understand whether the process is carried out efficiently. Universities' investment budgets constitute a significant part of a country's financial resources allocated for research. Investigation of the effect of the amount allocated for research and development from the investment budgets of universities on research outputs will give an idea of how effectively the process is carried out.

This master's thesis investigates the effects of financial resources allocated to research and development by universities on research performance. Investment Budget Ratio Spent on R&D is used as the independent variable to represent R&D expenditures. The dependent variables representing research performance the number of publications, and the number of citations. Multiple regression models were established to demonstrate that as R&D expenditures increase in Turkish universities, research performance also significantly increases.

This thesis aimed to elucidate the influence of universities' R&D expenditures on research performance. To achieve this, two distinct regression models were constructed using data from the annual University monitoring and evaluation criteria reports published by YÖK. The outcomes of both regression models indicate that an increase in universities' R&D expenditures correlates with enhanced research performance. Given these statistically significant findings, it is advisable to closely monitor universities' R&D expenditures and implement measures to ensure their effective utilization.

One of the most fundamental resources necessary for productive scientific investigation is adequate financial support. The strong association between these two factors is evident to both policymakers and scientists. Our recommendation is to consider this fact when making decisions regarding higher education at the national level.

In future studies correlation analysis can be used to measure the relationship between variables. Additionally, different variables can be used to represent research performance better and increase the level of statistical significance.

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