BAYH-DOLE IN TURKEY: HOW THE 2017 LEGISLATION CHANGE AFFECTED UNIVERSITY PATENTS IN TURKEY?

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Submitted by **İREM ÇORUM AKTAŞ** in partial fulfillment of the requirements for the degree of **Master of Science in Economics, the Graduate School of Social Sciences of Middle East Technical University** by,

Prof. Dr. Saadettin KİRAZCI
Dean
Graduate School of Social Sciences _____

Prof. Dr. Şirin SARAÇOĞLU
Head of Department
Department of Economics _____

Prof. Dr. Erkan ERDİL
Supervisor
Department of Economics _____

Lecturer Uğur Gürşad YALÇINER
Co-Supervisor
Graduate School of Social Sciences _____

Examining Committee Members:

Prof. Dr. M. Teoman PAMUKÇU (Head of the Examining Committee)
Middle East Technical University
Department of Science and Technology Policy Studies _____

Prof. Dr. Erkan ERDİL (Supervisor)
Middle East Technical University
Department of Economics _____

Dr. Başak OZAN ÖZPARLAK
Özyeğin University
Department of Law _____

I hereby declare that all information in this document has been obtained and presented 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 material and results that are not original to this work.

Name, Last Name: İrem Çorum Aktaş

Signature:

ABSTRACT

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ÇORUM AKTAŞ, İrem
M.S., The Department of Economics
Supervisor: Prof. Dr. Erkan ERDİL
Co-supervisor: Lecturer Uğur Gürşad YALÇINER

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In 2017, Turkey made significant revisions to its Industrial Property Law, specifically in relation to university patents. This change was inspired by the famous Bayh-Dole Act of the USA in 1980. The primary objective of these legislative changes was to streamline the patent application procedures for academics and entities within universities. This study tries to find an answer to the question of whether the change in the legislation affected university patents positively in Turkey. Additionally, employing advanced econometric techniques, the study investigates the plausibility of a trajectory resembling that of the United States for Turkish university patents in the coming years. The results show that the legislation change has positively affected Turkish university patenting. However, this positive impact appears to be more pronounced in developed regions of Turkey and specific sectors.

Keywords: University inventions, University patents, Bayh-Dole Act, Turkish Industrial Property Legislation

ÖZ

TÜRKİYE'DE BAYH-DOLE: 2017 MEVZUAT DEĞİŞİKLİĞİ ÜNİVERSİTE PATENTLERİNİ NASIL ETKİLEDİ?

ÇORUM AKTAŞ, İrem
Yüksek Lisans, İktisat Bölümü
Tez Yöneticisi: Prof. Dr. Erkan ERDİL
Ortak Tez Yöneticisi: Öğr. Gör. Uğur Gürşad YALÇINER

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2017 yılında Türkiye Sınai Mülkiyet Kanunu üniversite patentlerindeki değişikliklerle revize edilmiştir. Bu değişiklik, 1980 yılında ABD'nin ünlü Bayh-Dole Yasası'ndan esinlenmiştir. Mevzuat, üniversite akademisyenleri ve bileşenlerinin patent başvuru süreçlerini kolaylaştırmayı amaçlamaktadır. Bu çalışma, mevzuat değişikliğinin Türkiye'deki üniversite patentlerini olumlu yönde etkileyip etkilemediği sorusuna cevap bulmaktadır. Son olarak bu çalışma, ekonometrik yöntemler kullanılarak, Türk üniversite patentlerinin gelecekte ABD ile benzer bir yol izleyip izlemeyeceğini ortaya koymaktadır. Sonuçlar, mevzuat değişikliğinin Türk üniversite patentlerini olumlu yönde etkilediğini göstermektedir. Ancak bu olumlu etki, yalnızca Türkiye'nin gelişmiş bölgelerinde ve belirli sektörlerde daha doğru görünmektedir.

Anahtar Kelimeler: Üniversite buluşları, Üniversite patentleri, Bayh-Dole Yasası, Türk Sınai Mülkiyet Mevzuatı

To my new family, Hakan and Simba

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LIST OF ABBREVIATIONS

AUTM	Association of University Technology Managers
COVID-19	Coronavirus disease 2019
CPC	Cooperative Patent Classification
GDP	Gross Domestic Product
GNP	Gross National Product
IDE	Integrated development environment
IP	Intellectual property
IPC	International Patent Classification
IPR	Intellectual property right
OECD	Organization for Economic Co-operation and Development
R&D	Research and Development
TL	Turkish Lira
TRIPS	Trade-Related Aspects of Intellectual Property Rights
TTO	Technology Transfer Office
TURKPATENT	Turkish Patent and Trademark Office
TUBITAK	Scientific and Technological Research Council of Turkey
TÜİK	Turkish Statistical Institute
USD	US Dollar
WIPO	World Intellectual Property Organization
YÖK	Council of Higher Education

CHAPTER 1

INTRODUCTION

Most countries have been trying to reach prosperous economic growth and development. The science of economics has been engaged in finding a solution to this challenge, leading economists to develop several theories to achieve this goal. Among these theories, Robert M. Solow's seminal work proposed that sustainable long-term economic growth could be achieved with an exogenous infusion of technological progress (Solow, 1956). In contrast, endogenous growth theory has given importance to technological progress for economic growth and development. This perspective contends that technological enhancements possess intrinsic characteristics that propel economic progress (Lucas, 1988; Romer, 1986, 1990). Although economists have different perspectives on this subject, they all believe that technology and technological progress is at the forefront of long-run economic growth and development. Recognizing this, government authorities have developed or enacted certain rights and regulations to foster technological innovation, whether exogenous or endogenous.

Intellectual property rights serve as a means to foster and encourage innovative activities. Eisenberg (1996a, p. 161) defines intellectual property as follows:

> "'Intellectual property' is a broad heading used to refer to a wide variety of rights associated with inventions, discoveries, writings, artistic works, product designs, and designations of the source of goods and services."

In this context, patents could be considered an essential source to promote innovation and, thus, technological development. A patent is an intellectual property right to safeguard inventions against unauthorized production, utilization, or trade by external parties, granted exclusively to the applicant by official authorities for a designated period of time (Köker & Yalçıner, 2020, p. 29). Due to the protection afforded to inventors or patentees, the realm of economics has extensively explored the

ramifications of patents. Since patent protection is given to the inventor for a period of time, it creates a temporary monopoly and, therefore, engenders monopolistic competition for other competitors within the market. Patents can also be considered a source of knowledge since patent documents present information about the invention or innovation. In other words, patents create blueprints for novel products.

Universities play a vital role as knowledge hubs. Aside from their educational mission, universities produce knowledge through different channels, including publications, licenses, start-ups, and patents. University patents embody a distinctive category wherein the inventive endeavors originate from academic personnel, yet the formal patent application is made by the university. In other words, university patents do not just create a source of knowledge but also help economic growth and development through the dissemination of knowledge, i.e., technology transfer.

Universities exhibit characteristics akin to those of entrepreneurial enterprises. An entrepreneurial university engages in commercial activities related to its research and educational services, which leads to the transfer of university innovations to companies, spin-offs, or entities that further refine and develop these innovations (Meissner, 2018). This concept has gained importance over the years and has become a staple for most countries to promote innovation and technological progress. Government authorities adapted their laws and regulations to reach the goal of technological progress, and it can be stated that the Bayh-Dole Act of 1980 in the USA is a milestone for improving technology transfer activities and, thus, economic growth and development. The Bayh-Dole Act, officially known as Public Law 96-517, was enacted by the US government to revise patent and trademark legislation, and it was an integral component of different policies that complemented each other, which resulted in a structural change in the US innovation policy for government-sponsored research (Eisenberg, 1996b). The Act became successful in reaching its objectives, and the US has become a key player in innovation (Loise & Stevens, 2010).

Although the Act was initially designed to improve technology transfer activities of American universities, it set an example for different countries. In 1999, France adopted the Innovation Act to increase academic patenting endeavors (della Malva et al., 2013). Japan also enacted a similar law widely known as Japanese Bayh-Dole as a

part of the Industrial Revitalization Special Law in 1999 (Takenaka, 2005). Germany enacted a similar law in 2002 to increase academic patenting and dissemination of knowledge across public universities (Grimm, 2011). The famous act also influenced Finland, prompting the enactment of a similar law in 2007 (Ejermo & Toivanen, 2018). In addition to developed countries, developing nations also strive to tailor their intellectual property regulations (IPRs) to align with these principles. An illustrative example is the case of India, which devised a bill in 2008, mirroring certain aspects and insights drawn from the Bayh-Dole Act (Sampat, 2009).

The debates on improving technology transfer and university patenting were also a primary concern in Turkey, prompting the introduction of legislation in 2017. This legislation was a part of Industrial Property Law, focusing primarily on streamlining university patenting and licensing overseen by the Turkish Patent and Trademark Office (TURKPATENT). The purpose of the legislation was to establish transparent procedures and principles for cost determination, arbitration protocols in instances of disputes, and the management of inventions originating from higher education institutions. It has paved the way for the inventions or innovations produced by academic personnel to be patented by the university or the university's technology transfer office. The prime intention behind this enactment was to simplify the patent application process for academic personnel. Notably, since the enactment of this legislation, there has been a discernible upswing in the count of university patents filed in Turkey (Patent Effect, 2020).

However, the data has not provided a comprehensive perspective on how this legislation impacted university patenting. Notably, patents generated prior to 2017, originating from academic personnel are not categorized as university patents, irrespective of whether the applications were made by the university or not. Consequently, the landscape of academic patents predating 2017—regardless of the entity responsible for their application—remains partially concealed. Hence, this study has the mission to unravel the impact of this legislation on university patenting, taking into account academic personnel's patents that were filed prior to 2017.

1.1. Problem Identification

The increasing demand for becoming a knowledge-based economy has paved the way for universities to capitalize on the inventions of academic personnel. University patenting has not only become a source of income for universities but also created a flow of information through the patent documents produced by these very individuals. It is worth acknowledging, however, that the financial burden associated with patent office fees—whether on a domestic or international scale—could potentially pose challenges for inventors. The advent of the 2017 legislation in Turkey has enabled the patents invented by the personnel to be owned by the university, which intends to remove the burden of the fees and other bureaucratic barriers to patenting the invention.

The 2017 legislation has impacted university patenting in Turkey, yet the exact impact is unknown. This is because the totality of academic personnel's patents preceding 2017 has not been comprehensively documented. In a similar vein, there exists the possibility that patents generated by personnel subsequent to 2017 might not fall under university ownership, potentially rendering these patents absent from the dataset.

1.2. Subject of the Research

The research aims to ascertain whether the 2017 legislation in Turkey has increased the possibility of a university invention being officially patented by the university itself. This subject is of great importance since university patenting stands as one of the key sources for fostering economic growth and development.

1.3. Research Question

How has the 2017 legislation influenced Turkish university patenting, and to what extent might this influence contribute to enhancing Turkey's economic growth and development?

1.4. Contribution to the Literature and Novelty

In this study, the impact of the legislation on university patenting in Turkey is measured with a logistic regression analysis approach. Although the legislation has

been newly enacted, its impact has not been comprehensively explored within the existing literature.

The foundations of this study draw inspiration from the study of della Malva et al. (2013), who investigated a parallel legislative shift in France. However, it's important to note that the variables considered in this study have been tailored to align with the data collected from the YÖK Academic Database and TURKPATENT Patent Records.

1.5. Organization of the thesis

This study is made up of six chapters. The first chapter lays out the focal points and overarching objectives of the study. The second and third chapters delve into a thorough review of the relevant literature. Chapter 2 presents the relationship between intellectual property rights and economic growth and development. The chapter also gives information about knowledge, technology transfer, and universities' role in this regard. Additionally, it delves into the realm of entrepreneurial universities and their intersection with university patents. In Chapter 3, information about laws and legislation about university patents is given for both the USA and Turkey. These two countries are selected because the famous Bayh-Dole Act of the USA has influenced other countries to amend or change the legislation regarding technology transfer and university patents. Notably, Turkey's legislative shift shares parallels with this renowned Act. Chapter 4 serves as the methodological core. It describes the data collection and manipulation process, as well as the main method of analysis to evaluate the impact of Turkey's 2017 legislation on university patenting, which is the logistic and multinomial logistic regression analysis. Chapter 5 presents the regression analysis results, which indicate that the 2017 legislation has positively impacted university patenting. However, this impact predominantly resonates within more developed regions of Turkey and specific patent categories. Chapter 6 concludes with comprehensive policy evaluation and recommendations.

CHAPTER 2

PATENTS AND UNIVERSITIES

Technological development is one of the critical sources of economic growth and development. Policies for this specific purpose have been meticulously developed accordingly. Government authorities develop laws and regulations to protect or encourage technological development, and these laws and regulations are often considered the subject of intellectual property rights.

There are multiple aspects to intellectual property rights (IPRs), with patents being one of them. Patents are the documents that protect the novelty of inventions for a period of time, and it creates a monopolistic structure for the given invention. Therefore, patents initiate both technological improvements and economic benefits for the patent holder. On the other hand, patents are one of the critical sources for knowledge generation since the nature of patent documents requires a detailed explanation of the invention's benefits and how it was created. In other words, patents help establish economic growth and development regarding novel technology and codified knowledge.

This perspective also extends to the realm of university patents, which holds a unique significance. Universities are essential for economic growth and development due to their role in education and knowledge generation through scientific and technological publications. University patents take on a specialized dimension here since they not only produce blueprints of inventions but also wield the potential to function as a source of income for the given monopolistic power for a period of time.

This chapter discusses the historical background of IPRs, and patents and how the economics of IPRs and patents are studied in the literature. In addition, knowledge creation and universities' importance in this process is investigated, and the concept

of entrepreneurial universities and university patents are touched upon. Finally, a concluding section that brings together these diverse threads of inquiry is presented.

2.1. Historical Background of Intellectual Property Rights and Patents

Intellectual property can be considered physical property, yet it is treated much more differently than regular properties. The reason for this divergence can be attributed to the fact that intellectual property encompasses a considerably broader spectrum than conventional physical assets. Landes and Posner (2003) define intellectual property as any potentially valuable human product that has an identity separable from a unique physical embodiment.

Intellectual properties have different forms. This category encompasses inventions, innovations, brands, artworks, and various other products stemming from creative thought. Therefore, the corresponding intellectual property rights are several, including patents, trademarks, or copyrights.

In most countries, intellectual property is bound to be protected by legislation and regulations. Every country establishes a regulatory framework for this purpose, while certain global agreements and organizations exclusively center around the realm of intellectual property rights. World Intellectual Property Organization (WIPO) is one of the specialized agencies under the United Nations. According to the establishment treaty of WIPO, which was signed in 1967, literature, artistic and scientific works, the products of artists, radio and television broadcasts, scientific and all other inventions, industrial designs, brands of goods and services, titles of commerce, rights against unfair competition, and all other rights emanating from the domains of science, literature, and art are protected in the context of intellectual property rights (Alan, 2008).

In this context, Sherwood (2015) posits that the intellectual property system functions as a passive industrial policy that effectively promotes innovation without requiring affirmative government action or public funds. This passive approach provides

researchers and their private investors with a well-defined set of property rights offering compelling incentives to guide their strategic choices.

According to the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), signed in 1994, IPRs encompass the legal provisions safeguarding the creative products of human ingenuity. These rights are typically conferred to the person who generated the thought for a designated period of time. The agreement classifies these rights into two distinct categories: those pertaining to intellectual and artistic works, and those governing industrial property (Alan, 2008).

Although they may be seen as a legal subject, IPRs have specific impacts on economies. With the ever-increasing importance of information and technology, IPRs have been discussed in politics, academia, and business spheres. In particular, patents have become a core subject for discussion on economic performance (Alan, 2008). Many studies have highlighted the importance of IPRs and patents. For instance, Mokyr (2009) proposes that the Industrial Revolution began in the United Kingdom (UK) because of the fact that the UK already had a patent system enacted in 1624.

2.2. Economics of IPRs and Patents

IPRs and patents are some of the subjects that are studied within the science of economics. The reason for this is the common belief that technological improvements and innovation are at the core of robust economic growth and development. Since IPRs and patents protect innovation and invention, the policies shaping IPRs have been a subject of economics. The roots of the economic analysis of IPRs can be traced back to Adam Smith and John Stuart Mill. Both economists, however, discuss patent protection in terms of the monopolistic power of the inventor.

In the *Lectures of Jurisprudence*, Adam Smith (1978, p. 83) discusses the notion of invention and the establishment of special privileges for inventors. He posits that the majority of exclusive privileges are a product of the civil constitutions of a country and, unfortunately, most of these harm society. However, he also asserts that some of these privileges are harmless. For example, he cites the case of an innovator devising

a novel machine or creation, entitling them to an exclusive right for manufacturing and vending their innovation within a country for a span of 14 years, as a form of recognition for their ingenuity. Smith (1978) proposes that this may be the fairest reward possible, as monetary rewards could not accurately reflect the true value of the invention. He notes that if the invention is valuable and beneficial to society, the creator can earn a fortune from it. However, they will not receive any benefits if it is not beneficial.

Similarly, John Stuart Mill (2004, p.271) underscores the need to discern patents when discussing monopolies. He asserts that patents allow the creator of a new and improved process to have exclusive rights to use their invention for a limited time. This does not make the product expensive for the creator's advantage, but rather delays some of the cost savings the public could have enjoyed if immediate access to the innovation were granted. It is vital to acknowledge and reward the inventor for their efforts, as they typically invest a significant amount of time, energy, and money in materializing their ideas. Mill (2004) maintains that if everyone were allowed to use the invention without contributing to its development, only extraordinarily wealthy or public-spirited individuals would be willing to take on the inherent risks and expenses. Alternatively, the government could assign a monetary value to the inventor's contribution and provide them with a grant. However, in most cases, it is better to grant the inventor temporary exclusive rights, as this ensures a fair reward based on the usefulness of their invention. Moreover, this reward is paid by the consumers of the product, who are the primary beneficiaries. Mill further postulates that even if the government were to replace the patent system with a reward structure, it would be best to impose a small, temporary tax on those using the invention for the inventor's benefit.

In contemporary literature in this field, Landes and Posner (2003) discuss the economics of IPRs in different forms of intellectual property, including copyrights and patents. For them, a property right is a legal power to prevent others from utilizing a specific resource, and it presents two types of economic benefit - static and dynamic. The static benefits entail the immediate exclusion of others from using the property during the present period. Conversely, dynamic benefits encompass investing in the aforementioned property during the initial phase so that others cannot use the property

in subsequent periods. Landes and Posner (2003, pp. 16–19) also discuss the cost of property rights, categorizing them into three distinct categories:

1. Transaction costs: the transfer of such rights,
2. Rent-seeking costs: the motivation underlying the acquisition of property rights,
3. Protection costs: the costs of protecting the property in question.

On the other hand, the authors posit that beyond property rights, there are also high social costs of IPRs, and they create uncertainty about whether they are cost-justified or not.

In another study, Helpman (1993) explores the IPRs within the context of international infringements, and he observes a dearth of substantial evidence regarding the welfare ramifications of this domain. He investigates this in a dynamic equilibrium framework involving two countries, a developed one and another less developed. He frames a picture where the developed country invents, and the less developed country imitates. As a result, tight IPRs harm the less developed country because manufacturing is reallocated in the developed country, which creates higher-priced products.

Similarly, Pouris and Pouris (2011) delved into the infringement issue and its impact on national innovation systems, technology transfer, and research and development (R&D) activities. According to the authors, IPR systems have the potential to contribute to long-term economic growth and development. However, they also believe this principle might not hold true for developing countries. The authors point out that European, American, and Asian countries have relied on the infringement of foreign technology to boost their development, leading to a top economic position that developing countries cannot access.

In her thesis for TURKPATENT, Alan (2008) investigates the impacts of IPRs on the global economy. She states that a significant portion of empirical analyses concerning the economic impacts of IPRs yields uncertain outcomes, and some findings contradict the established economic theories. In her study, she finds that IPRs affect the economy indirectly rather than directly. She categorizes these indirect effects into two as

positive and negative. The positive effects are listed as follows (Alan, 2008, pp. 80–83):

- Increase in invention and innovations,
- Facilitation of global research,
- Cultivation of market depth,
- Facilitation of both national and international technology transfers.

On the other hand, she emphasizes the negative impacts of IPRs on the economy as follows:

- The costs of administrative configuration,
- Monopoly pricing,
- High imitation costs.

The impact of IPRs, in general, could be several, yet patent protection in economics is one of the main subjects that attracts scholars from diverse backgrounds. However, before discussing patents and their economic impacts, it is necessary to discuss the innovation process. This is because patents can be envisioned as outcomes arising from inventive endeavors. Throughout history, people have consistently improved technology through research and development activities, such that technology and innovation have dominated everyday lives. Consequently, scientists and scholars have investigated how technological progress affects different areas of our lives, and one of the aspects of it is the economy. In this context, Köker (2005) states that the innovation process has been a primary concern for many scholars. This is mainly because all economies are based on information within their historical context, and one of the characteristics of information is its universality, spanning across a multitude of industries irrespective of their technological orientation, whether classified as high or low-tech.

In his book, Lundvall (2010) describes how the innovation process cannot be thought of differently than other economic and social activities. He advocates that innovation should be investigated within a *systems framework*. This framework includes individual, organizational, and inter-organizational learning and forms the link between innovation and economic growth.

Lundvall (2010) claims this framework is based on the work of famous economists including Adam Smith, Friedrich List, Karl Marx, Alfred Marshall, Joseph Schumpeter, and Christopher Freeman. First, he asserts that Adam Smith embraced scientific improvements as the first step towards technology and innovation. Smith's concepts of learning-by-doing, learning-by-using, and learning-by-interacting underscore the fundamental tenets of this framework. Second, in addition to Smith, the author mentions Friedrich List as one of the pioneers of systems framework and economics of innovation. List asserts that government intervention has an essential role in catching up. Third, Karl Marx is mentioned since he developed valuable guidelines on how to study innovation systems. In *Das Kapital*, he offers valuable insights into how new technologies impact society and the economy. His analysis highlights the conflict between new productive forces and existing production relations. In addition, Marx underscores the importance of scientific pursuits and technological competition for reducing costs and gaining market share. Fourth, further enriching modern innovation research, the author draws inspiration from Alfred Marshall, who deeply delved into incremental innovation. Fifth, Lundvall (2010) expresses that Joseph Schumpeter has made essential contributions to the field because he believed innovation is the principal mechanism behind economic dynamics. Lastly, Christopher Freeman's contributions are acknowledged, particularly his conceptualization of innovation as a dynamic and non-linear process, effectively underscoring the interactive nature of the innovation journey.

Having discussed innovation, it is also essential to discuss the concept of invention and its economic implications. Schmookler (1957) defines invention as an activity focused on discovering novel and practical knowledge about products and processes, and he believes that it is one of the most critical aspects of the advancement of civilization. Given the paramount significance of invention in the modern world, economists try to construct theories on how invention impacts economy or vice versa.

In his inspirational work, Arrow (1962) investigates the concept of invention as a creation of knowledge. He stresses that the welfare economics framework puts technological features of the invention process and the market for knowledge as the key dependents for the optimal allocation of inventions. Arrow (1962, p.609) evaluates

this theory through the lens of Pareto optimality under two mathematical assumptions and lists three reasons that lead to possible failure: indivisibilities, inappropriability, and uncertainty. He advocates that the allocation problem can be solved by competition in an ideal economy; therefore, he adds some of the agents into the analysis from real-world practice. He concludes that governments or some other legislative bodies would need to optimally allocate innovative activities to finance research and invention.

In another study, Aghion and Tirole (1994) analyze the organization of research and development activities within an incomplete contract framework. The motivation underlying the use of this framework is multiple. One of the most important reasons to mention is to understand how property rights allocation on innovations impacts the frequency and magnitude of innovations. In their analysis, the authors claim that research and development activities could be performed by one representative agent as prescribed by patent and endogenous growth theories. However, in practice, these activities are performed either within firms or through contractual agreements.

Lastly, Nelson (1959) reviews the literature on the economics of invention. He stresses two aspects of the subject: (1) the profit motivation behind invention and (2) invention as an uncertain activity. In his study, he finds that a significant portion of industrial research is operated under flexible regulation, as observed through the review of management practices within the research laboratories of the US industry. Nelson (1959) also asserts that the interplay between technological change and capital formation is intimate, yet the distinction economists make between the two is deceptive in explaining long-term economic growth. In his study, Nelson provides insights into the research conducted by notable scholars such as Rossman, Gilfillan, and Conant, each contributing to the body of knowledge surrounding the production of inventions.

According to Nelson (1959), Rossman categorizes inventions into two as basic inventions and developments centered around existing products and processes. Rossman suggests that basic inventions often revolve around the dissemination of new knowledge and that the telephone, radio, dynamo, and incandescent lamp are basic

inventions in this regard. On the other hand, the developments in the existing machinery or tools are defined as marginal inventions. However, Rossman highlights that the difference between these two is unclear and blurry.

On the other hand, Gilfillan believes that inventions usually occur incrementally rather than significant changes. He contends that social need is the main impetus for innovation, driven by the anticipation of profit. Therefore, Nelson highlights that Gilfillan's theory underlines two essential elements: demand and learning through experience. According to this theory, these elements deduct that after an initial improvement and secondary increase in inventions, the pace of innovation slows down as demand dictates an equilibrium growth rate. However, Nelson (1959, p. 104) posits that this theory might encounter objections from various quarters for three distinct reasons:

1. Gilfillan's approach to the process of inventions is primarily mechanical and automatic, yet chance has a vital role in this process.
2. The timeline for the innovation process's unfolding is not straightforward in the theory.
3. He may be overrating the demand factor in the process, and Nelson believes that most of the innovations occurred due to a reduction in the costs of innovation.

Another notable work examined by Nelson is that of Conant, wherein Conant challenges the notion that the distinction between science and invention is not sharp. Instead, he asserts that there is a continuous spectrum of scientific activities. Moving from basic scientific research to engineering development, the spectrum becomes more clearly defined and uncertainty decreases.

In conclusion, Nelson describes other scholars' works in his study and points to the fact that invention is not a rationally planned process. He states that scientific breakthroughs have often led to primary inventions, although the desire for the invention was not necessarily the initial motive for the research. While some argue for a formal set of control practices that involves periodic evaluation of operating projects, others, including many scientists and research administrators, are concerned that such formalization may stifle potentially valuable projects. They believe that decisions

should be guided by the institutions of the research worker rather than being solely profit-oriented. However, due to the significant uncertainty involved, predicting or controlling the course of any project remains a challenge.

While the act of inventing is often not a structured process, the process of obtaining a patent is significantly more systematic. To safeguard the uniqueness of a product or process, there are various forms of IPRs, with patenting being one of them. The impetus behind the creation of an invention often revolves around the acquisition of patent rights, either implicitly or explicitly, as a form of intellectual property right. According to Köker and Yalçıner (2020, p. 29), a patent is a right given to the applicant by the official authorities for a specific duration to prevent the invention from being produced, used, or traded by others without permission. This right includes transferring the applicant's right to third parties to benefit from the invention for a certain period. In this context, discussing an invention in accordance with patent law necessitates the presence of certain prerequisites, including the identification of a technical problem, the introduction of a technical solution to address this problem, and the absence of this solution prior to the invention's emergence.

Köker and Yalçıner (2020) claim that the patent provides a temporary monopoly on the invention and protection against certain violations. In order to provide the protection that a patent submits, the invention must be clearly explained to the whole society, including the competitors. This statement by an official authority contributes to the legitimacy of the disclosure. Moreover, the conditions of protection must be evaluated and determined under the control of the official authority in line with the principles of the law. Therefore, it becomes imperative to submit a patent application to the designated governing body, following a formal request by either the inventor or the applicant.

The authors believe that patent protection serves several primary objectives: the acknowledgment of intellectual creation, the encouragement of producing inventions and R&D studies, rewarding inventors, and the sustainability of the dissemination of technical knowledge through patent documentation. Hence, the main targets of the

patent system are to encourage invention and innovation in a national economy and to contribute to the international competitive edge and comparative advantage.

The functions of patent protection are twofold: the monopoly function and the information function. The monopoly function is given to the inventor or the applicant to produce the invention. The applicant presents all the detailed information to the official authority to obtain this right. Thus, all the information related to the invention is publicly announced, contributing to the accumulation and dissemination of knowledge within the economy. It is important to note that undisclosed information cannot be protected by a patent (Köker & Yalçıner, 2020).

In his study, Köker (2005) notes that the rising importance of information has led to an increase in the investigation of the impacts of patents on economies. He states that patents confer a competitive advantage through the market power they provide, as well as by acting as an isolation mechanism within the market. The patent system gives protection in a legal context; it sustains the development of innovative activities, increasing efficiency. Therefore, it affects the desired region's economic performance, whether local or global. The patent system mandates that the inventor discloses all information in detail while demanding the patent right and that unexplained information is not included in the protection. Hence, the patent evolves into an information resource.

The author also discusses how intellectual property rights affect economy, and he finds a positive correlation between gross national product (GNP) per capita and patent application counts in the USA. When this correlation analysis is done for Turkey, he identifies a meaningful relationship between the two indicators previously investigated in the USA. However, the exact relationship does not manifest in Turkey when the results concerning gross domestic product (GDP) per capita and patent application are assessed. He suggests this is the case since Turkey has not reached sufficient R&D activities, although the Turkish Patent Institute was founded in 1994. Thus, the author concludes that Turkey has yet to produce significant economically impactful innovations. Nevertheless, Köker (2005) holds an optimistic perspective because although the patent counts are relatively low, there is an increasing trend.

In another study, Langinier and Moschini (2002) review the economic impacts of intellectual property rights and focus on the economics of patent systems. They claim that there are two crucial characteristics of the patent system (Langinier & Moschini, 2002, p. 2):

1. The system addresses novel knowledge arising from innovative products or processes.
2. It grants the inventor exclusive rights for a limited monopoly.

Therefore, the authors believe that patents can contribute to the dissemination of knowledge, curb wasteful innovation efforts, and foster technology transfer and commercialization. However, given that patents give a monopoly on inventors, a dynamic inefficiency is introduced to encourage innovation. This inefficiency subsequently creates static inefficiency due to monopolistic gains. Thus, the authors find that the incentive to innovate becomes lower in a monopolistic market compared to a competitive market, ceteris paribus. As a result, the authors suggest that official authorities must be informed about the costs and benefits of research activities in order for the patent system to be efficient.

There are various aspects to patent protection, one of which pertains to the duration of protection for the invention. In their study, Horowitz and Lai (1996) models the impact of patent length on the frequency of innovation and consumer welfare. They use the quality ladder model based on Grossman and Helpman's study published in 1992. In brief, they claim that an extended patent duration correlates with a decreased frequency of innovation. In addition, they compare two different optimization results, one for the rate of innovation and one for consumer welfare. They find that the optimal patent length for the frequency of innovation is higher than the optimal patent length that maximizes consumer welfare. They conclude that this creates a tension between the main objectives of patent law, which are to enhance consumer welfare by fostering economic growth and promoting innovation. In addition, the authors observe that although more extended patent protection increases the magnitude of innovation, it diminishes the pace of innovation. On the other hand, if the patent protection is too short or long, they determine that it erodes the incentives for innovation.

On the other hand, van Waarden (2001) investigates how patent law and regulations impact the economy and innovation activities from a legal perspective. He compares two countries -the USA and the Netherlands, which have fundamentally different legal systems on innovation. The author believes that the American system is much less effective and efficient in decreasing uncertainty, yet it is clear that innovativeness is not affected negatively by this. On the other hand, the Dutch system is based on a regulatory tradition, yet innovative activities are regulated less harshly with less detailed standards. In the end, the author deduces that the American system is less efficient in decreasing uncertainty, and therefore, institutions built to decrease the level of uncertainty could be a source of uncertainty. In fact, despite the anticipation that an economy operating within such a legal framework might exhibit diminished innovation, he contends that the contrary appears to hold true. He believes that this is understandable since the institutions built for innovation are representatives of a country's cultural values.

It is undeniable that patents affect the economy, and most economists have tried to use patent data as they become more available. Griliches (1990) delves into the increasing utilization of patent data within economics, particularly as an indicator of technological change. He asserts that the urge to understand and measure the process of economy better leads to an increase in the usage of patent data. This is because patent data represents an innovation or invention in which the patent is determined as novel and valuable by the patent office. Griliches (1990) also touches upon the measurement of research and development spillovers, proposing that exploring detailed patent information could be helpful in many other areas, such as technological clusters.

On the contrary, Takalo and Kanniainen (2000) conducted a study that questions the belief in industrial organization literature that patents accelerate technological progress. Their research shows that patents limit competition and allow innovators to delay the introduction of innovations to the market. This is because patents make innovators less worried about competitors, whereas, without patents, innovation is considered a public good.

A critique of the patenting system by Stiglitz (2008) highlights significant flaws, both static and dynamic. The author argues that knowledge no longer functions as a public good after patenting, leading to monopolistic power and intense competition, resulting in administrative costs that harm social benefits. Additionally, the benefits of patenting do not align with social returns, increasing the cost of knowledge and hindering market competition, ultimately harming social welfare. Intellectual property is difficult to define precisely, making it challenging to determine how innovations or inventions should be protected. Finally, patenting activity distorts research activities and deflects the pattern of innovations.

In order to attain the objective of ensuring adequate protection for innovative activities, it is essential to delve into the concept of knowledge. As Köker (2005) states, information forms the foundation of an economy; therefore, it is crucial to explore the process of knowledge creation, the significance of universities in this process, and the transfer of technology.

2.3. Knowledge, Universities, and Technology Transfer

Knowledge has become an essential aspect of the modern world. Drucker (1993) believes that utilization and meaning of knowledge stimulated the transformation of capitalism with the Industrial Revolution. This transformation has impacted the economic conditions such that knowledge has become one of the critical sources of competitive advantage, especially for advanced economies.

Knowledge as a commodity has become a central field of study. However, aligning it with conventional economic commodities, as Erdil et al. (2018) warns, might be deceptive. They assert that knowledge as a commodity adheres to the customary economic conditions and assumptions. For instance, while the use value of typical commodities declines through consumption, knowledge follows an opposing trajectory—its use value tends to increase as it is consumed. Viewing knowledge as an economic commodity means that it is exchangeable in the market. In this context, Erdil et al. assert that knowledge's exchangeability depends on its transformation, particularly the transition from tacit to codified knowledge. This finalized output generates a measurable activity with the potential for material value.

Beyond its macro-level implication, knowledge yields substantial benefits at the micro-level. In his inspirational article, Nonaka (1991) postulates that knowledge is one of the primary sources of long-lasting competitive advantage for companies. He asserts that successful firms are the ones that consistently create new knowledge, circulate it comprehensively throughout their organization, and quickly assimilate it into their products. Nonaka defines such enterprises as "knowledge-creating" entities whose sole business is continuous innovation. He, then, mentions that the Japanese approach to creating new knowledge does not depend on processing objective information. Rather, it depends on making connections in tacit knowledge, individual insights, intuitions, and hunches and making these insights available for examination to determine whether they are usable for the firm. According to Nonaka (1991), a knowledge-creating company revolves around ideals and ideas and sustains innovation.

It could be said that the rising importance of knowledge has gained momentum with the information revolution. According to Porter and Millar (1985, p. 3), information revolution impacts competition in three main ways:

1. It alters the industry's structure and, consequently, the competition rules.
2. It produces a competitive advantage by giving firms new means to predominate their competitors.
3. It generates new business through a firm's existing operations.

As briefly mentioned, knowledge could have different forms, tacit and codified. Tacit knowledge refers to unwritten, instinctive knowledge and know-how. On the other hand, codified knowledge includes text and written knowledge; one can think of it as blueprints, textbooks, etc. The transition from tacit to codified knowledge is called codification of knowledge. However, it is also true that all tacit knowledge cannot be codified fully. For instance, the domain of know-how is often in this category.

According to Roberts (2000), with the codification process, knowledge can be scaled down to information, which can be altered back into knowledge. Therefore, one can conclude that knowledge is not entirely tacit or codified in the end; whether it is codified or tacit, knowledge becomes a commodity that can be used and exchanged in various ways. Nelson and Winter (1982) posit that firms and markets cooperate for

this knowledge transfer in an economic environment through legal and commercial arrangements. Codified knowledge can be presented in blueprints, patents, etc., and as a result, it can be protected with institutional agreements, which can ease the commercialization process.

In this cycle of knowledge, Cowan and Foray (1997, p. 609) assign a pivotal function to technological change in the economics of codification in four different ways:

1. Development of new languages, which may endorse the codification process to be conducted efficiently.
2. Changes in our ability to model creation.
3. Changes in coding and decoding technologies.
4. Developments in storage technologies.

Although knowledge, and specifically codification of knowledge, may be beneficial in several ways, there may be risks involved in this process. According to Roberts (2000, p. 12), there are three main reasons for this. Firstly, knowledge has a dynamic nature, yet codification overlooks dynamism by neglecting social context. Different cultures may need a different process of codification, which could impede the transfer of knowledge. Secondly, the initial costs of codification and the distribution of this knowledge may lead to a tendency to withhold incentives, and consequently, codification may result in monopoly power. This can harm market competition, leading to a decrease in consumer surplus. Lastly, the codification process may shape the frameworks and comprehension paradigms of those who engage with knowledge. This influence might constrain individuals. For instance, technology limitations could restrain creative activities as reliance on computers escalates in the codification and knowledge creation processes. Other than the risks regarding the codification process, Roberts (2000) also touches upon another point. Although codification is meant to decrease uncertainty, the non-codified expression of that knowledge could propose threats and opportunities since it may offer ambiguity and uncertainty. Therefore, the author underscores the importance of carefully acknowledging the tacit dimension of codified knowledge.

Even though the codification of knowledge could have several negative impacts, it plays a vital role in transferring such knowledge. According to Roberts (2000),

transferring knowledge between economic agents is crucial because of the efficient use of knowledge. The creation and utilization of knowledge ensures the codification process, yet Polanyi (1966) asserts that knowledge may not be fully codified because it has a tacit characteristic. Although it cannot be wholly codified, knowledge is an economic activity since it involves learning and innovation activities. Roberts (2000, p. 2) defines three main concepts to understand knowledge transfer better: knowledge, information, and data. Data is a series of observations, measurements, or facts without meaning. On the other hand, information is the meaningful arrangement of the data; lastly, knowledge is the application and efficient use of information, which contains an understanding obtained through experiences. Thus, the author claims that there is an interactive relationship between knowledge and information.

Universities are often considered to be significant role players, especially in education. They have been one of the most essential sources to create and disseminate knowledge. This mission of universities impacts the economy since they both create a skilled labor force by educating students and generate new technologies through the creation and dissemination of knowledge, which could perpetuate and enhance economic growth and development.

Universities' role in knowledge could be considered from different perspectives. According to Delanty (2001), universities serves as both the creator and the converter of knowledge, encompassing scientific and cultural aspects. They are not limited to either of these categories, as they act as a medium that connects various discourses in society. This includes the interaction between academic discourse and cognitive structures that are culturally expressed.

The relationship between knowledge and information mirrors those between knowledge and technology. Technology and technological progress can occur through knowledge production and transfer. Therefore, knowledge producers, i.e., universities, research centers, etc., create a technology transfer process, ultimately leading to a vicious cycle of knowledge and technology.

In their two-part study, Van Norman and Eisenkot (2017a, 2017b) describe the technology transfer process among agents. They define technology transfer as a process in which innovations occur from basic research into commercial activities and eventually into public usage. This process could be achieved (1) through innovation publication to general publication without commercialization incentives, (2) through private industry-funded research agreements, and (3) through start-ups within the university.

Van Norman and Eisenkot (2017b) assert that this process traces its roots back to the renowned Bayh-Dole Act of 1980 in the USA. In essence, the provisions of the act served as the cornerstone for establishing the foundation of technology transfer processes within academic institutions. This is because the regulations made it possible for universities to claim their innovations and inventions, and eventually, the technology transfer offices became a milestone in this environment. Van Norman and Eisenkot (2017b) then illustrate how technology transfer offices (TTOs) work, and they assert that TTOs are assigned with the management and commercialization of essential intellectual property rights. They believe that TTOs are created to fund innovations, operate intellectual property protection, administer the commercialization process, and discuss or implement licensing. In the second part of their study, Van Norman and Eisenkot (2017a) delve into technology transfer processes and offices, primarily focusing on the commercialization process. They believe that universities are assigned a duty to make sure that their inventions, innovations, and new scientific functions translate into practical goods and services for the public. Therefore, to facilitate these endeavors, universities need to master technology transfer activities so that they can easily get funded and make collaborations with the industry. In other words, the authors believe that successful technology transfer enhances the university's competitive edge over other institutions. In this process, technology transfer offices play an important role; they manage intellectual property assets such as patents, licenses, and contract law, develop a perspective and understanding of business management, and connect with industry and investment environments. In addition, they need to operate within the academic institution by resolving conflicts.

2.4. Entrepreneurial Universities and University Patents

Technology transfer may seem to work in one direction only; knowledge is created, published through the process of codification, and presented to the public. However, the cycle may not need to end here. Van Norman and Eisenkot (2017b) claim that universities have evolved into pivotal drivers of economic and social advancement in the era of globalization, consequently assuming an entrepreneurial role. Meissner (2018) defines the entrepreneurial university concept as an institution that engages with commercial activities in research and education, effectively facilitating the dissemination of university innovations and substantially advancing the innovations through collaborations with firms and spin-offs originating from the universities. In addition, Merhacı (2015) posits that the Bayh-Dole Act, enacted in 1980, made technology transfer processes in the USA possible. Therefore, one can conclude that technology transfer and entrepreneurial universities have a strong relationship. This relationship eventually created a collaboration between universities, industry, and government. Public-funded research centers have become a milestone in this practice as technology progressed and consequently encouraged university-industry collaboration (Yalçıntaş et al., 2015).

Erdil et al. (2018) describe how universities have gained entrepreneurial characteristics over the last decades. They believe this occurred since universities have enlarged their education and teaching missions towards knowledge creation and technology transfer. As universities have been involved in more of these activities, literature on this concept has expanded. The authors mention that the lineage of this notion can be traced back to Richard Cantillon, a 17th century Irish French economist, who attempted to emphasize the entrepreneur's role in economic theory. The relationship between innovation and entrepreneurship was also put forward by Joseph Schumpeter, who posited that entrepreneurs have a distinctive capacity for innovation.

The authors then discuss the definition and scope of an entrepreneurial university. However, as the term "entrepreneurial university" has gained popularity, the authors believe there may be some misconceptions. They suggest that for a university to adopt entrepreneurial characteristics, there should be visible and measurable manifestations

of the contributions of the university to entrepreneurship and innovation. Erdil et al. (2018) believe that the university becomes more entrepreneurial as an evolutionary process occurs in the innovation environment. Therefore, as a part of this environment, universities cannot be isolated from this process. The authors suggest that this evolutionary process increases the complexity of the production systems, which requires the commercialization and integration of knowledge that should be safeguarded within academic institutions. Hence, for universities to be more entrepreneurial, there should be changes in their structures, strategies, practices, and mindset. The authors highlight that mindset changes are the most important. However, there are also some criticisms of this. For instance, Anra and Yamin (2017) suggest that the university's primary mission is to enhance social welfare via creating and disseminating knowledge.

Meissner (2018) describes the entrepreneurial university concept and how it should be reconsidered. He argues the concept was used extensively when Etzkowitz and Leydesdorf coined it in the early 2000s. The author mentions that according to Etzkowitz and Leydesdorf, universities should also fulfill the innovation mission, other than education and research, so that they gain an entrepreneurial aspect, leading to technology transfer. Meissner (2018) believes this notion could be misleading since it highlights only the entrepreneurial aspect but overlooks the research and education mission of universities. Therefore, the author suggests that the concept should be revised due to the following reasons (Meissner, 2018, p. 41):

1. The main focus on knowledge and technology transfer hardly displays the universities' research and educational programs contents.
2. The intricate connections facilitating knowledge transfer within the university through education and research remain unacknowledged.
3. The main focus on technology transfer and commercialization fails to encompass the entire spectrum of available avenues for knowledge and technology exchange.
4. The aforementioned emphasis overlooks the holistic life cycle of technologies and leads intermediate or immature technologies to be considered for transfer purposes.

5. The concept could result in universities taking action for short-term gains since the concept could be interpreted solely in terms of commercialization activities.

Due to the reasons above, Meissner (2018) defines entrepreneurial universities as institutions that are continuously changing their activities, adapting to the demands and expectations of the stakeholders and coordinating the activities for the development of social welfare. Thus, these universities advance academic freedom, scientific values, and awareness of including value thinking in education and research. In addition, they develop, preserve, and broaden the linkages with other institutions, including government and industry.

Meissner and Erdil (2018) highlight that the objective of an entrepreneurial university is not a one-time achievement but an ongoing pursuit. Universities need to adapt to the innovative environment, which is constantly changing. The authors believe that this needs to be in a way that universities reconsider new challenges and opportunities. Therefore, universities need to readjust their activities and missions to impact innovation ecosystems in several aspects in a sustainable manner. They summarize their study with the conclusion that these universities as we know them today will alter their mindset and practices towards an activity portfolio approach. In addition, they believe that the entrepreneurial university could be enhanced not through performance indicators or administration but through risk-taking in research and an innovation-friendly internal environment and organization.

Fini et al. (2010) analyze academic entrepreneurship in their collaborative study, investigating the assumption that academic members of universities initiate businesses based on their patented inventions. They found that many entrepreneurial activities occur outside the university intellectual property system, and two-thirds of the academic members involved in these activities do not base their businesses on disclosed and patented innovations. The authors suggest that this is the case since the formal intellectual property system of the university for entrepreneurial activities may not include all of the academic disciplines, which might prevent universities from engaging in more entrepreneurial activities. Although there are several forms of commercialization of academic research, patenting, licensing, and new business creation, the entrepreneurship activities that are documented in the official statistics

are the ones that take place inside the university's formal intellectual property system. Therefore, we can conclude that those outside the intellectual property system are not included in these statistics, and it can be interpreted that the system is insufficient to generate such activities.

The last issue that will be considered in this section, and the main subject of this study is university patents. These patents constitute a subset of the patent system, encompassing patents filed by universities. The overarching rationale behind the existence of university patents centers around knowledge creation.

Hellmann (2005) proposes that there are compelling justifications to engage in patenting activities beyond the anticipated outcome, eventually leading to scientific discoveries. In addition, he believes that patents may not be a distraction from conducting research activities for scientists; in fact, he believes that patenting may complement research. In addition, Kitch (1977) asserts that patents not only enhance the dissemination of scientific knowledge but also extend beyond the welfare impacts inherent to the patent system.

On the other hand, Agrawal and Henderson (2002) try to understand how university patents contribute to knowledge spillovers. They interviewed professors from the Massachusetts Institute of Technology and the Departments of Mechanical and Electrical Engineering. They found that patenting is insignificant, and publication rates are emphasized more. However, surprisingly, the authors found that patent volume is positively correlated with academic paper citations, meaning that patent counts could be the meaningful measurements of determining research impact. In other words, university patenting may not be a robust indicator in determining academic publishing. However, some evidence suggests that academicians who patent more produce papers with more citations.

Therefore, one can conclude that patents have economic and social characteristics, both ex-post and ex-ante. Even though patents are motivated mainly by long- and short-term profits, university patents came into the scene in developing scientific information. In addition, although university patents are not the first choice of

academics, they aim to measure the scholarly impact of the scholars and, therefore, the standing of the university.

In another study, Henderson et al. (1995) reported that university patents constitute a small proportion of all patents; therefore, it would be unwise to anticipate a comprehensive understanding of universities' research endeavors solely through their patenting behaviors. However, the authors also noted that these patents are informative since they indicate that the research activities undertaken by the university are envisioned to have practical commercial applications. Hence, changes in patenting behavior may indicate changes in motives within university research activities. In addition, the authors believed that these patents are interesting since they bear the method of technology transfer.

Henderson et al. (1995) examined the university patenting behavior in the USA between 1965-1988. They found that university patents increased almost 15-fold, and real university spending tripled. When they investigated the behavior of these patents, they found that university patents were getting high citations and were cited by diverse patents in terms of technology around the mid-1980s. They believe this result is consistent with the fact that university inventions bear more importance and involve mostly basic science compared to an average invention. However, the authors believe that the difference between university inventions and average inventions disappeared in the middle of the 1980s for two distinct reasons (Henderson et al., 1995, p. 1):

1. Citation rates of all universities were in decline.
2. Smaller institutions had a rising share of patents and high citations in this period.

The authors also reported that the increase in the patents that have high importance[1] originating from universities exhibited a growth rate lower than that of the overall increase in university patenting during the specified timeframe.

University patents are similar to standard patents, except that the university is the inventor or the owner. According to Geuna and Nesta (2006), the difference between

[1] Here, what the authors mean by “high importance” is a measure of the citation rates of the given patents.

university-owned and university-invented patents is important. They define university-invented patents as patenting with at least one inventor at the designated university. The authors assert that university patenting has increased dramatically in Europe, whether owned or invented by the university. They believe that this is because university licensing is not the most profitable activity for universities, and this might be because patents and publications that are established by the academicians usually go hand in hand. Although university patenting is mostly beneficial for improvements in technology and, consequently, technology transfer, the authors mention that there might be criticisms about the primary mission of these institutions. Their analysis revealed that most university patents in Europe have little economic value and seldom become successful; in other words, these patents, according to the authors, are far from being a "golden egg."

Geuna and Nesta (2006) interviewed several researchers about the notion that university patents develop with publicly funded research, or academicians within the university develop an invention using the university's resources. One of the researchers replied that the motivation to make a researcher apply for patents does not make any sense, and they are trained to do research, not for patenting. Ultimately, the authors warn that as university patenting increases, universities could face scarcer resources in the future. In a constantly changing environment, the mechanisms for research activities may strengthen and exacerbate the existing differences among universities regarding financial resources, leading to significant disparities in research output.

Even though there might be opposition to university patents, they could indicate universities' entrepreneurship level. Henderson et al.'s (1995) study investigates this phenomenon by exploring the changes in university patenting behavior between 1965 and 1988. They notice that these patents rose fifteen-fold during the specified period, and real university spending almost tripled. In addition, the authors realized that until the 1980s, these patents were the most highly cited. Upon closer examination, they discovered that these patents received citations from a wider range of technologically distinct patents when contrasted with a randomly selected sample of all patents. In line with this, Henderson et al. (1995) mentioned that this is coherent given that university

inventions are more critical and more related to basic research. However, they found that these differences began to diminish around the middle 1980s between university patents and the sample of all patents. According to the authors, this decline in patent citation rates among universities may be attributed to an overall decrease in citation rates and smaller institutions receiving a more significant share of patents, which tend to be less highly cited. In the study, the authors conclude that although one can make inferences about a university's research and entrepreneurial activities by looking at the patents, it is essential to note that one cannot hope to learn all about research and entrepreneurial activities done by the university. Nevertheless, the authors believe these patents are unique indicators of technology transfer.

It is important to note that university patenting is essential to technology transfer. However, this was not the case until recently. Mowery and Sampat (2001) assert that although university patents date back to the early 20th century in the USA, universities have historically refrained from direct involvement in such pursuits, thereby impeding patenting activities. In the 1970s, this perspective started to shift toward a positive look at university patenting, and most universities began to engage in patent portfolios. According to the authors, the shift in this perspective stimulated changes in law and regulations, famously known as the Bayh-Dole Act. The Act's primary purpose was to bring to the national level the same rationale that public universities had employed in the 1920s and 1930s to justify their engagement in patenting and licensing. These arguments were particularly relevant in the late 1970s when the US faced a significant economic challenge in terms of global competitiveness, which became a central topic of political discussion.

It is also important to note that the main reason for university patenting to be acclaimed is economic development through technology transfer. Mansfield (1991) worked on academic research and innovations and found a trend in the 1960s and 1970s, where academic research developed a high social rate of return to investment. Therefore, universities as institutions engaging in technology-driven patent activities bear an essential role in regional and national economic development. The role of institutions in the technological development of economies is emphasized in Richard R. Nelson's works on innovation systems (Mowery & Sampat, 2001). According to Nelson and

Rosenberg (1993), understanding technical advancements in today's world is crucial for comprehending national innovation systems. Technology is closely linked with scientific fields that provide essential insights and methodologies to enhance progress in the modern world. However, innovation efforts often require significant experimentation and learning from mistakes. Therefore, the design and presence of institutions encouraging innovative activities, such as companies, universities, and government agencies and policies, is vital for understanding national innovation systems and, thus, economic growth and development.

2.5. Concluding Remarks

This chapter delves into the importance of IPRs within economic theory, with a particular emphasis on patents. Additionally, it explores the relevant subsections regarding knowledge, universities, and university patenting.

Intellectual properties have been considered valuable thought products. These products are protected by specific laws and regulations, both internationally and domestically. The WIPO is a United Nations-affiliated international organization dedicated to the protection and advancement of the realms of intellectual property. The importance of IPRs historically was pointed out by Mokyr (2009), who suggested that the Industrial Revolution was established in the UK since the country already enacted a patent system.

The literature on the economics of IPRs and, consequently, patents presents many different points of view when economic benefits are considered. Early influential economists like Adam Smith and John Stuart Mill usually discuss this notion within micro levels and touch upon the implications of IPRs and legislation. Similar perspectives could be found in the studies of Lundvall (2010) and Nelson (1959), yet Arrow (1962), Schmookler (1957), and Aghion and Tirole (1994) mainly develop mathematical modeling to create optimization solutions. From a macro-level perspective, Alan's (2008) findings suggest that IPRs indirectly impact economy both positively and negatively. These indirect impacts could either encourage or discourage economic growth and development. Similarly, Helpman (1993) believes that IPRs

might negatively impact developing countries when they are too tight. Lastly, Landes and Posner (2003) study the impact of IPRs in an economic framework, in which IPRs have both static and dynamic effects. In conclusion, I am of the opinion that establishing rights and safeguards for innovative activities has the potential to enhance economic circumstances. However, it's important to note, as highlighted by van Waarden (2001), that institutions reflect a nation's character. If a country's culture fosters innovative endeavors, its legal framework would naturally align with that inclination, potentially paving the way for robust economic progress and advancement. Studies by Stiglitz (2008) and Takalo and Kannianinen (2000) also criticize patenting systems.

This chapter has also reviewed scholarly work on knowledge and technology transfer, entrepreneurial universities, and university patenting. The economic power of knowledge has been highlighted by Drucker (1993), and Erdil et al. (2018) discussed the implications of knowledge as a commodity. Nonaka (1991) and Porter and Miller (1985) investigated knowledge to improve micro-level efficiency. On the other hand, the creation process of knowledge, knowledge's tacit and codified dimensions, and codification processes are also touched upon by reviewing Roberts (2000), Nelson and Winter (1982), and Cowan and Foray (1997). In this regard, the role of universities has been examined, and aside from educational purposes, universities are both creators and converters of knowledge (Delanty, 2001). Technology transfer activities of universities created a different route for the dissemination of knowledge and made it possible to gain entrepreneurial characteristics. The literature on entrepreneurial universities underscores that the objective of such institutions is not a one-time attainment; rather, it demands continual adaptations to align with the evolving innovative landscape. The result of this adaptation could be considered as university patenting. Although there are some studies suggesting that university patenting is not the primary goal of academic personnel (Agrawal & Henderson, 2002; Geuna & Nesta, 2006; Henderson et al., 1995; Mansfield, 1991; Mowery & Sampat, 2001), these patents boost the dissemination of knowledge and could complement research activities (Hellmann, 2005; Kitch, 1977).

In conclusion, the literature on IPRs and patents suggests that their impact on the economy can be significant. However, it is also true that this influence can be either advantageous or detrimental. It should be noted that most of the studies have primarily approached the implications of IPRs, particularly patents, from the perspective of economic growth rather than economic development. Examining these issues within the context of developing countries and institutional perspectives is essential to gain a more comprehensive understanding of the topic.

The importance of patents is widely discussed as they serve as a critical measure of technological advancement. In particular, university patents have become increasingly significant. Several studies have demonstrated that, albeit indirectly, university patenting can positively impact economic conditions. Enhancing institutions and IPRs is vital for achieving sustainable economic growth and development. Patents represent one crucial aspect in this regard.

In the following chapter, we delve into the policies pertaining to this objective, focusing particularly on their implementations in both the USA and Turkey. The well-known Bayh-Dole Act has significantly impacted technology transfer and university patenting laws worldwide, including the 2017 legislation in Turkey that reflects these influences. Through the laws and legislations discussed in the next chapter, we will gain an insight into how these countries aimed to achieve long-term economic growth and development by designing these policies.

CHAPTER 3

LAW AND LEGISLATIONS

As mentioned in the second chapter, the law and regulations for intellectual properties influence the economy indirectly. The IPRs could have the ability to impact a nation's economic development through several channels, including patents, licenses, brands, and geographical indications. Each of these channels has distinct characteristics that make them suitable for their specific categorizations, and they can enhance a country's economic activity. They could provide insights into how the economy is built with creative and innovative processes, and their protection via necessary laws and regulations indicates the robustness of the legal system for IPRs.

In the same chapter, how university patenting gained importance was explored, and it is critical to note that it can have crucial impacts in this sense. The reforms and amendments in the judiciary system have paved the way for university patenting to gain influence and importance. One of the pioneers of these reforms is the USA's famous Bayh-Dole Act, and several other countries have developed their own Bayh-Dole Act, in a sense, including Turkey. In this chapter, the law and regulations for university patenting are discussed. While the first section examines the USA's famous Bayh-Dole Act, the second section discusses how the emulation of the Bayh-Dole in Turkey developed. The third section presents concluding remarks for the chapter.

3.1. The USA and the Bayh-Dole Act

University patenting has generally been in trend primarily because it serves as an indicator of diverse university actions and the facilitation of technology transfers. It is important to bear in mind that these activities are conducted within the framework of distinct laws and regulations. In the subsequent section, we delve into the laws and

regulations governing this process in the USA. Following that, we explore several studies that shed light on the impacts of these laws.

Public Law 96-517, widely known as The Bayh-Dole Act, was enacted in 1980 by the 96th Congress of the USA to revise the patent and trademark laws. The act had several aims (Public Law 96-517, 1979):

1. To promote the usage of inventions derived from federally supported research,
2. To encourage small business firms' participation to a maximum in these research activities,
3. To stimulate cooperation between commercialization activities and nonprofit organizations, which includes universities,
4. To ensure the inventions from nonprofit organizations and small business firms are applied for the promotion of free competition and enterprise,
5. To boost the commercialization and public availability of inventions that are made in the USA by the American industry and labor,
6. To establish that the government gains sufficient rights in these federally supported inventions to meet the demands of the government and preserve the public against non-usage or impractical use of inventions,
7. And to lessen the costs of administration policies in this area.

The Act (1979) also clearly defines how federal agencies are authorized. Each one of them is entitled to (1) charge, declare, or gather patents or other forms of intellectual property (IP) protection domestically and globally where the agency owns a right, title, or interest, (2) assign different levels of licenses under federally owned patent applications or other IP protection forms gathered, (3) commence all appropriate and essential steps to assure and maintain rights to federally owned inventions either directly or through contract, and (4) carry custody and administration, entirely or partly, to another federal agency of the right, title, or interest.

According to Eisenberg (1996b), the act was a part of different policies that complemented each other, which created a structural change in the United States' (US) innovation policy for government-sponsored research. The first act, the Stevenson-Wydler Technology Innovation Act, caused technology transfer to become an essential

responsibility of federal laboratories and their employees. On the other hand, the complementary act, Bayh-Dole Act, allowed small businesses and nonprofit organizations to patent government-sponsored research results.

After it was enacted, it had more significant implications in the USA, especially in universities. According to the Association of University Technology Managers, or AUTM (n.d.), much of the university research is federally funded, and the act buoyed universities to collaborate with industry for commercialized products that benefited the public. Therefore, it created technology transfer processes to enhance its impacts. The act marked a fundamental change in the US innovation policy, granting ownership and title of inventions stemming from federal funds to nonprofit organizations and small businesses. Following the Act, the US universities gave rise to more than four thousand firms, and it is estimated that if the act was not enacted, thirty percent of the value of university research inventions might not have been commercialized (AUTM, n.d., p. 2). Therefore, it can be deduced that the Bayh-Dole Act has significantly facilitated the attainment of technology transfer.

Another study by Loise and Stevens (2010) revealed that the Bayh-Dole Act impacted the US economy. The data in the study demonstrates that the US economy has shifted from manufacturing to innovation with the act. The authors claim that the act enabled the foundation of university technology transfer offices. However, the Economist (2005) raises concerns about potential consequences of this act, including shifts in the academic ethos, a transition from basic to applied research focus, cultivation of secrecy within universities, and the failure in public good protection. However, according to the authors, these claims and criticisms have not created significant impacts since they assert that many studies on technology transfer show that encouraging academic entrepreneurship has several benefits. They conclude that this act is an initiative for competitiveness and economic development, and it partly played a role in positioning the USA as an innovation leader.

Even though the act has been considered one of the most effective actions in the US innovation history, some studies question this idea. Two studies by Mowery and Sampat (2001, 2005) investigate whether the act created a structural break in university

patenting. In the first study, Mowery and Sampat (2001) investigates the evolution of the US university patenting in the "before Bayh-Dole" era, specifically between 1925-1980. The authors agree that institutions play a vital role in driving the technological advancement of the economy.

The importance of institutions, specifically universities, for technological development is presented in the study by Rosenberg and Nelson (1994). The authors claim that the universities in the US established tight relations with industry in research and educational activities throughout the 20th century. On the other hand, Mowery and Sampat (2001) challenge the assertion that university-industry technology transfer only gained economic significance within the past two decades. They find that between 1925-1980, the data demonstrate a dramatic increase in private university patenting during the 1970s. In addition, university patenting in the US goes back to the early 20th century; however, the authors claim that most universities discouraged direct involvement in such activities. In the 1970s, this perspective of the universities shifted, and especially private institutions began to be involved in patent portfolio management. Hence, the authors assert that the Bayh-Dole Act resulted from these shifting trends, although the act mainly concerns public universities and nonprofit organizations for patenting and licensing.

In the second study by Mowery and Sampat (2005), the authors investigate the impact of the act on domestic university-industry collaboration and technology transfer. They find that the act in university patenting trends caused no significant structural break. Although numerous studies (Henderson et al., 1995) studied the effect of the Act on university patenting and licensing since 1980, the authors claim that the act should be considered the latest phase of US university patenting. This phase is commonly characterized by an elevated level of universities' engagement in patenting and managing licensing activities. However, it is also neglected that many universities in the US were directly involved in such activities before the 1970s. The authors demonstrate that studies indicating the positive impacts of the act on university patenting activities are typically backed by counts of patents and licenses held by the universities. Thus, the authors claim that the act was not necessary nor sufficient for the increase in university patenting and licensing after 1980.

In addition, Mowery and Sampat (2005) point to the possible negative impacts of the act. Some suggest that the commercialization concerns resulting from the act could shift the focus of university research from basic to applied research studies (Mowery & Sampat, 2001). The authors believe that the consequences of these shifts on academic research since the act's implementation have not been substantial. Another possible negative impact is that the increase in licensing and patenting could deter the "open science" commitments of scholars (Dasgupta & David, 1994, p. 518).

In conclusion, the USA's university patenting law, Bayh-Dole Act, was enacted in 1980, and it conferred several responsibilities to the universities involved in patenting and licensing activities. The act seemed to affect the US universities and innovation capacity positively. However, some scholars claim the act was not essential to grow and develop such activities. In addition, the act could negatively impact universities, as mentioned by Mowery and Sampat's studies (2001, 2005).

3.2. Turkey and University Patent Regulations

The Bayh-Dole Act has not only influenced the technology and innovation policy in the US but also led several countries to think differently about technology policies. The governments, especially in the OECD (Organization for Economic Co-operation and Development) countries, have emulated the act in their policy systems. Although there are some believers in this notion, Mowery and Sampat (2005) have different opinions about this. In their study, they mention that the emulation of the act in some OECD countries could have minimal impacts on the countries since their higher education and technology transfer system structures are different. In addition, the authors highlight the fact that the emulation of the act is a difficult task because of historical differences, path dependence, and institutional embeddedness. Nevertheless, this emulation became popular in technology and innovation policies, especially in collaborative R&D policies. On the other hand, the authors claim that although university patenting and licensing are essential, it has secondary purposes, and the emulation of the act could result in insufficiency in technology transfer and university-industry relations. Hence, it is suggested that governments prioritize supporting

external institutional contributors to establish new businesses and the commercialization of technology.

Additionally, Mowery and Sampat (2005) recommend implementing reforms that promote inter-institutional competition and autonomy within national university systems, which they deem to be of greater significance. Furthermore, the authors assert that the emulation of the act could be unfavorable for other industrial economies since there may be other crucial features for technology transfer and exploitation by industry. According to Mowery and Sampat (2005), focusing solely on licensing as the technology transfer channel may hurt other important channels and could lead to alienation. They believe there are possible risks for university research that increased the engagement of university administration and faculty in licensing commercialization activities, and inaccurate emulation of the act in a completely different institutional structure could enhance these risks.

Turkey is one of these countries that implemented some regulations similar to the Bayh-Dole Act. The implementation was enacted officially in 2017, with the amendments to the Industrial Property Law. Before 2017, there were discussions about the law's scope regarding university-industry technology transfer and whether the Bayh-Dole Act should be implemented. In the study of Merhacı (2015), the IPR system of Turkey and different arguments for law amendments are discussed. The author highlights that the academic activities resulting from university-generated inventions should be considered in the context of technology transfer and commercialization. Numerous legal frameworks and protocols have been put in place by developed nations to simplify the utilization of university discoveries for the benefit of the general public and promote the monetization of the earnings generated from such inventions, which consequently serves to benefit the innovators. The first is the regulations for the right ownership of the inventions. At the time of the author's publication, innovations created by university staff were classified as free inventions, and the ownership of these inventions was attributed to the respective university member in Turkey. However, the author claims that the latest developments paved the way for new arrangements in the right to ownership.

Merhacı (2015) also asserts that the need for new arrangements in industrial rights as stipulated by various decree laws, had gained prominence in Turkish law, although the enactment of these draft laws was still pending. Another advancement in the country is the establishment of TTOs, which have built IPR and licensing services departments in their organization. During this period, the author acknowledges that TTOs faced challenges stemming from the limitations imposed by the decree laws on ownership rights regulations. In other words, the common consensus in these offices is that these laws and regulations have been interrupted due to the categorization of university inventions as free inventions. Reviewing the new regulations and ensuring that universities are granted proper ownership rights is necessary. Additionally, the approach taken by the Bayh-Dole Act should be made public. The Bayh-Dole Act had several benefits regarding technology transfer from university to industry. The noteworthy surge in patent applications from universities and the proliferation of license agreements with the industry, along with the substantial advantages yielded by these agreements, serve as compelling evidence that the act has had a favorable impact on technology transfer in the USA. However, under Turkish law, arriving at a generalization regarding the ownership rights of university inventions in Turkey proves to be challenging. It becomes evident that inventions from public universities are considered free inventions, whereas the protocols in place within private universities could differ significantly.

The legal framework governing intellectual property rights in Turkey is known as the Industrial Property Law, numbered 6769. The law aims to protect the rights of brand, geographical indication, design, patent, utility model, and traditional specialty guaranteed and thus to contribute to the enhancement of technological, economic, and social progress. The law was recently revised in 2017 with the changes in university patenting and licensing by the TURKPATENT legislation. The changes can be found in Articles 121 and 122, named as “Inventions made in higher education institutions” and “Inventions emerging from publicly supported projects”, respectively. The legislation aims to specify the procedures and principles pertaining to fees, as well as the arbitration process in the event of disagreements, concerning inventions originating from higher education institutions. The legislation stipulates that the inventor should notify the higher education institutions of these inventions. In addition,

the income gained from the invention should be shared between the institution and the inventor, and at least one-third of the income should be given to the inventor.

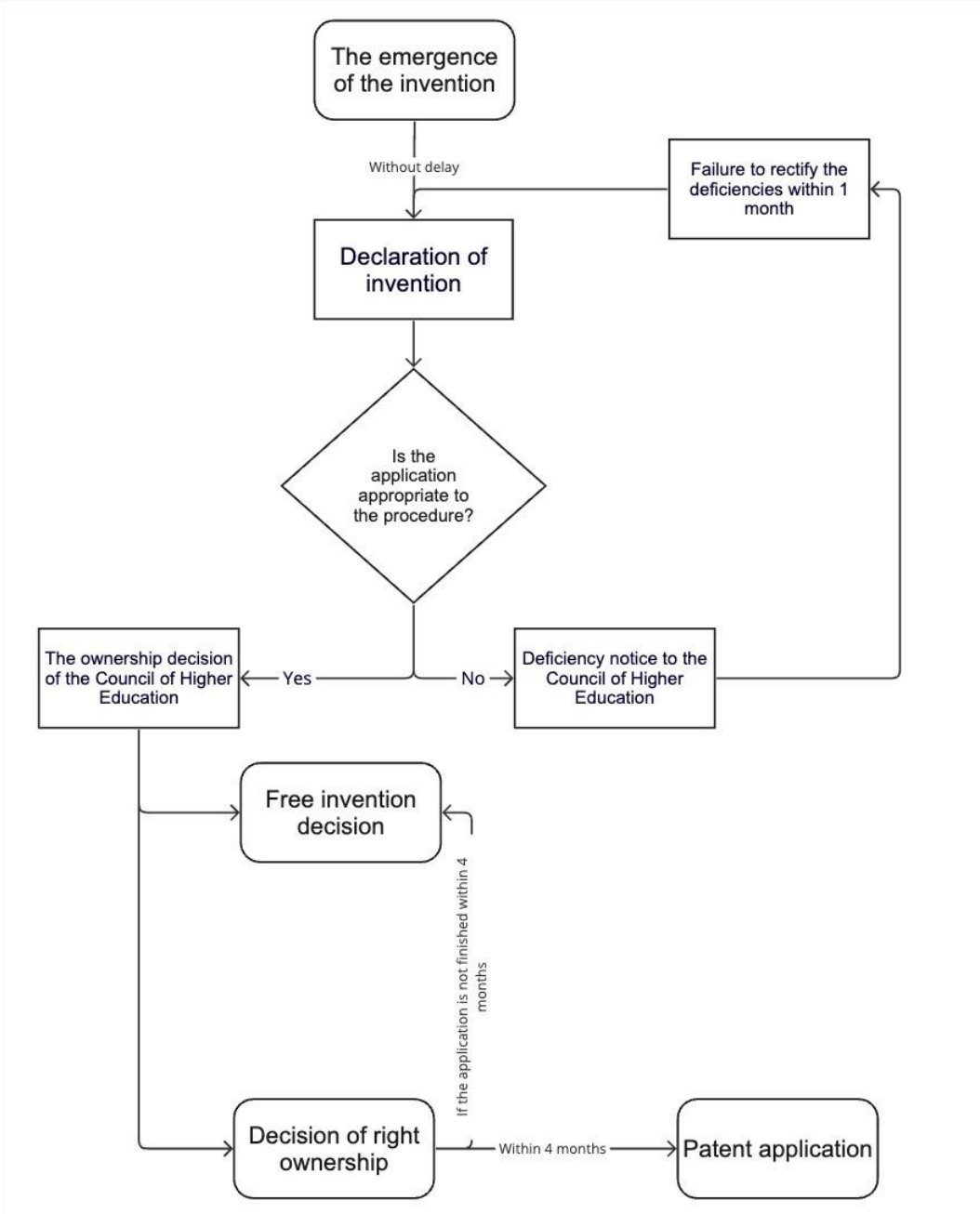

Figure 1. Flowchart of the university patenting procedure by TURKPATENT
Source: (Turkish Patent and Trademark Office, 2020)

In the rubric by TURKPATENT (2020), the procedure of inventions by higher education institutions is demonstrated via a diagram. This illustration outlines that the

institution must be promptly notified of the invention. If the application is successful, then the decision for the right ownership must be decided within four months. After that, the patent application is submitted to domestic and global patent offices. If this four-month timeframe is surpassed, the invention is categorized as a free invention. It is essential to notify the Office of the invention as soon as possible. This can impact whether the invention is granted a patent or utility model status and could hinder the process of academic publications.

3.3. Concluding Remarks

In conclusion, the US developed the Bayh-Dole Act to enhance its global competition through university patenting and technology transfer activities. While some studies show that the act dramatically impacted technology policy, universities, and global competition, some studies demonstrate that the act was unnecessary. The focus should be on the different channels of the technology transfer process. Nevertheless, the act has become a pivotal reference point in shaping US technology policy, exerting an influence that prompted numerous other countries to revise their IPRs regulations concerning universities. One of these countries is Turkey. Turkey has developed similar legislation to Bayh-Dole to benefit from the positive impacts of university patenting, licensing, and technology transfer for economic development. The amendment to the Industrial Property Law was long-awaited and officially enacted in 2017. The following chapters will discuss whether this change significantly impacted university patenting and the Turkish economy.

CHAPTER 4

METHODOLOGY

As mentioned in the previous chapters, technological progress is essential for economic growth and development. Patenting, and especially university patenting, could enhance the technological progress of a country or a region since it is an activity that improves knowledge production. To encourage university patenting activity, Turkey enacted the 2017 legislation. While there appears to be an improvement in university patents subsequent to this change, the data does not comprehensively capture the precise impact. Certain patents conceived or filed by academic staff in Turkey prior to the 2017 legislation were not designated as university patents, primarily because universities were not actively involved in the patent application process. The Article 41 of Decree Law No. 551 Pertaining to the Protection of Patent Rights (1995, p. 732), effective from June 27, 1995, to January 10, 2017, it is stipulated that: "Inventions made by the teaching staff of universities during their scientific studies at universities or higher schools shall be free inventions."

In order to see the specific impact of the 2017 legislation, it is essential to include the academic personnel patents that were filed before 2017 and see whether there was a change toward university patenting.

This chapter describes the research process for this thesis, and its methods are defined within the subsections of this chapter. The data collection, descriptive statistics of the data, and primary method of analysis are presented in this chapter.

This study draws inspirations from the study of della Malva et al. (2013), in which they studied a similar act of change in France. However, the variables in this study have been modified to align with the data collected from the Council of Higher Education (YÖK) Academic Database and TURKPATENT Database.

The method to investigate the impact of 2017 legislation was chosen as the logistic regression analysis because there are only a limited number of categories for the application ownership in the data. One patent could be applied by a university, a company, an institution, or a person. There are some combinations of these categories in the actual data, but since the main focus is on universities' share and their probabilities, there have been some alterations or exceptions when constructing these categories. In this context, when a patent application is jointly owned by a university and individuals, it falls within the university category. The reason for this is described in the paragraphs 2 and 3 of the Article 121 of the Industrial Property Law numbered 6769 (2017, p. 12622):

> (2) When an invention is made in consequences of scientific studies and researches conducted in higher education institutions; the inventor shall be obliged to notify their invention in written to the higher education institution without a delay. If a patent application is filed, a notification shall be made to the higher education institution regarding the patent application.
>
> (3) In case the higher education institution claims rights on the invention, they shall be obliged to make a patent application. Otherwise, the invention acquires the qualifications of an independent invention.

According to these provisions, the owner of the inventions invented by any university member is the university of the inventor, even if it is invented by collaboration with any company or government institution or any third party. In these cases, the ownership is shared by the university and all other inventors.

This analysis was conducted for both binomial and multinomial models, encompassing the two dependent variables. For binomial regression, the dependent variable is UNI, which depicts whether the patent applicant is a university. On the other hand, for the multinomial regression, the dependent variable was chosen as TYPE, which can take four values from 1 to 4, each defining a type of applicant. University applicants take the value 1, personal applications take the value 2, companies or corporations take the value 3, and institutions take the value 4 in this regard.

For the general logistic regression analysis, the following formula was used:

$$p(x) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 x)}}$$

where $y = \beta_0 + \beta_1 x$.

If the dependent variable *y* takes only two different values, the regression becomes a binomial logistic regression. On the other hand, if it takes more than two values, the regression becomes a multinomial logistic regression. The regression analysis has been created several times for different dependent and independent variables to produce different explanations. In addition, the marginal effects were calculated.

To compute the analysis results, the Python programming language was used. The code includes several packages for manipulating the data: NumPy (Harris et al., 2020), pandas (The pandas development team, 2023), and statsmodels (Seabold & Perktold, 2010). The packages are used for different purposes, where NumPy is for mathematical operations, and pandas and statsmodels are for creating data frames and dummy variables and conducting regression analysis. Detailed information on the code script written for the analysis can be found in Appendix A of this study.

4.1. Data Collection and Cleaning

The data was collected from the Council of Higher Education's YÖK Academic Database. It contains several aspects of Turkish universities, including theses, projects, and main fields. The database could be used to search for a specific type of information. It offers a comprehensive overview of an academic personnel's detailed information, encompassing personal details, publications, books, articles, proceedings, projects, courses, supervised theses, awards, patents, memberships, artistic activities, administrative roles, and non-academic experience.

All this detailed information is positioned on the left-hand side of the YÖK Academic Database web page. The category "Patents" contains the patent applications for the inventions the academic personnel invented or applied. This category also gives information about the patent name, applicants, patentees, and their main international patent classification (IPC) category. This information is used to create a database to investigate patents in Turkish universities. This data was collected from the "Patents" category for every university per academic personnel listed in that university into a Microsoft Office Excel Worksheet. The worksheet first contained the university name, academic personnel's name, patent name, applicant name, inventor/patentee name,

and patent application number. However, foreign patents, i.e., the inventions patented in different countries such as the US, Japan, or EU, were not considered in this research since it is thought that the academic personnel would first patent their inventions in Turkey to use priority rights. Therefore, these patents were removed or not recorded in the database for consistency. In addition, some of the information in the YÖK Academic Database was missing, such as patent application numbers or patentees. To overcome this problem, the data was matched with TURKPATENT records using the Patent Search engine. The missing information and specific IPC numbers were retrieved through searches using either the academic's name or the patent application number. The created Excel Worksheet was filled based on the records obtained from TURKPATENT.

There were situations where a single academic personnel's name was associated with multiple patents in TURKPATENT records. Fortunately, TURKPATENT provides an applicant/patentee number for inventors, simplifying the process of identifying the patents to be selected. This also proved beneficial for patents listed in the YÖK Academic Database but not present in TURKPATENT records. In essence, in cases of discrepancies between the two databases, such records were removed to maintain consistency.

This matching process effectively addressed the gaps in information, particularly with regards to patent application numbers, IPC numbers, and patentee/inventor names. In the end, the data worksheet had seven columns: university, scholar name, patent/utility model name, patent/utility model application owner name, patent/utility model inventors, patent/utility model application number, and IPC number. This data collection process can be summarized in Figure 2.

After data collection, the data cleaning and ordering process was pursued. Several new columns, which are variables of the analysis, were constructed to make a numerical analysis: IPCd, Year, UNI, TYPE, and Region. IPCd denotes the main IPC category of the patent, year shows the patent application year, and region demonstrates the level-1 region information of the university. On the other hand, UNI and TYPE columns show the application ownership information, which was used as dependent variables in the the data analysis. Figure 3 shows how the data cleaning and ordering

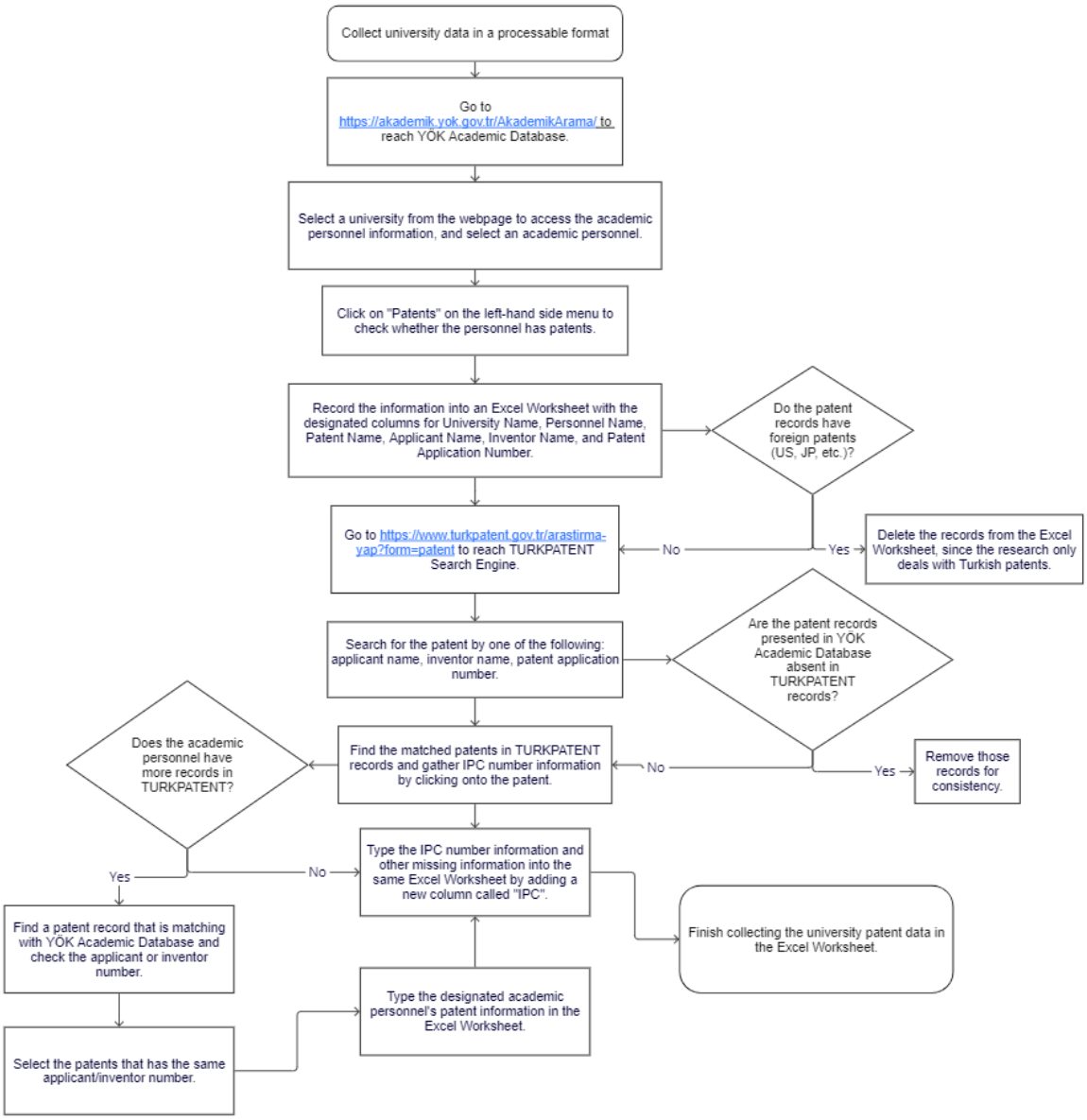

Figure 2. Data collection flowchart for a single data point.

process was conducted. In the next section, these variables are described in a detailed manner with their descriptive statistics.

4.2. Variables and Descriptive Statistics

The data constructed for the analysis has 12 columns and 12852 rows (or patent applications) without duplicate values. The columns are namely university name, scholar/academic personnel name, patent/utility model name, patent/utility model application owner name, patent/utility model inventors, patent/utility model number

in TURKPATENT records, IPC name, main IPC category denoted as *IPCd*, patent/utility model application year, university dummy variable (UNI), level-1 region code, and application owner type (TYPE). In this section, these columns will be investigated in a detailed manner to understand the constructed data and variables of the model. The dependent and independent variables for the model are also described.

In general, there are 188 Turkish universities in the dataset. The patent distribution of these universities between 2000-2023 is listed in Appendix B. The highest and lowest patent application counts of the universities can be found in Tables 1 and 2.

Table 1: Highest patent application counts and their percentages.

University Name	Region information	Patent application counts	Percentage of total patent application counts
İstanbul Üniversitesi - Cerrahpaşa	Istanbul	534	4.15%
İstanbul Teknik Üniversitesi	Istanbul	502	3.91%
Bursa Uludağ Üniversitesi	East Marmara	464	3.61%
Gaziantep Üniversitesi	Southeast Anatolia	351	2.73%
Yıldız Teknik Üniversitesi	Istanbul	312	2.43%
İstanbul Üniversitesi	Istanbul	289	2.25%
Ege Üniversitesi	Aegean	284	2.21%
Gazi Üniversitesi	West Anatolia	269	2.09%
Orta Doğu Teknik Üniversitesi	West Anatolia	268	2.09%
İstanbul Medipol Üniversitesi	Istanbul	265	2.06%

The highest patent applications belong to Istanbul University, Cerrahpaşa campus, which is the Faculty of Medicine. Similarly, Istanbul University ranks prominently with 289 patent applications, constituting 2.25% of the overall patent applications in the dataset. Almost all the universities in the table are located in the major metropolitan areas of Turkey, except Gaziantep University, located in the Southeast Anatolia of Turkey.

Figure 3. Data cleaning and ordering flowchart for a single data point

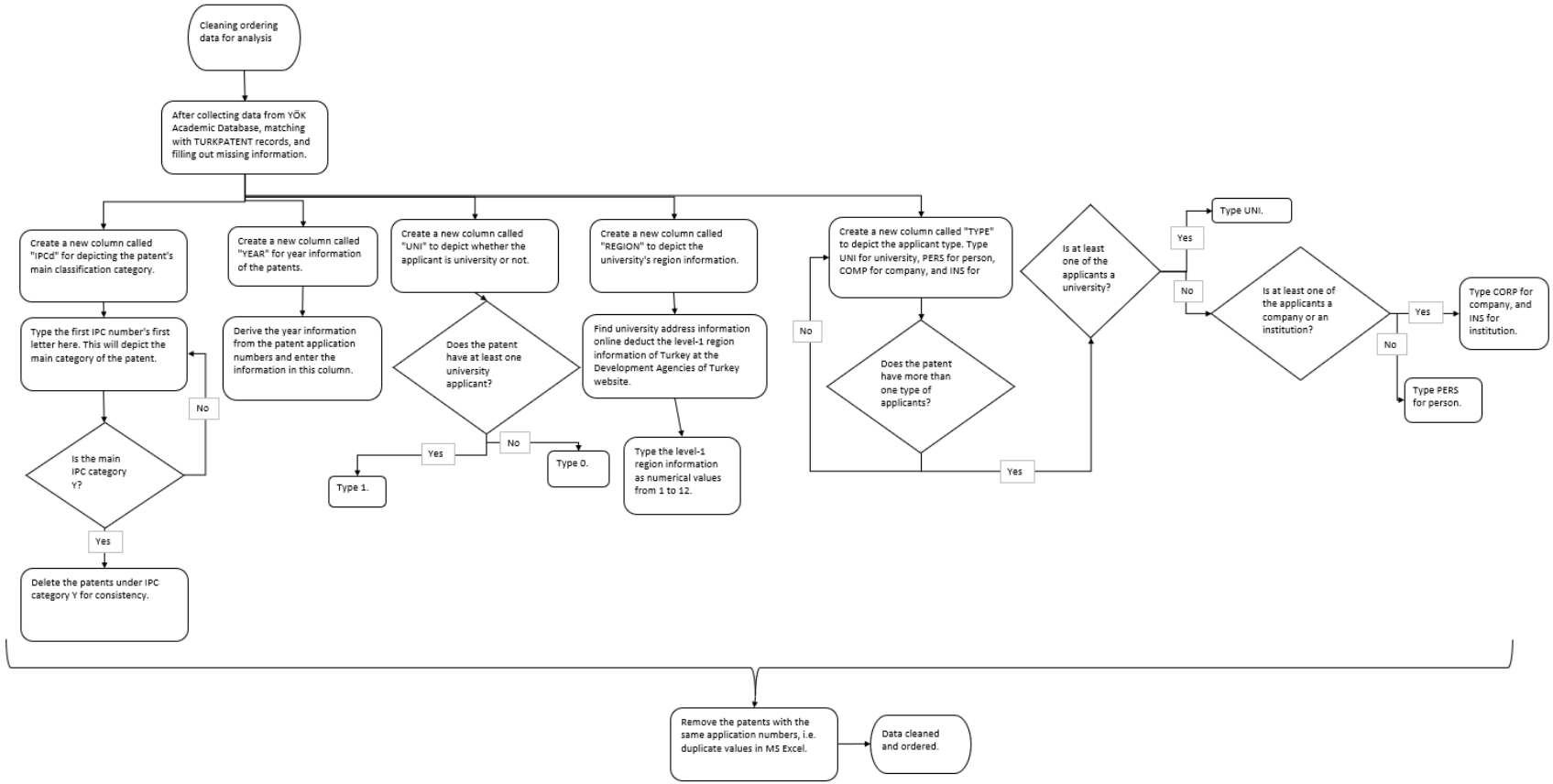

Table 2: Lowest patent application counts and their percentages.

University name	Region information	Patent application counts	Percentage of total patent application counts
Kadir Has Üniversitesi	Istanbul	2	0.02%
Bitlis Eren Üniversitesi	Middle east Anatolia	2	0.02%
Bayburt Üniversitesi	Northeast Anatolia	2	0.02%
Kocaeli Sağlık ve Teknoloji Üniversitesi	East Marmara	2	0.02%
Ataşehir Adıgüzel Meslek Yüksekokulu	Istanbul	1	0.01%
Mef Üniversitesi	Istanbul	1	0.01%
Yüksek İhtisas Üniversitesi	West Anatolia	1	0.01%
İstanbul Şişli Meslek Yüksekokulu	Istanbul	1	0.01%
Şırnak Üniversitesi	Southeast Anatolia	1	0.01%
İstanbul Kent Üniversitesi	Istanbul	1	0.01%

The lowest contributions to university patent applications in the data belong to universities from Istanbul, Bitlis, Bayburt, Kocaeli, Ankara, and Şırnak. The presence of universities in Istanbul, Ankara, and Kocaeli can be attributed to the establishment of several new or recently opened universities in these cities. On the other hand, the other universities in this list are generally located in Turkey's less developed or developing regions except some foundation universities in Istanbul.

4.2.1. Independent Variables

Three distinct independent variables have been selected for the analysis, namely the *is_after_2017, is_istanbul*, and *is_ipc_A*. These variables denote whether the patent application year is after 2017, whether the university is in Istanbul region, and whether the patent application belongs to the main IPC category A. They are derived from the data matched with TURKPATENT and YÖK Academic Database records. In other

words, categorical variables are derived from textual data and turned into numeric values for analysis.

The main question for the research is to reveal the impact of the 2017 legislation; therefore, it was necessary to include a dummy variable in the data to distinguish the year 2017. Prior to generating the variable, it was necessary to define the patent application years. Fortunately, the patent application numbers created by TURKPATENT include the application year. The format of these numbers is *yyyy/xxxxx*, where *yyyy* designates the application year, and *xxxxx* defines the specific patent of that year. For instance, if a patent has the identifier 2018/01234, that implies the patent was submitted in the year 2018. Hence, a column was created in the data for the application year with the help of these numbers.

The year interval for the data set was chosen as 2000-2023. The patent applications before 2000 were relatively small and thus were neglected for consistent data analysis. The yearly distribution of the patent applications is displayed in Figure 4.

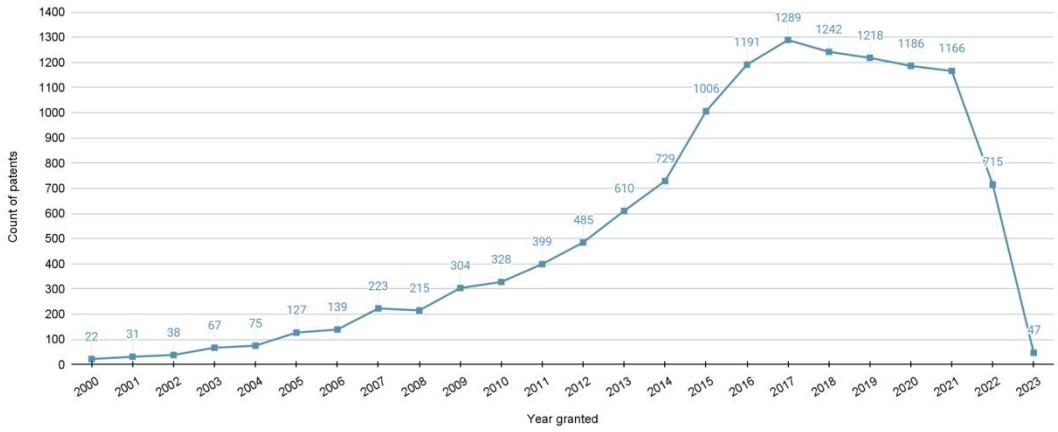

Figure 4: Patent application counts by year.

The yearly distribution of these patent applications does not follow a normal distribution; rather, it is left-skewed. In addition, patent applications peaked in 2017 with 1289 patent applications. The reason for decreasing number of patent applications in 2022 can be attributed to the cessation of incentives provided by the Scientific and Technological Research Council of Turkey (TUBITAK). Universities started using solely their own resources to cover patent expenses in 2022 and beyond.

After choosing the time interval, a dummy variable was constructed for the year 2017, which is called *is_after_2017* in the data. If the patent application was made before 2017, it takes the value of 0; if it was made in 2017 and after 2017, it takes the value of 1.

The second independent variable is *is_istanbul*. The level-1 region information of universities was incorporated as a dummy variable for this specific variable. According to the Development Agencies of Turkey, there are 12 level-1 regions in Turkey, which are Istanbul (TR1), West Marmara (TR2), Aegean (TR3), East Marmara (TR4), West Anatolia (TR5), Mediterranean (TR6), Middle Anatolia (TR7), West Black Sea (TR8), East Black Sea (TR9), Northeast Anatolia (TRA), Middle east Anatolia (TRB), and Southeast Anatolia (TRC). Other than Istanbul, all regions contain several cities, which are listed in Table 3.

Table 3: Level-1 regions of Turkey and the cities

Level-1 Region Code	**Level-1 Region Name**	**Cities contained in the region**
TR1	Istanbul	İstanbul
TR2	West Marmara	Tekirdağ, Edirne, Kırklareli, Balıkesir, Çanakkale
TR3	Aegean	İzmir, Aydın, Denizli, Muğla, Manisa, Afyonkarahisar, Kütahya, Uşak
TR4	East Marmara	Bursa, Eskişehir, Bilecik, Kocaeli, Sakarya, Düzce, Bolu, Yalova
TR5	West Anatolia	Ankara, Konya, Karaman
TR6	Mediterranean	Antalya, Isparta, Burdur, Adana, Mersin, Hatay, Kahramanmaraş, Osmaniye
TR7	Middle Anatolia	Kırıkkale, Aksaray, Niğde, Nevşehir, Kırşehir, Kayseri, Sivas, Yozgat
TR8	West Black Sea	Zonguldak, Karabük, Bartın, Kastamonu, Çankırı, Sinop, Samsun, Tokat, Çorum, Amasya
TR9	East Black Sea	Trabzon, Ordu, Giresun, Rize, Artvin, Gümüşhane
TRA	Northeast Anatolia	Erzurum, Erzincan, Bayburt, Ağrı, Kars, Iğdır, Ardahan
TRB	Middle east Anatolia	Malatya, Elazığ, Bingöl, Tunceli, Van, Muş, Bitlis, Hakkâri
TRC	Southeast Anatolia	Gaziantep, Adıyaman, Kilis, Şanlıurfa, Diyarbakır, Mardin, Batman, Şırnak, Siirt

Before creating a dummy variable to include this parameter into the analysis, the regional distribution of the patent applications, it is important to see the differences between regions. This distribution in the data set can be found in Figure 5.

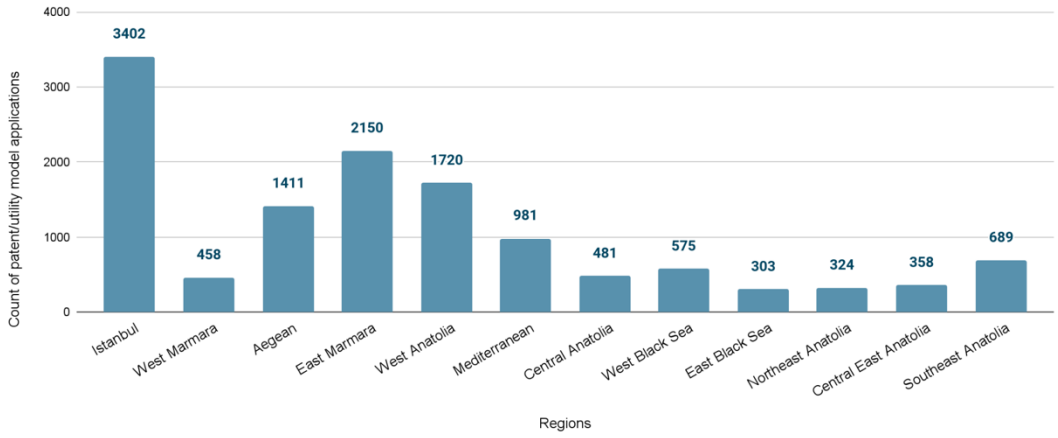

Figure 5: Distribution of patent applications by region

The highest portion of university patent applications belongs to Istanbul. There are fifty-four universities in the dataset for this region, making up 3402 patent applications. The second place belongs to East Marmara, a highly industrialized area of Turkey, and it is in the same region as Istanbul geographically. Finally, the third highest share of university patent applications is observed in West Anatolia. This region comprises three cities, one of which is the capital city of Turkey, Ankara, another metropolitan area of Turkey.

After seeing that Istanbul region have drastically higher patent applications than other regions, a dummy variable named *is_istanbul* is created to differentiate Istanbul and other regions. In other words, if the level-1 region information of the university's public address belongs to Istanbul, that application takes the value 1, and otherwise 0.

Other parameters like regional differences and the classification of patents are also included in the analysis of whether there are meaningful results. The first IPC number is taken for the classification of the patents since this usually indicates the main category of the patent. The main category could also be easily shown in the number; for instance, if the first IPC number of a patent is C08G 65/00, the main category of the IPC category is C, which is chemistry/metallurgy. Based on this information, a

new column was created for the main IPC categories of the patents, which are A, B, C, D, E, F, G, H, and Y. In the WIPO classification, these categories, labeled A through H, correspond to human necessities, performing operations; transporting, chemistry; metallurgy, textiles; paper, fixed constructions, mechanical engineering; lighting; heating; weapons; blasting, physics, and electricity, respectively. However, category Y is not listed on the official website of IPC. In Cooperative Patent Classification (CPC) documents, category Y serves as a comprehensive tagging system for novel technological advancements. For consistency, the patents under category Y were not included in the analysis since it only consists of 0.07% of the whole data, thereby potentially yielding insignificant outcomes for the analysis. The definition of main IPC categories is shown in Table 4.

Table 4: IPC categories and their names and subcategories

IPC Category	Name and subcategories
A	Human Necessities: agriculture; foodstuffs, tobacco; personal or domestic articles; health, lifesaving, amusement
B	Performing Operations, transporting separating, mixing; shaping; printing; transporting; microstructural technology, nanotechnology
C	Chemistry, Metallurgy: chemistry; metallurgy; combinatorial technology
D	Textiles, Paper: textiles or flexible materials not otherwise provided for; paper
E	Fixed Constructions: building, earth or rock drilling, mining
F	Mechanical Engineering; Lightning; Heating; Weapons; Blasting: engines or pumps; engineering in general; lightning, heating; weapons, blasting
G	Physics
H	Electricity

The distribution of the main IPC categories of patent applications can be seen in Figure 6.

Most patent applications fall under the main IPC category A, mainly for human necessity inventions and health fields. This might imply that most university patent applications are by health or medicine academic personnel. The lowest part of these applications goes to the main IPC category D, textiles, and paper. Given the historical notion that Turkey hosts most of the textile production and has attempted to develop the sector, it is surprising that this section has a lower patent application in universities. The reason for this is that the universities mainly prefer to own and file the patent

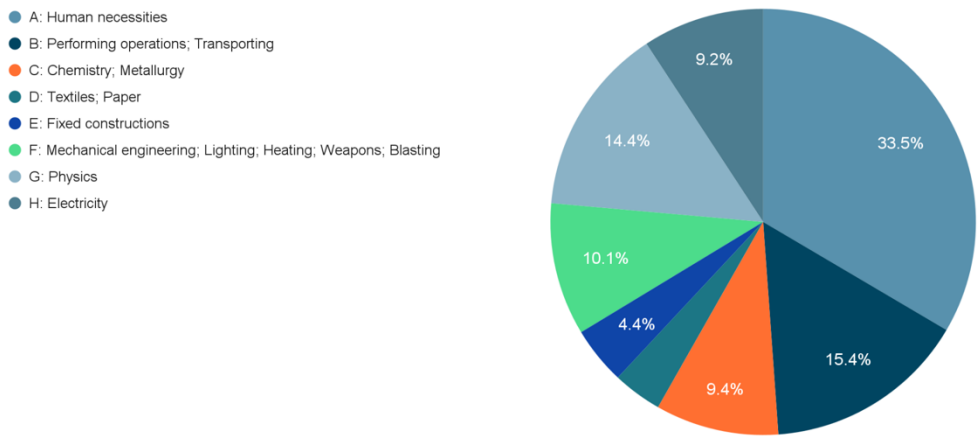

Figure 6: Main IPC category distribution of the patent applications

applications for the inventions having higher commercial value. For this reason, universities mainly prefer to own the inventions in the fields of human necessities and health. Additionally, the inventions in the field of category D, textiles, and paper have short term of commercial life. Thus, universities do not prefer to own patents in these fields.

Ultimately, the primary category is established based on the corresponding patent, and the category variable is then employed as a dummy variable in the analysis. Since the IPC category A dominates the other categories, the dummy variable named *is_ipc_A* is constructed whether the patent application belongs to the main IPC category A. This dummy variable contains two values. If the patent application's main IPC category is A, it takes the value 1, and otherwise 0.

This section provides an overview of the independent variables used in the analysis. Following the generation of the respective dummy variables, the dependent variables are described in the following subsection, and their descriptive statistics are presented.

4.2.2. Dependent Variables

Two different logistic regression models are chosen for the analysis, binomial and multinomial. Since the data in this form was in text values and we wanted to make a regression analysis out of this data, numerical values were attached for the dependent

variables as well. These dependent variables are categorical variables, similar to the independent variables.

For the first logistic regression analysis, a binomial dependent variable, *is_university_application*, was created to depict which patent applications are owned by universities. If the patent has a university applicant, it takes the value 1 and 0 otherwise. For instance, if one of the patent applicants is a university, this variable takes the value 1, even though other persons or institutions participate in the application.

To address the multinomial dependent variable, a variable named *applicant_type* was generated to distinguish between the owners of patent applications, aiming to uncover whether this distinction yields valuable insights. The data has four types of applicants: university, person, company, and institution. The types took values from 1 to 4, respectively. Their share of the data is shown in Table 5.

Table 5: Applicant types and their values in the data

Applicant type	Value in the data	Count	Percentage
University	1	3694	28.74%
Person	2	3597	27.99%
Company	3	5264	40.96%
Institution	4	297	2.31%

4.3. Concluding Remarks

This chapter presented the data collection, data cleaning and order, the main method of analysis, and the independent and dependent variables used in the analysis. The data collection process was conducted using two different databases: YÖK Academic Database and TURKPATENT Patent Search Engine. For consistency purposes, only the Turkish patents were considered, and some other outliers were left out, such as IPC category Y. After transforming the data for numerical analysis, the dependent and independent variables were selected to answer the research question. The independent variables were selected as the year dummy variable, region information, and IPC

category of the patent. On the other hand, the dependent variables encompassed is_university_application, a binary variable indicating whether the patent is university-applied or not, and applicant_type, a multinomial variable with four potential values, each representing a distinct patent application ownership type.

As shown in this chapter, university patents are more common in developed regions of Turkey, especially in the Istanbul region. In addition, most of these patents peaked in 2017 and seem to have decreased in the years that followed. Another critical point that can be observed in the data is that most of these patents are categorized under the IPC category A, which defines the inventions in the field of human necessities and health. When descriptive statistics are checked for the dependent variables is_university_application, and applicant_type, it can be said that these patents are most likely to be applied by a different agent than a university, more specifically, a company. The majority of patent applications in this dataset are submitted by companies.

In the next chapter, the results of the data analysis are presented. The results are presented in relation to the literature review presented in Chapters 2 and 3.

CHAPTER 5

ANALYSIS OF FINDINGS

In the previous chapter, the data collection and order process, the data, and the variables were presented. In this chapter, the results of the data analyses are explained. The primary method of data analysis is logistic regression modeling. The regression modeling is performed for two dependent variables, so both logistic and multinomial logistic regression models are estimated. The parameters and marginal effects of these models are also presented and interpreted. Other than dependent variables, independent variables are also investigated in different regression models. In other words, the regression models incorporate the variables *is_after_2017*, *is_istanbul*, and *is_ipc_A*, each separately, to ascertain whether these variables exert a statistically significant influence.

To construct the dummy variables and make a numerical analysis, the Python programming language was used. The integrated development environment (IDE) tool Jupyter Notebook via the Anaconda Navigator distribution tool, which is an open and accessible software, was used for this purpose. Before the regression analysis, some necessary packages were imported, namely NumPy, pandas, and statsmodels. NumPy is a Python package that enables to make mathematical operations, whereas pandas and statsmodels enable data manipulation and analysis. After importing these, the data was imported into the IDE tool, and some arrangements for the analysis were developed. Unnecessary columns -university name, patent name, applicant name, inventor name, and IPC number columns- for the analysis were removed. Although they were discarded during the data order process in MS Excel, the duplicate and null values were double-checked in the program. After ensuring there are none, the dummy variables were created by imposing functions. The independent variable *is_after_2017* was constructed by 0 or 1 to define whether the patent application was made before or after 2017. For the *is_ipc_A* variable, the category label A was assigned 1, and otherwise 0. Lastly, the *applicant_type* variable was also formulated to designate the

specific patent application ownership type, where university denotes 1, personal is 2, company is 3, and institution is 4. After developing these variables, the logistic and multinomial logistic regression analyses were run to gather the results and marginal effects. This process can be summarized in Figure 7 as a flowchart. In addition, the code for the analysis can be found in Appendix A of this thesis.

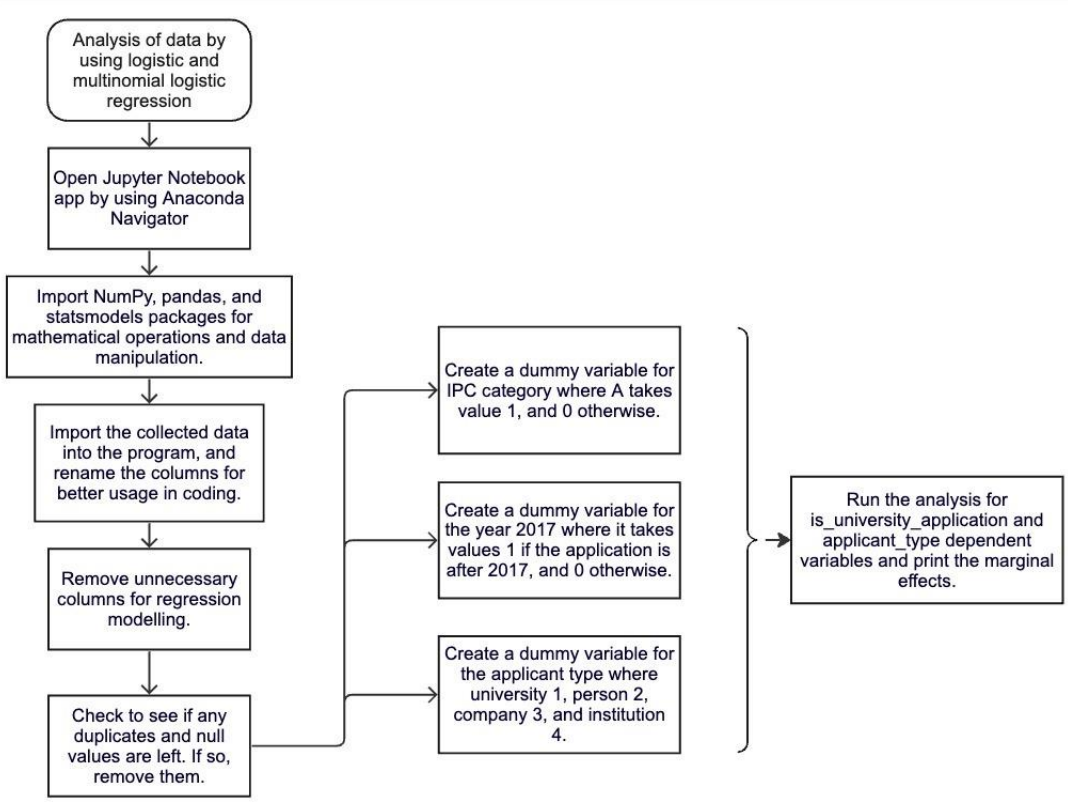

Figure 7: Data analysis flowchart.

5.1. Logistic Regression Results

This analysis has three different logistic regression models, with the dependent variable *is_university_application*, the dummy variable that describes whether the patent application owner is a university. The initial logistic regression, labeled as A, exclusively encompasses the independent variable *is_after_2017*. The second regression, labeled as B, incorporates both *is_after_2017* and *is_istanbul*. Finally, the third regression, labeled as C, encompasses *is_after_2017*, *is_istanbul*, and *is_ipc_A* as independent variables. Three distinct models have been formulated by introducing regional information and IPC categories to examine whether regional or sectoral

disparities influence the likelihood of patent applications being attributed to university ownership.

Table 6: Logistic regression results with binomial dependent variable

	A	B	C
Constant	-2.0014**	-2.2621**	-2.5247**
	(0.040)	(0.044)	(0.048)
is_after_2017	1.7374**	1.7448**	1.7622**
	(0.047)	(0.047)	(0.048)
is_istanbul		0.8623**	0.8699**
		(0.046)	(0.046)
is_ipc_A			0.6871**
			(0.044)
Pseudo R-squared	inf	inf	inf
Log-likelihood	-2.96E+06	-3.20E+06	-3.32E+06
LL-null	0	0	0

(** = 5% significance level, standard errors are presented in parentheses.)

Table 7: Marginal effects of the logistic regressions

	A	B	C
is_after_2017	0.3128**	0.3040**	0.3003**
	(0.007)	(0.007)	(0.007)
is_istanbul		0.1503**	0.1482**
		(0.008)	(0.007)
is_ipc_A			0.1171**
			(0.007)

(** = 5% significance level, standard errors are presented in parentheses.)

The results of the logistic regression model A with the independent variable *is_after_2017* revealed that the parameter of *is_after_2017* is statistically significant and positively impacts the probability of the patent application being owned by a university. The marginal effect, on the other hand, is also positive and statistically significant. This means that 2017 played a vital role in this probability, and it could be concluded that the legislation year positively impacted university patent applications.

In the logistic regression model B with independent variables *is_after_2017* and *is_istanbul*, it could be seen that both of the parameters of independent variables are statistically significant. Again, the parameter of *is_after_2017* exhibits a positive value, as does its marginal effect; therefore, the 2017 year has a positive impact similar to the findings of previous regression. On the other hand, the parameter of *is_istanbul* and marginal effect are positive and statistically significant. It should be noted that the structure of the *is_istanbul* variable is aligned with the official level-1 list of Development Agencies in Turkey, Istanbul is assigned the code 1 and other regions are assigned the code 0. Therefore, one can conclude that this probability decreases as the region moves from Istanbul to other regions of Turkey.

In model C with independent variables *is_after_2017*, *is_istanbul*, and *is_ipc_A*, the year 2017 has preserved its positive impact since the parameter and the marginal effect of the variable are statistically significant. The positive impact of the *is_istanbul* variable on the probability is also seen in this model, compared to the second regression. Similarly, the IPC category variable also bears a positive impact. Both the parameter and the marginal effect are positive and statistically significant. This result suggests that the patents classified under the IPC category A have a higher probability of being university patents, which is aligned with the actual data since the highest share of university patents in the data arose from Istanbul University Cerrahpaşa Campus.

5.2. Multinomial Logistic Regression Results

Similar to the previous subsection, this analysis employs three distinct multinomial logistic regression models, each utilizing the dependent variable *applicant_type*, a dummy variable used to characterize the type of patent application owner. The first logistic regression (A) includes the independent variable *is_after_2017* only. The second (B) includes *is_after_2017* and *is_istanbul*, and the third (C) includes *is_after_2017*, *is_istanbul*, and *is_ipc_A*.

In the multinomial model A, it can be concluded that the legislation year 2017 has negative impacts on the other types of application ownership other than university. Given that the variable's parameters and marginal effects are statistically significant, this result is consistent with the 2017 legislation aims and objectives. The other types

of ownership, person, company, and institution seem to be affected negatively by this legislation.

In the multinomial model B with independent variables *is_after_2017* and *is_istanbul*, the results alter depending on the ownership type, which needs further attention. In regression results, marginal effects are statistically significant; however, other than university ownership type, the *is_istanbul's* marginal effects become negative, contrary to the binomial logistic regression results. This could mean that the person, company, and institution ownership types for the patents have a higher share in other parts of Turkey.

In the multinomial logistic model C with the independent variables *is_after_2017*, *is_istanbul*, and *is_ipc_A*, the results vary depending on the types of ownership. For the first type of ownership, university, the results are aligned with the logistic regression. The variables exhibit a positive influence on the probability of a patent being applied by a university. This is supported by the statistically significant marginal effects of these variables.

For the second type of ownership, person, the coefficient of the IPC category variable is statistically significant, and it does exhibit a positive impact. In contrast, the year 2017 has exerted a negative impact on this probability, and this impact is statistically significant, as evidenced by the marginal effect.

For the third type of ownership, company, all the coefficients of the variables are statistically significant and demonstrate a similar impact to the results observed in the previous regression and person ownership findings. In addition, the marginal effects of all variables are statistically significant and bear negative probability.

Lastly, for the fourth type of ownership, institution, a comparable pattern emerges as seen in the results for university ownership for the *is_after_2017* variable. However, it is noteworthy that the marginal effect of *is_ipc_A* in this case is not statistically significant.

Table 8: Multinomial logistic regression results with their marginal effects

	University (TYPE=1)			**Person (TYPE=2)**			**Company (TYPE=3)**			**Institution (TYPE=4)**		
	A	B	C	A	B	C	A	B	C	A	B	C
is_after_2017	0.3064**	0.2982**	0.2937**	-0.2249**	-0.2211**	-0.2217**	-0.0943**	-0.0905**	-0.0857**	0.0128**	0.0134**	0.0137**
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.003)	(0.003)	(0.003)
is_istanbul		0.1506**	0.1486**		-0.0843**	-0.0857**		-0.0539**	-0.0517**		-0.0124**	-0.0123**
		(0.008)	(0.007)		(0.009)	(0.009)		(0.010)	(0.010)		(0.003)	(0.003)
is_ipc_A			0.1198**			0.0833**			-0.1975**			-0.0056
			(0.007)			(0.008)			(0.009)			(0.003)

(** = 5% significance level, standard errors are presented in parentheses.)

5.3. Discussion of Findings

The results show that, in both logistic and multinomial logic regression analyses, the impact of the 2017 legislation change is positive for university patenting, i.e., the patents that are applied by universities. However, this impact is not seen in different application types. As can be seen in Table 9, the marginal effects of the year 2017 dummy variable are negative for person and company application types. Although the marginal effect of the year dummy variable in institution application type is positive, the impact is much smaller than university application type. This result suggests that the 2017 legislation change has worked in favor of university patenting. In other words, the policy change has been successful in this regard.

When incorporating additional parameters into the analysis, this positive impact differs. Before delving into these differences, it is crucial to present a background of IPC categories and Turkey's regional differences. To start with IPC categories, it is important to notice differences among categories. As mentioned in the previous chapter, there are eight main IPC categories that are denoted with letters from A to H. In the collected data, the majority of the data belongs to category A, which describes the patents in the field of human necessities and health. On the other hand, category D, textiles, has the least share among the data. This distribution could also be seen in the multinomial regression analysis results. As the value of IPC category variable only goes from the value 0 to 1, the marginal effect of the variable on university application type becomes positive. However, this changes when the application type is company. This may suggest that the inventions or patents of academic personnel have the probability of being patented by companies mostly. Therefore, it could be concluded that Turkish universities are more prone to encouraging academic patenting in human necessities such as medicine and agriculture.

This result could be interpreted as a requirement for an overall increase in university funding. The domination of the patents by only one main IPC category could mean that Turkish universities are more prone to applying for patents that are more likely to have commercial success in the market. The IPC category A dominance is due to the fact that agricultural and medicinal activities have a better yield of income to universities. In addition, these medicinal activities are more likely to be researched in

medical schools, which already have the necessary equipment to produce such innovations and inventions. On the other hand, patenting new or more complex technologies could be much harder for universities to patent because they may be costly. Moreover, patenting complex innovations could also require foreign patenting, increasing the university authorities' patenting fees.

It should also be stated that these patenting activities are mostly in the same category because of a needs-based approach. There are cases when a university or government authority department has requested or needed a product or process to develop. In that case, the invention will likely be produced when needed. One of the examples of this is the recent Coronavirus disease 2019 (COVID-19) pandemic. The pandemic has affected many aspects of daily life, and authorities have called for action to end the pandemic or slow down the effects of it. In the data used for the analysis in this thesis, there are 34 patents for this purpose. While 8 of these patents deal with vaccination processes, 26 deal with the diagnosis of COVID-19. Nineteen of these patents belong to the main IPC category A, twelve belong to C, and three belong to the G category. Furthermore, these inventions are patented by universities mostly, with 22 patent applications from 2020 to 2023. Therefore, it could be concluded that Turkish universities are more prone to patent innovations related to human necessities, possibly driven by financial considerations or emerging needs.

On the other hand, when the region parameter is added to the analysis, both regressions present a positive marginal effect when the application type is university. This means that as region’s value decreases, the probability of the invention being patented by a university increases significantly. Hence, it can be concluded that there is a regional difference in university patenting. This result could result from the developmental difference among the regions of Turkey. According to the data of the Turkish Statistical Institute (TÜİK), the GDP per capita differs among these regions, and it can be seen that the highest GDP per capita in US Dollars (USD) belongs to the region TR1, i.e., Istanbul. In contrast, the lowest GDP per capita in USD belongs to the region TRB, i.e., Middle East Anatolia, in 2021. Figure 8 shows the differences in GDP per capita among these regions.

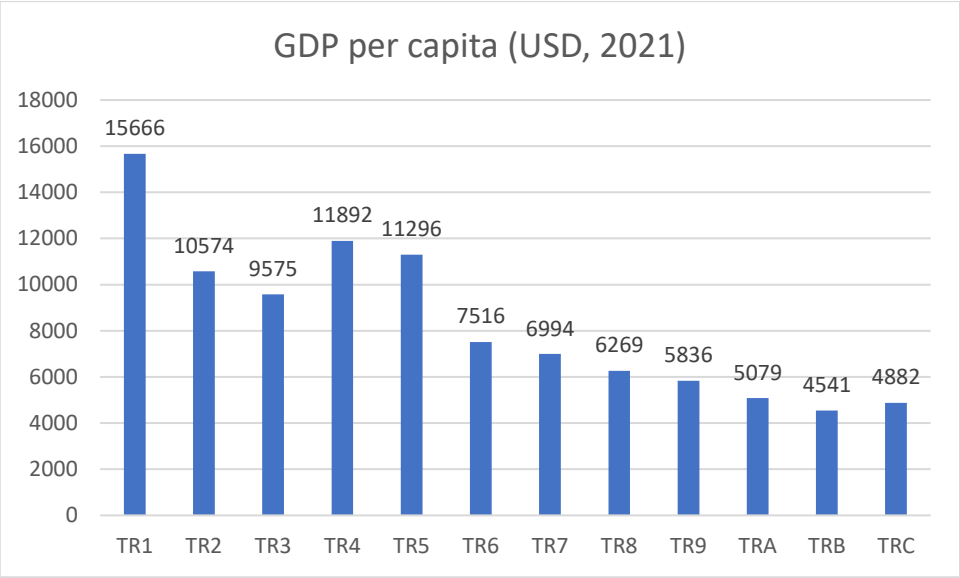

Figure 8: GDP per capita in US Dollars among regions of Turkey in 2021.

Source: (https://biruni.tuik.gov.tr/medas/?kn=116&locale=tr, 2023)

Turkey has been dealing with developmental differences for a long time, especially east-west and coast-inland divides have been persistent for many years (Karaalp-Orhan, 2020). In addition, migration from developing to developed regions has hindered this development process in developing regions (Gezici & Keskin, 2005). One of the reasons for this could be the lack of necessary added value of human capital in developing regions and thus migration for better job opportunities (Kılıç, 2017). Another reason could be the lack of physical and social infrastructure in developing regions (Saygılı & Özdemir, 2017). To solve this problem, there have been attempts to improve the conditions in these regions with the introduction of regional development agency tool, which became an essential actor to eliminate the imbalances among the regions in Turkey (Toktaş et al., 2013).

However, it is clear that these imbalances still persist, and this could affect the probability of an academic invention being patented by a university. On the other hand, when other application types are investigated, only the marginal effect of the person application type is revealed as significant and positive. This could mean that academic personnel working in different regions other than Istanbul may have a higher tendency to patent their inventions personally or by themselves. However, this relationship does not appear in company and institution application types; the marginal effects of region

parameters in these application types are positive but not statistically significant. Thus, it is not possible to deduct a conclusion from these types of applications in terms of regional differences.

5.4. Concluding Remarks

In this chapter, the analysis of the findings is presented. The data collected from the YÖK Academic Database and matched with the TURKPATENT records made it possible to decipher whether the 2017 legislation impacted Turkish university patents. The primary analysis method employed is the logistic regression analysis, and both binomial and multinomial approaches show that 2017 positively impacted university patenting.

As literature shows, patenting and specifically university patenting is one of the main sources of economic growth and development. The implementation of the Bayh-Dole Act in 1980 within the United States has had a profound influence on the global impact of American innovation. The success of this act has influenced many developed and developing countries. The analysis results show that the 2017 legislation of Turkey could have a similar influence in university patenting among Turkish universities. The probability of academic personnel's inventions being patented by universities is higher compared to other types of applications. Therefore, it could be said that this legislation will increase university patenting further, and indirectly help to perpetuate economic growth and development. On the other hand, this legislative change negatively impacted the patents invented by academic personnel and applied by other types of applicants.

However, while the legislation had a positive impact on university patenting, it appears that its influence might be more pronounced in the more developed regions of Turkey. Most of the university patents in the data belong to universities in the Istanbul region, as shown in the previous chapter. The dominance of these developed regions could hinder the patenting progress of other universities, leading to a more disparate scenario in the future. The universities in less developed regions tend to be less involved in university patenting than academic personnel patenting in general, which indicates a lower occurrence of other types of applications. To promote balanced economic

development, these regional disparities in Turkey must be addressed by these universities and their endeavors in patenting.

The impact of the technological category of these patents also plays a significant role, as the analysis suggests. The patents that belong to the human necessities category of IPC are more likely to be invented and applied by universities. This specialization could have advantages and disadvantages for the technological progress in Turkey. As an advantage, Turkey, with its niche inventions, could be one of the future main actors in this sector. On the other hand, this specialization may not open up places for different subsets of technological improvement, especially newer technologies.

CHAPTER 6

CONCLUSION

This chapter centers on policy evaluation and recommendations derived from the study's findings, ultimately concluding the research.

6.1. Policy Evaluation

The Bayh-Dole Act was enacted in 1980 in the US to encourage technology transfer activities. The act became so successful that it influenced many countries to adopt such a law or legislation in their constitution. One of the countries that adopted this change was Turkey.

Turkey adopted a version of the Bayh-Dole Act in 2017 with the changes in the Industrial Property Law. The law aims to protect intellectual property rights, with the revision enacted in 2017 to extend these rights in university patenting and licensing. This legislation defined the procedures and principles for university patenting activities.

This thesis has studied whether this legislation has impacted university patenting positively in Turkish universities. As demonstrated in the preceding chapter, it is evident that the alteration in legislation in 2017 has yielded a positive impact on the likelihood of an academic personnel's invention being patented through university application. Consequently, the policy can be deemed successful in achieving its intended goal.

Nonetheless, this impact appears to hold significance under specific circumstances. In simpler terms, this change exhibits greater endurance within the developed regions of Turkey compared to the developing ones. Furthermore, a substantial proportion of these patents fall within the primary IPC category A, with other categories constituting

a smaller fraction. Hence, a reasonable deduction is that the likelihood of a patent being university-patented is higher when it aligns with the main IPC category A.

Another result is that patenting activities patented by university authorities are much higher in developed regions of Turkey. Turkey's regional imbalance has been persistent for many years, especially the east-west divide. Hence, it is clear that the university patenting legislation of 2017 is much more effective in the developed regions, especially in Istanbul.

Overall, the 2017 legislation has positively affected university patenting in Turkish universities, and it could be concluded that the policy change is successful. However, the results of the discrepancies among regions and other types of inventions should not be ignored since economic growth and development can only be reached through planned and balanced technology transfer activities within different regions, and different IPC categories, especially new technologies. The following subsection presents some policy recommendations to overcome this challenge.

6.2. Policy Recommendations

Before discussing the policy recommendations, it is essential to take into account the following factual considerations.

As outlined in Article 121 of the Industrial Property Law numbered 6769 (Sınai Mülkiyet Kanunu, 2017, p. 12621), under the title "Inventions made in Higher Education Institutions," it is stipulated that when an invention results from scientific studies and research conducted within higher education institutions, the inventor is required to promptly notify the institution in writing. Consequently, all inventions developed by university members are reported to the respective university. Universities primarily take into account the following factors when determining their ownership claim over an invention:

- The commercial value of the invention, and
- University budget for patent prosecution expenses.

Budget limitation forces universities to own and file lower number of patent applications. Additionally, universities prefer to own and file patent applications for inventions having higher commercial value. As a result, universities mainly prefer to own the inventions in the fields of human necessities and health.

Moreover, there is a significant need for patent valuation services in Turkey. These services are needed to determine or estimate the commercial value for any invention, whether at the stage of invention development or for granted patents. In Turkey, at the moment, TUBITAK provides support for covering the fees associated with obtaining valuation reports for inventions or patents. This incentive is 20,000. - TL (Turkish Lira) and is not sufficient to obtain a reasonable and acceptable valuation report. In recent years, TUBITAK has discontinued providing incentives for patent granting fees, but it is essential to include such fees within incentive policies for patent procedures.

Furthermore, apart from addressing the removal of these incentives, there is room for enhancements in both regional and sectoral dimensions.

From a regional perspective, it might be beneficial to establish government-backed incentives in partnership with regional and local authorities to stimulate university patenting in less developed areas of Turkey. This collaborative effort could involve universities, Regional Development Agencies, and local government bodies. However, it is crucial to prioritize the streamlining of bureaucratic processes and overcoming financial obstacles to ensure the effectiveness of such initiatives.

Conversely, with regards to sectoral considerations, the government could offer subsidies or grants to incentivize universities to innovate and successfully patent novel technologies spanning various IPC categories. This financial support could be allocated either during the patent application phase or when the commercialization process is underway.

Additionally, these recommendations could be merged from a local perspective. Collaborative efforts between local authorities and universities, backed by government funding, could aim to patent academic personnel's innovations in less developed

regions while also focusing on emerging technologies. This holistic approach could effectively address both regional and sectoral disparities.

6.3. Limitations of the Study

This study has some limitations when evaluating the true effect of the legislative. Given the proximity of the year 2017, the immediate impact of the change has only been recently uncovered. In order to make a comprehensive assessment, it is essential to extend the study into subsequent years to see the real impact of the change.

Another limitation of this study is that the commercialization outcomes of these patents and the bureaucratic obstacles encountered have not been explored. Regrettably, these aspects fall beyond the scope of this thesis and remain unexplored.

6.4. Concluding the Thesis

This thesis has studied the impacts of the 2017 legislation change on university patenting in Turkey. The legislation is inspired by the famous Bayh-Dole Act of the US, enacted in 1980. The reason why the legislation was enacted was to promote and encourage university patenting in Turkey. In order to measure this impact, logistic and multinomial logistic regression analysis was used in the study with the data collected from the YÖK Academic Database and TURKPATENT Patent Search.

The logistic regression analysis results indicate that the probability of academic personnel’s invention being patented by universities is higher with the legislation change. This means that the legislation has impacted university patenting positively. Similarly, the multinomial logistic regression analysis revealed that this is also true. Specifically, it is evident that the likelihood of an academic personnel's invention being patented by an individual or a corporation is lower in comparison to it being patented by a university. However, upon introducing various parameters such as regional and categorical information into the analyses, it can be seen that this probability of being patented by a university changes. The results suggest that the legislation exerts a significantly greater positive influence in developed regions of Turkey compared to developing regions.

These findings also exhibit similarities with the patent IPC categories. The majority of university patents fall under the primary IPC category A, which corresponds to human necessities. This suggests a prevalence of academic patenting in the medical field. This prominence is evidenced in both the logistic and multinomial logistic regression analyses.

The thesis concludes by assessing the implications of the 2017 legislation and presenting two interconnected policy recommendations.

In conclusion, this thesis is the first academic study that investigates the actual impact of the 2017 legislative change on university patenting in Turkey and presents policy recommendations to improve the positive impact of university patenting. Therefore, it serves as a guide for prospective investigations in the field.

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APPENDICES

A. CODES FOR DATA ANALYSIS

```
# Import necessary packages for analysis
import numpy as np
import pandas as pd
import statsmodels.api as sm

# Inserting the data file
raw_patent_data = pd.read_excel("./turkpatentrawdata.xlsx")

# Assigning as a dataframe for the data
patents_df = pd.DataFrame(raw_patent_data)

# Renaming the columns of the data set
patents_df.columns = ['university', 'scholar_name', 'patent_name', 'owner_name',
'inventor_name', 'app_no', 'ipc', 'ipc_category', 'application_year',
'is_university_application', 'region', 'applicant_type']

# Remove unnecessary columns
patents_df = patents_df.drop(['scholar_name', 'patent_name',
'owner_name','inventor_name', 'ipc' ], axis=1)

# There may be duplicates for several scholars since a patent or a utility model is
developed by more than one scholar.
# So we need to remove duplicate rows
patents_df.app_no.duplicated().sum()
patents_df.loc[patents_df.app_no.duplicated(), :]

# Detecting null values, if any
```

```
patents_df.isnull().any()

# Creating a dummy variable for IPC category:
def determine_ipc_classification(row):
    if row['ipc_category'] == 'A':
        return 1
    else:
        return 0

patents_df['is_ipc_A'] = patents_df.apply(lambda row:
determine_ipc_classification(row), axis=1)

# Creating a dummy variable for region:
def determine_if_region_1(row):
    if row['region'] == 1:
        return 1
    else:
        return 0

patents_df['is_istanbul'] = patents_df.apply(lambda row:
determine_if_region_1(row), axis=1)

# Creating a categorical variable for applicant type:
def determine_applicant_type_no(row):
    if row['applicant_type'] == 'UNI':
        return 1
    elif row['applicant_type'] == 'PERS':
        return 2
    elif row['applicant_type'] == 'CORP':
        return 3
    elif row['applicant_type'] == 'INS':
        return 4
```

```
patents_df['applicant_type'] = patents_df.apply(lambda row:
determine_applicant_type_no(row), axis=1)

# Creating a dummy variable for applicant type and rearranging the columns
patents_df = pd.get_dummies(patents_df, columns=['applicant_type'],
prefix='is_applicant')
patents_df = patents_df[['university', 'app_no', 'ipc_category', 'application_year',
'is_university_application', 'region', 'is_ipc_A', 'is_istanbul', 'is_applicant_UNI',
'is_applicant_PERS', 'is_applicant_CORP', 'is_applicant_INS']]

# Create a dummy variable for the legislation year 2017:
def determine_is_year_after_2017(row):
    if row['application_year'] < 2017:
        return 0
    else :
        return 1
patents_df['is_year_after_2017'] = patents_df.apply(lambda row:
determine_is_year_after_2017(row), axis=1)



# Logistic regression analysis with dependent variable is_university_application, and
independent variable is_year_after_2017
# Adding a constant term to model A:
year_constant = sm.add_constant(patents_df['is_year_after_2017'])
model_A = sm.Logit(patents_df['is_university_application'], year_constant).fit()
print(model_A.summary())

# Marginal effects of model A:
print(model_A.get_margeff().summary())

# Logistic regression with dependent variable is_university_application, and
independent variables is_year_after_2017, is_istanbul
# Combining the year and region independent variables into year_region_constant.
```

```
year_region_constant = sm.add_constant(patents_df[['is_year_after_2017',
'is_istanbul']])

model_B = sm.Logit(patents_df['is_university_application'],
year_region_constant).fit()
print(model_B.summary())

# Getting the marginal effects of model B:
print(model_B.get_margeff().summary())



# Logistic regression with dependent variable is_university_application, and
independent variables is_year_after_2017, is_istanbul, and is_ipc_A
# Combining the three independent variables into one; y denotes year, i denotes
ipc_dummy, and r denotes region.
year_region_IPC_constant = sm.add_constant(patents_df[['is_year_after_2017',
'is_istanbul', 'is_ipc_A']])

model_C = sm.Logit(patents_df['is_university_application'],
year_region_IPC_constant).fit()
print(model_C.summary())

# Marginal effects of model C:
print(model_C.get_margeff().summary())

# Multinomial logistic regression analysis with dependent variable applicant type,
and independent variable is_year_after_2017
applicant_type_dummy_columns = patents_df[['is_applicant_UNI',
'is_applicant_PERS', 'is_applicant_CORP', 'is_applicant_INS']]
mlog_model_A = sm.MNLogit(applicant_type_dummy_columns,
year_constant).fit()
print(mlog_model_A.summary())
```

```
# Marginal effects of mlog model A
print(mlog_model_A.get_margeff().summary())

# Multinomial logistic regression analysis with dependent variable applicant type,
and independent variables is_year_after_2017, and is_istanbul
mlog_model_B = sm.MNLogit(applicant_type_dummy_columns,
year_region_constant).fit()
print(mlog_model_B.summary())

# Marginal effects of mlog model B
print(mlog_model_B.get_margeff().summary())


# Multinomial logistic regression with dependent variable applicant type, and
independent variables is_year_after_2017, is_istanbul, and is_ipc_A
mlog_model_C = sm.MNLogit(applicant_type_dummy_columns,
year_region_IPC_constant).fit()
print(mlog_model_C.summary())

# Marginal effects of mlog model C
print(mlog_model_C.summary())
```

B. PATENT APPLICATION COUNT DISTRIBUTION BY UNIVERSITY

Table 9. Patent application count distribution by university in the data.

UNIVERSITY NAME	PATENT COUNT
ABDULLAH GÜL ÜNİVERSİTESİ	25
ACIBADEM MEHMET ALİ AYDINLAR ÜNİVERSİTESİ	15
ADANA ALPARSLAN TÜRKEŞ BİLİM VE TEKNOLOJİ ÜNİVERSİTESİ	18
ADIYAMAN ÜNİVERSİTESİ	23
AFYON KOCATEPE ÜNİVERSİTESİ	131
AFYONKARAHİSAR SAĞLIK BİLİMLERİ ÜNİVERSİTESİ	10
AĞRI İBRAHİM ÇEÇEN ÜNİVERSİTESİ	15
AKDENİZ ÜNİVERSİTESİ	101
AKSARAY ÜNİVERSİTESİ	50
ALANYA ALAADDİN KEYKUBAT ÜNİVERSİTESİ	17
ALANYA ÜNİVERSİTESİ	4
ALTINBAŞ ÜNİVERSİTESİ	23
AMASYA ÜNİVERSİTESİ	21
ANADOLU ÜNİVERSİTESİ	123
ANKARA BİLİM ÜNİVERSİTESİ	2
ANKARA HACI BAYRAM VELİ ÜNİVERSİTESİ	7
ANKARA MEDİPOL ÜNİVERSİTESİ	31
ANKARA ÜNİVERSİTESİ	128
ANKARA YILDIRIM BEYAZIT ÜNİVERSİTESİ	66
ANTALYA BİLİM ÜNİVERSİTESİ	21
ARDAHAN ÜNİVERSİTESİ	56
ATAŞEHİR ADIGÜZEL MESLEK YÜKSEKOKULU	1
ATATÜRK ÜNİVERSİTESİ	191
ATILIM ÜNİVERSİTESİ	16
AVRASYA ÜNİVERSİTESİ	2
AYDIN ADNAN MENDERES ÜNİVERSİTESİ	49
BAHÇEŞEHİR ÜNİVERSİTESİ	37
BALIKESİR ÜNİVERSİTESİ	43
BANDIRMA ONYEDİ EYLÜL ÜNİVERSİTESİ	9
BARTIN ÜNİVERSİTESİ	36
BAŞKENT ÜNİVERSİTESİ	21
BATMAN ÜNİVERSİTESİ	36
BAYBURT ÜNİVERSİTESİ	2
BEYKOZ ÜNİVERSİTESİ	12
BEZM-İ ÂLEM VAKIF ÜNİVERSİTESİ	23

BİLECİK ŞEYH EDEBALİ ÜNİVERSİTESİ	71
BİNGÖL ÜNİVERSİTESİ	19
BİRUNİ ÜNİVERSİTESİ	39
BİTLİS EREN ÜNİVERSİTESİ	2
BOĞAZİÇİ ÜNİVERSİTESİ	118
BOLU ABANT İZZET BAYSAL ÜNİVERSİTESİ	94
BURDUR MEHMET AKİF ERSOY ÜNİVERSİTESİ	63
BURSA TEKNİK ÜNİVERSİTESİ	114
BURSA ULUDAĞ ÜNİVERSİTESİ	464
ÇANAKKALE ONSEKİZ MART ÜNİVERSİTESİ	104
ÇANKAYA ÜNİVERSİTESİ	17
ÇANKIRI KARATEKİN ÜNİVERSİTESİ	52
ÇUKUROVA ÜNİVERSİTESİ	191
DEMİROĞLU BİLİM ÜNİVERSİTESİ	32
DİCLE ÜNİVERSİTESİ	38
DOĞUŞ ÜNİVERSİTESİ	22
DOKUZ EYLÜL ÜNİVERSİTESİ	54
DÜZCE ÜNİVERSİTESİ	115
EGE ÜNİVERSİTESİ	284
ERCİYES ÜNİVERSİTESİ	226
ERZİNCAN BİNALİ YILDIRIM ÜNİVERSİTESİ	18
ERZURUM TEKNİK ÜNİVERSİTESİ	23
ESKİŞEHİR OSMANGAZİ ÜNİVERSİTESİ	237
ESKİŞEHİR TEKNİK ÜNİVERSİTESİ	220
FATİH SULTAN MEHMET VAKIF ÜNİVERSİTESİ	25
FENERBAHÇE ÜNİVERSİTESİ	7
FIRAT ÜNİVERSİTESİ	178
GALATASARAY ÜNİVERSİTESİ	9
GAZİ ÜNİVERSİTESİ	269
GAZİANTEP ÜNİVERSİTESİ	351
GEBZE TEKNİK ÜNİVERSİTESİ	199
GİRESUN ÜNİVERSİTESİ	13
GÜMÜŞHANE ÜNİVERSİTESİ	57
HACETTEPE ÜNİVERSİTESİ	238
HAKKARİ ÜNİVERSİTESİ	3
HALİÇ ÜNİVERSİTESİ	6
HARRAN ÜNİVERSİTESİ	38
HASAN KALYONCU ÜNİVERSİTESİ	105
HATAY MUSTAFA KEMAL ÜNİVERSİTESİ	45
HİTİT ÜNİVERSİTESİ	9
IĞDIR ÜNİVERSİTESİ	15
ISPARTA UYGULAMALI BİLİMLER ÜNİVERSİTESİ	146
IŞIK ÜNİVERSİTESİ	9

İHSAN DOĞRAMACI BİLKENT ÜNİVERSİTESİ	146
İNÖNÜ ÜNİVERSİTESİ	109
İSKENDERUN TEKNİK ÜNİVERSİTESİ	64
İSTANBUL AREL ÜNİVERSİTESİ	67
İSTANBUL ATLAS ÜNİVERSİTESİ	13
İSTANBUL AYDIN ÜNİVERSİTESİ	26
İSTANBUL BEYKENT ÜNİVERSİTESİ	22
İSTANBUL BİLGİ ÜNİVERSİTESİ	5
İSTANBUL ESENYURT ÜNİVERSİTESİ	39
İSTANBUL GEDİK ÜNİVERSİTESİ	22
İSTANBUL GELİŞİM ÜNİVERSİTESİ	121
İSTANBUL KENT ÜNİVERSİTESİ	1
İSTANBUL KÜLTÜR ÜNİVERSİTESİ	33
İSTANBUL MEDENİYET ÜNİVERSİTESİ	39
İSTANBUL MEDİPOL ÜNİVERSİTESİ	265
İSTANBUL NİŞANTAŞI ÜNİVERSİTESİ	9
İSTANBUL OKAN ÜNİVERSİTESİ	21
İSTANBUL RUMELİ ÜNİVERSİTESİ	14
İSTANBUL SABAHATTİN ZAİM ÜNİVERSİTESİ	30
İSTANBUL SAĞLIK VE TEKNOLOJİ ÜNİVERSİTESİ	15
İSTANBUL ŞİŞLİ MESLEK YÜKSEKOKULU	1
İSTANBUL TEKNİK ÜNİVERSİTESİ	504
İSTANBUL TİCARET ÜNİVERSİTESİ	8
İSTANBUL TOPKAPI ÜNİVERSİTESİ	16
İSTANBUL ÜNİVERSİTESİ	289
İSTANBUL ÜNİVERSİTESİ-CERRAHPAŞA	534
İSTANBUL YENİ YÜZYIL ÜNİVERSİTESİ	6
İSTİNYE ÜNİVERSİTESİ	22
İZMİR BAKIRÇAY ÜNİVERSİTESİ	21
İZMİR DEMOKRASİ ÜNİVERSİTESİ	13
İZMİR EKONOMİ ÜNİVERSİTESİ	56
İZMİR KATİP ÇELEBİ ÜNİVERSİTESİ	71
İZMİR YÜKSEK TEKNOLOJİ ENSTİTÜSÜ	146
KADİR HAS ÜNİVERSİTESİ	2
KAFKAS ÜNİVERSİTESİ	4
KAHRAMANMARAŞ İSTİKLAL ÜNİVERSİTESİ	74
KAHRAMANMARAŞ SÜTÇÜ İMAM ÜNİVERSİTESİ	61
KARABÜK ÜNİVERSİTESİ	69
KARADENİZ TEKNİK ÜNİVERSİTESİ	150
KARAMANOĞLU MEHMETBEY ÜNİVERSİTESİ	46
KASTAMONU ÜNİVERSİTESİ	60
KAYSERİ ÜNİVERSİTESİ	24
KIRIKKALE ÜNİVERSİTESİ	35

KIRKLARELİ ÜNİVERSİTESİ	9
KIRŞEHİR AHİ EVRAN ÜNİVERSİTESİ	11
KİLİS 7 ARALIK ÜNİVERSİTESİ	11
KOCAELİ SAĞLIK VE TEKNOLOJİ ÜNİVERSİTESİ	2
KOCAELİ ÜNİVERSİTESİ	181
KOÇ ÜNİVERSİTESİ	61
KONYA GIDA VE TARIM ÜNİVERSİTESİ	4
KONYA TEKNİK ÜNİVERSİTESİ	79
KTO KARATAY ÜNİVERSİTESİ	27
KÜTAHYA DUMLUPINAR ÜNİVERSİTESİ	70
KÜTAHYA SAĞLIK BİLİMLERİ ÜNİVERSİTESİ	6
LOKMAN HEKİM ÜNİVERSİTESİ	23
MALATYA TURGUT ÖZAL ÜNİVERSİTESİ	13
MALTEPE ÜNİVERSİTESİ	27
MANİSA CELÂL BAYAR ÜNİVERSİTESİ	179
MARDİN ARTUKLU ÜNİVERSİTESİ	4
MARMARA ÜNİVERSİTESİ	124
MEF ÜNİVERSİTESİ	1
MERSİN ÜNİVERSİTESİ	48
MİMAR SİNAN GÜZEL SANATLAR ÜNİVERSİTESİ	10
MUĞLA SITKI KOÇMAN ÜNİVERSİTESİ	180
MUNZUR ÜNİVERSİTESİ	5
MUŞ ALPARSLAN ÜNİVERSİTESİ	16
NECMETTİN ERBAKAN ÜNİVERSİTESİ	101
NEVŞEHİR HACI BEKTAŞ VELİ ÜNİVERSİTESİ	14
NİĞDE ÖMER HALİSDEMİR ÜNİVERSİTESİ	28
ONDOKUZ MAYIS ÜNİVERSİTESİ	143
ORDU ÜNİVERSİTESİ	41
ORTA DOĞU TEKNİK ÜNİVERSİTESİ	268
OSMANİYE KORKUT ATA ÜNİVERSİTESİ	12
OSTİM TEKNİK ÜNİVERSİTESİ	18
ÖZYEĞİN ÜNİVERSİTESİ	57
PAMUKKALE ÜNİVERSİTESİ	72
PİRİ REİS ÜNİVERSİTESİ	7
RECEP TAYYİP ERDOĞAN ÜNİVERSİTESİ	40
SABANCI ÜNİVERSİTESİ	61
SAĞLIK BİLİMLERİ ÜNİVERSİTESİ	85
SAKARYA UYGULAMALI BİLİMLER ÜNİVERSİTESİ	67
SAKARYA ÜNİVERSİTESİ	137
SAMSUN ÜNİVERSİTESİ	26
SELÇUK ÜNİVERSİTESİ	184
SİİRT ÜNİVERSİTESİ	83
SİNOP ÜNİVERSİTESİ	6

SİVAS BİLİM VE TEKNOLOJİ ÜNİVERSİTESİ	4
SİVAS CUMHURİYET ÜNİVERSİTESİ	26
SÜLEYMAN DEMİREL ÜNİVERSİTESİ	95
ŞIRNAK ÜNİVERSİTESİ	1
TARSUS ÜNİVERSİTESİ	8
TED ÜNİVERSİTESİ	5
TEKİRDAĞ NAMIK KEMAL ÜNİVERSİTESİ	239
TOBB EKONOMİ VE TEKNOLOJİ ÜNİVERSİTESİ	14
TOKAT GAZİOSMANPAŞA ÜNİVERSİTESİ	107
TOROS ÜNİVERSİTESİ	15
TRABZON ÜNİVERSİTESİ	2
TRAKYA ÜNİVERSİTESİ	54
TÜRK HAVA KURUMU ÜNİVERSİTESİ	9
TÜRK-ALMAN ÜNİVERSİTESİ	37
UŞAK ÜNİVERSİTESİ	42
ÜSKÜDAR ÜNİVERSİTESİ	16
VAN YÜZÜNCÜ YIL ÜNİVERSİTESİ	13
YALOVA ÜNİVERSİTESİ	127
YAŞAR ÜNİVERSİTESİ	27
YEDİTEPE ÜNİVERSİTESİ	105
YILDIZ TEKNİK ÜNİVERSİTESİ	312
YOZGAT BOZOK ÜNİVERSİTESİ	38
YÜKSEK İHTİSAS ÜNİVERSİTESİ	1
ZONGULDAK BÜLENT ECEVİT ÜNİVERSİTESİ	46
TOTAL	12861

C. TURKISH INDUSTRIAL PROPERTY LAW ARTICLE 121 / TÜRK SINAİ MÜLKİYET KANUNU 121. MADDE

Turkish Industrial Property Law has been altered for university patenting in 2017 with changes in Article 121, titled as "Inventions made in Higher Education Institutions". The article can be found below in Turkish and English.

Inventions made in Higher Education Institutions

ARTICLE 121- (1) The provisions regarding workers' invention shall be applied to the inventions made in consequences of scientific studies and researches conducted in higher education institutions which are defined in subparagraph (c) of paragraph 1 of Article 3 of the Law numbered 2547; and in higher education institutions connected to Ministry of National Defence and Ministry of Interior, without the prejudice to the provisions of special law and the regulations within the context of this article.

(2) When an invention is made in consequences of scientific studies and researches conducted in higher education institutions; the inventor shall be obliged to notify their invention in written to the higher education institution without a delay. If a patent application is filed, a notification shall be made to the higher education institution regarding the patent application.

(3) In case the higher education institution claims rights on the invention, they shall be obliged to make a patent application. Otherwise, the invention acquires the qualifications of an independent invention.

(4) In contrast to the higher education institution's claim of rights; the inventor can make an objection alleging that the invention is an independent invention. The objection is concluded by the higher education institution also specifying the written grounds. Otherwise, the invention acquires the qualifications of an independent invention.

(5) The articles 115, 116, 118 and paragraph 4 of article 119 shall not be applied to the inventions made in higher education institution.

(6) If the higher education institution wishes to renounce the application or the patent right; or the invention acquires the qualifications of an independent invention after a patent application; the higher education institution, first, offers the inventor to take

over the application or the patent right. In case the inventor considers the offer, the rights shall be transferred. In this case, the higher education institution delivers the required documents to obtain and protect a patent to the inventor. In case of the higher education institution transferring the application or patent right to the inventor; a non-monopolized tenancy can be reserved for a decent fee. In case the inventor refuses the offer, the patent application or the power of disposition on the patent will belong to the higher education institution.

(7) If the higher education institution causes any loss of application process or patent right inflicting from a fault of their own, they shall be obliged to cover the inventor's sustained loss.

(8) Sharing form of the revenue earned from the invention between the higher education institution and the inventor shall be determined by means of at least one third of the revenue to be paid to the inventor. The higher education institution's share of the revenue will be registered in the budget of the higher education institution as the equity revenue; and will be used for covering the needs, particularly scientific researches of the higher education institution.

(9) In determining the right ownership on the inventions generated in the consequences of the studies performed within the context of a specific agreement between the instructors defined in the subparagraph (b) of paragraph 1 of Article 3 of the Law number 2547 along with interns and students; and other public institutes or private organizations; the provisions of the agreement will be based on without prejudice to the provisions of other laws.

(10) Procedure and rules regarding implementation of this article shall be determined by a regulation.

Yükseköğretim kurumlarında gerçekleştirilen buluşlar

MADDE 121- (1) 2547 sayılı Kanunun 3 üncü maddesinin birinci fıkrasının (c) bendinde tanımlanan yükseköğretim kurumları ile Millî Savunma Bakanlığı ve İçişleri Bakanlığına bağlı yükseköğretim kurumlarında yapılan bilimsel çalışmalar veya araştırmalar sonucunda gerçekleştirilen buluşlar için, özel kanun hükümleri ve bu madde kapsamındaki düzenlemeler saklı kalmak kaydıyla, çalışanların buluşlarına ilişkin hükümler uygulanır.

(2) Yükseköğretim kurumlarında yapılan bilimsel çalışmalar veya araştırmalar sonucunda bir buluş gerçekleştiğinde buluşu yapan, buluşunu yazılı olarak ve geciktirmeksizin yükseköğretim kurumuna bildirmekle yükümlüdür. Patent başvurusu yapılmışsa yükseköğretim kurumuna başvuru yapıldığına dair bildirim yapılır.

(3) Yükseköğretim kurumu, buluş üzerinde hak sahipliği talebinde bulunması durumunda, patent başvurusu yapmakla yükümlüdür. Aksi takdirde buluş, serbest buluş niteliği kazanır.

(4) Yükseköğretim kurumunun hak sahipliği talebine karşı buluşu yapan, buluşunun serbest buluş olduğunu ileri sürerek itiraz edebilir. Yapılan itiraz, yükseköğretim kurumu tarafından yazılı gerekçeler de belirtilerek karara bağlanır. Aksi takdirde buluş, serbest buluş niteliği kazanır.

(5) Yükseköğretim kurumlarında gerçekleştirilen buluşlar hakkında 115 inci, 116 ncı, 118 inci maddeler ile 119 uncu maddenin dördüncü fıkrası hükümleri uygulanmaz.

(6) Yükseköğretim kurumu başvurudan veya patent hakkından vazgeçmek isterse veya buluş, patent başvurusu yapıldıktan sonra serbest buluş niteliği kazanırsa, yükseköğretim kurumu öncelikle buluşu yapana başvuru veya patent hakkını devralmasını teklif eder. Buluşu yapanın teklifi kabul etmesi durumunda haklar devredilir. Bu durumda yükseköğretim kurumu, buluşu yapana patent alınması ve korunması için gerekli olan belgeleri verir. Yükseköğretim kurumu, başvuru veya patent hakkını buluşu yapana devretmesi durumunda inhisari nitelikte olmayan kullanım hakkını uygun bir bedel karşılığında saklı tutabilir. Buluşu yapanın teklifi kabul etmemesi durumunda patent başvurusu veya patent üzerindeki tasarruf yetkisi yükseköğretim kurumuna ait olur.

(7) Yükseköğretim kurumu, kusuru nedeniyle başvuru işlemlerinin veya patent hakkının sona ermesine sebep olursa buluşu yapanın uğradığı zararı tazmin etmekle yükümlüdür.

(8) Buluştan elde edilen gelirin yükseköğretim kurumu ve buluşu yapan arasındaki paylaşımı, buluşu yapana gelirin en az üçte biri verilecek şekilde belirlenir. Buluştan elde edilen gelirin yükseköğretim kurumu hissesi ilgili yükseköğretim kurumu bütçesine özgelir olarak kaydedilir ve başta bilimsel araştırmalar olmak üzere yükseköğretim kurumunun ihtiyaçlarının karşılanması için kullanılır.

(9) 2547 sayılı Kanunun 3 üncü maddesinin birinci fıkrasının (l) bendinde tanımlanan öğretim elemanları ile stajyerlerin ve öğrencilerin diğer kamu kurumları veya özel kuruluşlarla belirli bir sözleşme kapsamında yapmış oldukları çalışmalar sonucunda ortaya çıkan buluşlar üzerindeki hak sahipliğinin belirlenmesinde, diğer kanunlardaki hükümler saklı kalmak kaydıyla sözleşme hükümleri esas alınır.

(10) Bu maddenin uygulanmasına ilişkin usul ve esaslar yönetmelikle belirlenir.

D. TURKISH SUMMARY / TÜRKÇE ÖZET

TÜRKİYE'DE BAYH-DOLE: 2017 MEVZUAT DEĞİŞİKLİĞİ ÜNİVERSİTE PATENTLERİNİ NASIL ETKİLEDİ?

Giriş

Çoğu ülke müreffeh ekonomik büyüme ve kalkınmaya ulaşmaya çalışıyor. İktisat bilimi bu zorluğa bir çözüm bulmakla meşgul olmuş ve iktisatçıları bu amaca ulaşmak için çeşitli teoriler geliştirmeye yönlendirmiştir. İktisatçıların bu konuya farklı bakış açıları olmasına rağmen hepsi teknoloji ve teknolojik ilerlemenin uzun vadeli ekonomik büyüme ve kalkınmanın ön saflarında yer aldığına inanmaktadır. Bunun bilincinde olan hükümet yetkilileri, teknolojik yeniliği teşvik etmek için belirli haklar ve düzenlemeler geliştirmiş veya yürürlüğe koymuştur.

Fikri mülkiyet hakları, yenilikçi faaliyetleri teşvik etmenin bir yoludur. Eisenberg'e göre (1996a, s. 161) "fikri mülkiyet" buluşlar, keşifler, yazılar, sanat eserleri, ürün tasarımları ve mal ve hizmetlerin menşeinin belirlenmesi ile ilgili çok çeşitli hakları kapsar. Bu bağlamda, patentler yeniliği ve dolayısıyla teknolojik gelişmeyi teşvik etmek için temel bir kaynak olarak kabul edilebilir. Patent ise, tanım olarak, resmi makamlarca başvuru sahibine izin verilmeksizin belirli bir süre için buluşun başkaları tarafından üretilmesini, kullanılmasını veya ticaretini yapmasını engelleyen fikri mülkiyet hakkıdır (Köker & Yalçıner, 2020, s. 29). Buluşu yapana veya patent sahibine verilen koruma nedeniyle, patentler ekonomi biliminin inceleme konusu olmuştur. Patent koruması buluş sahibine belirli bir süre için verildiğinden, geçici bir tekel ve dolayısıyla pazardaki diğer rakipler için tekelci bir rekabet yaratır. Öte yandan, patent belgeleri buluş veya yenilik hakkında bilgi sunduğundan, patentler de bir bilgi kaynağı olarak kabul edilebilir.

Üniversiteler bilgi kaynağı olarak hayati bir rol oynamaktadır. Üniversiteler eğitim misyonlarının yanı sıra yayınlar, lisanslar, girişimler ve patentler gibi farklı kanallar aracılığıyla da bilgi üretirler. Üniversite patentleri, akademik personel tarafından icat edilen ancak patent başvurusu üniversite tarafından yapılan patentlerdir. Diğer bir deyişle, üniversite patentleri sadece bir bilgi kaynağı oluşturmaz, aynı zamanda

bilginin yayılması yani teknoloji transferi yoluyla ekonomik büyüme ve kalkınmaya da yardımcı olur.

Üniversite patentleri ve teknoloji transferi yıllar içinde önem kazanmış ve çoğu ülke için inovasyonu ve teknolojik ilerlemeyi teşvik etmek için temel bir unsur haline gelmiştir. ABD'nin 1980 tarihli Bayh-Dole Yasası teknoloji transfer faaliyetlerini ve dolayısıyla ekonomik büyüme ve kalkınmayı iyileştirmede bu bağlamda bir kilometre taşı olduğu söylenebilir. Yasa, ABD hükümeti tarafından patent ve ticari marka yasalarını revize etmek için çıkarılmıştır ve birbirini tamamlayan farklı politikaların bir parçasıydı (Eisenberg, 1996b). Yasa, hedeflere ulaşmada başarılı oldu ve ABD, inovasyonda kilit bir oyuncu haline geldi (Loise & Stevens, 2010).

Yasa, birçok ülkeye örnek teşkil etti. Teknoloji transferi ve üniversite patentlerinin geliştirilmesi tartışmaları Türkiye'de de öncelikli bir konuydu ve 2017 mevzuatı bunun için çıkarıldı. Bu mevzuat Sınai Mülkiyet Kanunu'nun bir parçasıydı ve değişiklikler ağırlıklı olarak Türk Patent ve Marka Kurumu mevzuatı tarafından üniversite patentleme ve lisanslama konularını ele alıyordu. Mevzuatın amacı, anlaşmazlık durumlarında ücretlendirme ve tahkim ile yükseköğretim kurumlarından kaynaklanan buluşların ele alınmasına ilişkin açık usul ve esasları belirlemektir. Akademik personelin ürettiği buluş veya yeniliklerin üniversite veya üniversitenin teknoloji transfer ofisi tarafından patentlenmesinin önünü açmıştır. Bu, akademik personel için patent başvuru sürecini kolaylaştırmak için kanunlaştırılmıştır. Mevzuat sayesinde Türkiye'deki üniversite patentlerinin sayısı artmıştır (Patent Effect, 2020).

Ancak bu veriler, bu mevzuatın üniversite patentlemesini nasıl etkilediğini tam olarak göstermemiştir. 2017 yılından önce akademik personel tarafından icat edilen veya başvurulan patentler üniversite patenti sayılmadığından, 2017 yılından önceki akademik patentlerin sayısı tam olarak bilinmemektedir. Dolayısıyla bu çalışma, 2017 yılından önce uygulanan akademik personel patentlerini de kapsayarak söz konusu mevzuatın üniversite patentlemesine etkisini anlama misyonu taşımaktadır.

Bölüm 2: Patentler ve Üniversiteler

Teknolojik gelişme, ekonomik büyüme ve kalkınmanın kritik kaynaklarından biridir. Bu özel amaca yönelik politikalar buna uygun olarak geliştirilmiştir. Devlet yetkilileri, teknolojik gelişmenin korunmasını teşvik etmek için kanunlar ve yönetmelikler oluşturur ve bunlar genellikle fikri mülkiyet haklarının konusu olarak kabul edilir.

Fikri mülkiyet haklarının birçok türü vardır ve bunlardan biri de patentlerdir. Patentler, buluşların yeniliğini belli bir süre için koruyan ve söz konusu buluş için tekelci bir yapı oluşturan belgelerdir. Bu nedenle patentler, patent sahibi için hem teknolojik gelişmeleri hem de ekonomik faydaları başlatır. Öte yandan, patent belgelerinin doğası, buluşun faydalarının ve nasıl yapıldığının ayrıntılı bir şekilde açıklanmasını gerektirdiğinden, patentler bilgi üretimi için kritik kaynaklardan biridir.

Üniversite patentleri ise patentlerin özel bir konusu olarak bu şekilde değerlendirilmektedir. Üniversiteler, bilimsel ve teknolojik yayınlar yoluyla eğitim ve bilgi yaratmadaki rolleri nedeniyle ekonomik büyüme ve kalkınma için vazgeçilmezdir. Burada üniversite patentleri, yalnızca buluşların planlarını üretmekle kalmayıp, aynı zamanda verili tekelci güç için bir süre için bir gelir kaynağı olarak da değerlendirilebildikleri için özel bir ilgiyle irdelenir.

Genel olarak fikri mülkiyet haklarının birçok farklı etkisi olabilir, ancak ekonomide patent koruması birçok akademisyen tarafından incelenen ana konulardan biridir. Ancak patentleri ve ekonomik etkilerini tartışmadan önce inovasyon sürecini tartışmak gerekir. Köker (2005), inovasyon sürecinin birçok akademisyen için öncelikli bir kaynak olduğunu belirtmektedir. Bunun başlıca nedeni, tüm ekonomilerin tarihsel bir bağlamdaki bilgilere dayanmasıdır ve bilginin özelliklerinden biri ister yüksek ister düşük teknoloji olsun, birkaç sektörle sınırlı olmamasıdır; hepsi için geçerlidir.

Bir mal olarak bilgi, son yıllarda bir çalışma alanı haline gelmiştir. Düzenli bir ekonomik mal ile benzer varsayımlara sahip olduğu varsayılabilmesine rağmen, Erdil ve ark. (2018) bir mal olarak bilginin ekonomik anlamda şartlar ve varsayımlarla karşılanmadığını ileri sürmektedir. Diğer malların kullanım değeri tüketim yoluyla azalsa da bilginin kullanımı tam tersi bir sonuç doğurur; genellikle tüketildikçe kullanım değeri artar. Bilgiyi ekonomik bir mal olarak tanımlamanın bir başka yolu da piyasada mübadele edilebilir veya mübadele değeridir. Bu durumda yazarlar, bilginin değiş tokuş edilebilirliğinin bilgiye dönüşmesi, yani zımni bilgiden kodlanmış bilgiye dönüşmesi yoluyla olduğuna inanırlar. Bu aktivitenin bu nihai çıktısı, ölçülebilir bir aktivite oluşturur ve potansiyel olarak maddi olarak değerlenir.

Bilgi, makro düzeydeki etkilerinin yanı sıra mikro düzeyde de fayda sağlar. Nonaka (1991) makalesinde, bilginin şirketler için uzun süreli rekabet avantajının birincil kaynaklarından biri olduğunu öne sürmektedir. Başarılı firmaların, sürekli olarak yeni

bilgi yaratan, bunu organizasyonlarında geniş çapta dağıtan ve ürünlerine hızla benimseyen firmalar olduğunu iddia etmektedir.

Bilgi ve enformasyon arasındaki ilişki, bilgi ve teknoloji ile benzerlikler taşımaktadır. Teknoloji ve teknolojik ilerleme bilgi üretimi ve transferi ile gerçekleşebilir. Dolayısıyla bilgi üreticileri, yani üniversiteler, araştırma merkezleri vb. bir teknoloji transferi yaratarak sonuçta bir bilgi ve teknoloji kısır döngüsü oluşturmaktadır.

Van Norman ve Eisenkot (2017a, 2017b) iki bölümden oluşan çalışmalarında teknoloji transferini, temel araştırmalardan ticari faaliyetlere ve nihayetinde kamu kullanımına kadar yeniliklerin meydana geldiği bir süreç olarak tanımlıyorlar. Bu süreç, (1) inovasyon yayınından ticarileştirme teşvikleri olmaksızın genel yayına, (2) özel sektör tarafından finanse edilen araştırma anlaşmaları yoluyla ve (3) üniversite içindeki yeni kurulan şirketler aracılığıyla yapılabilir. Buna ek olarak, yazarlar üniversitelere girişimci bir rol atayan küreselleşmenin yardımıyla üniversitelerin ekonomik ve sosyal kalkınma için bir kilometre taşı haline geldiğini iddia etmektedir. Meissner (2018), girişimci üniversite kavramını, araştırma ve eğitim alanındaki hizmetlerinin ticari faaliyetleriyle etkileşime giren, böylece üniversite yeniliklerini aktaran veya yenilikleri üniversitelerden firmalar ve yan ürünler tarafından önemli ölçüde ilerleten bir üniversite olarak tanımlamaktadır. Bu konuda kanun ve düzenlemeler çıkarılmış ve özellikle 1980 yılında yürürlüğe giren Bayh-Dole Yasası'nın ABD'de teknoloji transfer süreçlerini mümkün kıldığını da ileri sürülmektedir (Merhacı, 2015). Dolayısıyla, teknoloji transferi ve girişimci üniversitelerin güçlü bir ilişkiye sahip olduğu sonucuna varılabilir. Bu ilişki sonunda üniversiteler, endüstri ve hükümet arasında bir iş birliği yaratır. Teknolojinin gelişmesi ve dolayısıyla üniversite-sanayi iş birliğini teşvik etmesi nedeniyle kamu destekli araştırma merkezleri bu uygulamada bir mihenk taşı olmuştur (Yalçıntaş vd., 2015).

Teknoloji transferinin önemli kollarından biri ve bu çalışmanın ana konusu ise üniversite patentleridir. Üniversite patentleri, üniversitelerden alınan patentlerden oluşan patent sisteminin bir parçasıdır. Üniversite patentlerinin bulunmasının ortak nedeni bilgi üretimidir. Üniversite patentlerinin önemsenmesinin temel sebebinin teknoloji transferi yoluyla ekonomik kalkınma olduğunu da belirtmek gerekir. Mansfield (1991) akademik araştırma ve yenilikler üzerinde çalıştığı makalesinde 1960'larda ve 1970'lerde akademik araştırmanın yüksek bir sosyal yatırım getirisi oranı geliştirdiği bir eğilim buluyor. Bu nedenle, teknoloji odaklı patent faaliyetleri

yürüten kurumlar olarak üniversiteler, bölgesel ve ulusal ekonomik kalkınmada önemli bir rol oynamaktadır.

Sonuç olarak, fikri mülkiyet hakları ve patentler hakkındaki literatür, ekonomi üzerindeki etkilerinin önemli olabileceğini göstermektedir. Ancak bu etkinin yararlı olabileceği gibi zararlı da olabileceği bir gerçektir. Çoğu çalışmanın öncelikle fikri mülkiyet haklarının, özellikle de patentlerin çıkarımlarına ekonomik gelişmeden ziyade ekonomik büyüme perspektifinden yaklaştığı belirtilmelidir. Bu konuları gelişmekte olan ülkeler ve kurumsal perspektifler bağlamında incelemek, konuyu daha kapsamlı bir şekilde anlamak için önemlidir.

Bölüm 3: Kanunlar ve Mevzuat

Fikri mülkiyet hakları, bir ülkenin ekonomik kalkınmasını çeşitli kanallar aracılığıyla etkileme yeteneğine sahip olabilir. Bu kanalların kendilerine has özellikleri vardır ve bir ülkenin ekonomik faaliyetlerini artırabilirler. Ekonominin yaratıcı ve yenilikçi süreçlerle nasıl inşa edildiğine dair fikir verebilir ve bunların gerekli yasa ve yönetmeliklerle korunması, fikri mülkiyet hakları için yasal sistemin sağlamlığını ima eder.

Bayh-Dole Yasası, 1980 yılında ABD 96. Kongresi tarafından patent ve ticari marka yasalarını revize etmek için yürürlüğe girmiştir. Yasa (1979), federal kurumların nasıl yetkilendirildiğini de açıkça tanımlamaktadır. Eisenberg'e (1996b) göre, yasa, ABD'nin hükümet destekli araştırmalara yönelik yenilik politikasında yapısal bir değişiklik yaratan, birbirini tamamlayan farklı politikaların bir parçasıdır. İlk yasa olan Stevenson-Wydler Teknoloji İnovasyon Yasası, teknoloji transferinin federal laboratuvarların ve onların çalışanlarının temel bir sorumluluğu haline gelmesine neden olmuştur. Öte yandan, tamamlayıcı yasa olan Bayh-Dole Yasası, küçük işletmelerin ve kâr amacı gütmeyen kuruluşların devlet destekli araştırma sonuçlarının patentini almasına izin vermiştir.

Loise ve Stevens (2010) Bayh-Dole Yasasının ABD ekonomisini olumlu etkilediğini belirtmektedir. Çalışmadaki veriler, yasa ile ABD ekonomisinin üretim temelinden inovasyon temeline geçtiğini göstermektedir. Yazarlar, yasanın üniversite teknoloji transfer ofislerinin kurulmasını sağladığını iddia etmektedir.

Bayh-Dole Yasası, yalnızca ABD'deki teknoloji ve yenilik politikasını etkilemekle kalmamış, aynı zamanda birçok ülkeyi teknoloji politikaları hakkında farklı

düşünmeye yöneltmiştir. Özellikle OECD ülkeleri politika sistemlerinde yasayı kendi ülkelerine adapte etmişlerdir.

Bu yasaya benzer düzenlemeleri hayata geçiren ülkelerden biri de Türkiye'dir. Uygulama 2017 yılında Sınai Mülkiyet Kanunu'nda yapılan değişikliklerle resmi olarak yasalaşmıştır. Kanun, marka, coğrafi işaret, tasarım, patent, faydalı model ve garantili geleneksel ürün haklarının korunmasını ve böylece teknolojik, ekonomik ve sosyal ilerlemenin artırılmasına katkıda bulunmayı amaçlamaktadır. Kanun en son 2017 yılında TÜRKPATENT mevzuatı ile üniversite patentleme ve lisanslamada yapılan değişikliklerle revize edilmiştir. Mevzuat, yükseköğretim kurumlarından kaynaklanan buluşlar ile anlaşmazlık halinde yargılama ve tahkim sürecine ilişkin usul ve esasları belirlemeyi amaçlamaktadır.

Sonuç olarak ABD, üniversite patentleme ve teknoloji transferi faaliyetleri yoluyla küresel rekabetini artırmak için Bayh-Dole Yasasını geliştirmiştir. Bazı araştırmalar yasanın teknoloji politikasını, üniversiteleri ve küresel rekabeti önemli ölçüde etkilediğini gösterirken, yasanın gereksiz olduğunu gösteren bazı araştırmalar da bulunmaktadır. Bununla birlikte, yasa ABD teknoloji politikası için bir ölçüt haline gelmiş ve diğer ülkelerin üniversiteleri için fikri mülkiyet haklarını değiştirme konusunda etkilemiştir. Bu ülkelerden biri olan Türkiye, ekonomik kalkınma için üniversite patentlemesi, lisanslama ve teknoloji transferinin olumlu etkilerinden yararlanmak amacıyla Bayh-Dole'ye benzer mevzuatlar geliştirmiştir.

Bölüm 4: Metodoloji

Bu bölümde, bu tez için araştırma süreci açıklanmakta ve yöntemleri bu bölümün alt bölümlerinde tanımlanmaktadır. Veri toplama, verilerin tanımlayıcı istatistikleri ve birincil analiz yöntemi bu bölümde sunulmaktadır.

2017 mevzuatının etkisini araştırma yöntemi olarak lojistik regresyon analizi seçilmiştir. Bu seçim, verilerde uygulama sahipliği için yalnızca sınırlı sayıda kategori bulunmasından kaynaklanmaktadır. Bir patent, bir üniversite, bir şirket, bir kurum veya bir kişi tarafından başvurulabilir. Gerçek verilerde bu kategorilerin bazı kombinasyonları vardır, ancak asıl odak noktası üniversitelerin payı ve olasılıkları olduğu için, bu kategorileri oluştururken bazı değişiklikler yapılmıştır. Örneğin patent başvurusu bir üniversiteye ve kişilere ait ise üniversite kategorisi altına alınmıştır.

Bu analiz, iki bağımlı değişken kullanılarak hem iki terimli hem de çok terimli için yapılır. Binom regresyon için bağımlı değişken, patent başvurusu sahibinin bir üniversite olup olmadığını gösteren is_university_application'dır. Öte yandan, çok terimli regresyon için bağımlı değişken, her biri bir başvuru tipini tanımlayan 1'den 4'e kadar dört değer alabilen applicant_type olarak seçilmiştir. Bu konuda üniversite adayları 1, kişisel başvurular 2, şirket veya kurumlar 3 ve kurumlar 4 değerini almaktadır.

Veri Toplama

Veriler, YÖK Akademik Veri Tabanından derlenmiştir. Veri tabanında akademik personellerin çeşitli bilgileri bulunmaktadır ve patentler bunlardan biridir. Bu patent bilgileri her üniversite için o üniversitede kayıtlı akademik personel başına bir MS Office Excel Çalışma Sayfasına toplanır. Fakat YÖK Akademik Veri Tabanında yer alan patent başvuru numaraları veya patent sahipleri gibi bazı bilgiler de eksik olarak gözlemlenmiştir. Bu sorunu aşmak için TÜRKPATENT Patent Arama motorunda veriler TÜRKPATENT kayıtları ile eşleştirilmiştir. Eksik bilgiler, akademisyenin adına veya patent başvuru numarasına göre aranmış ve oluşturulan Excel Çalışma Sayfası TÜRKPATENT'te bulunan kayıtlara göre doldurulmuştur.

Bu eşleştirme işlemi, özellikle patent başvuru numaraları, IPC numaraları ve patent sahibi/mucit isimleri gibi eksik bilgileri tamamlamak için kullanılmıştır. Sonunda, veri çalışma sayfasında yedi sütun oluşmuştur: üniversite, akademisyen adı, patent/faydalı model adı, patent/faydalı model başvurusu sahibinin adı, patent/faydalı model mucitleri, patent/faydalı model başvuru numarası ve IPC numarası.

Bağımlı ve Bağımsız Değişkenler

Verilerin toplanmasından sonra veri temizleme ve sıralama işlemine geçilir. Sayısal bir analiz yapmak için analizin değişkenleri olan birkaç yeni sütun oluşturulmuş ve matematiksel değerler atanmıştır. IPCd, patentin ana IPC kategorisini; year, patent başvuru yılını; ve region, üniversitenin düzey 1 bölge bilgisini göstermektedir. is_university_application ve applicant_type sütunları ise veri analizinde bağımlı değişken olarak kullanılan uygulama sahiplik bilgilerini gösterir.

Analiz için oluşturulan veriler, mükerrer değerler içermeyen 12 sütun ve 12852 satıra sahiptir. Sütunlar; üniversite adı, akademisyen/akademik personel adı, patent/faydalı

model adı, patent/faydalı model başvurusu sahibinin adı, patent/faydalı model mucitleri, TÜRKPATENT kayıtlarındaki patent/faydalı model numarası, IPC adı, ana IPC kategorisi şeklinde ifade edilmektedir.

Araştırmanın temel amacı 2017 mevzuatının etkisini ortaya koymaktır; bu nedenle 2017 yılını ayırt etmek için verilere bir kukla değişken eklenmiştir. Bu yüzden yıl bilgisini de içeren patent başvuru numaralarından yararlanılmıştır.

Zaman bilgisi belirlendikten sonra 2017 yılı için verilerde is_after_2017 olarak adlandırılan bir kukla değişken oluşturulur. Patent başvurusu 2017 yılından önce yapılmışsa 0 değerini alır; 2017'de ve 2017'den sonra yapılmışsa 1 değerini alır.

İkinci bağımsız değişken ise is_istanbul değişkenidir. Bu değişkene kukla değişken olarak üniversitelerin 1. düzey bölge bilgisi eklenmiştir. Türkiye Kalkınma Ajanslarına göre Türkiye'de 12 düzey-1 bölgesi vardır.

Bu değişkenin eklenmesinden sonra patentlerin sınıflandırılması parametresi de eklenmiştir. Patentlerin sınıflandırılması için ilk IPC numarası alınır çünkü bu genellikle patentin ana kategorisini gösterir. Bu bilgilerden, patentlerin ana IPC kategorileri olan A, B, C, D, E, F, G, H ve Y için yeni bir sütun oluşturulmuş fakat Y kategorisinin IPC'nin resmi internet sitesinde yer almamasından ve bu kategori altındaki patentler tüm verilerin yalnızca yüzde 0,07'sini oluşturduğundan analize dahil edilmemiştir. Bu kukla değişken, 0 ve 1 değerlerini içerir, yani A, 1 değerini alırken ve diğer kategoriler 0 değerini alır.

Veri metin değerleri taşıdığından regresyon analizi yapabilmek için bağımlı değişkenler için sayısal değerler iliştirilmiştir. Bu bağımlı değişkenler, bağımsız değişkenlere benzer kategorik değişkenlerdir.

İlk lojistik regresyon analizi için hangi patent başvurularının üniversitelere ait olduğunu gösteren binom bağımlı değişken is_university_application oluşturulmuştur. Patentin üniversite tarafından başvurusu varsa 1, yoksa 0 değerini almıştır. Çok terimli bağımlı değişken için, uygulama sahiplerini farklılaştırmak ve bu farklılaştırmanın anlamlı içgörüler yaratıp yaratmadığına yönelik uygulama sahipliği için applicant_type oluşturulmuştur. Verilerin dört tür başvuru sahibi vardır: üniversite, kişi, şirket ve kurum, her biri sırasıyla 1'den 4'e kadar değerler almıştır.

Veri toplama ve düzenleme işleminden sonra, oluşturulan bağımlı ve bağımsız değişkenler ile lojistik ve çok terimli lojistik regresyon analizi uygulanmıştır. Analizin sonuçları ve yorumlaması ise 5. bölümde belirtilmiştir.

Bölüm 5: Bulguların Analizi

Kukla değişkenleri oluşturmak ve sayısal bir analiz yapmak için Python programlama dili ve bu dil için ise Jupyter Notebook kullanılmıştır. Veri Jupyter Notebook aracına aktarılmış ve analiz için bazı düzenlemeler geliştirilmiştir. Analiz için gereksiz olan değişkenler kaldırılmış ve fonksiyonlar sayesinde kukla değişkenler oluşturulmuştur. Bu değişkenleri geliştirdikten sonra, lojistik ve çok terimli lojistik regresyon analizleri sonuçları ve marjinal etkileri hesaplanmıştır.

Lojistik Regresyon Sonuçları

Bu analiz, patent başvurusu sahibinin üniversite olup olmadığını açıklayan kukla değişken is_university_application bağımlı değişkeni ile üç farklı lojistik regresyon modeline sahiptir. Bölgesel veya sektörel farklılıkların patent başvurusunun bir üniversiteye ait olma olasılığını etkileyip etkilemediğini görmek için bölgesel bilgi ve IPC kategorisinin dahil edildiği üç farklı model vardır. İlk lojistik regresyon modeli (A), yalnızca bağımsız değişken is_after_2017'yi içerir. İkinci lojistik regresyon modeli (B) is_after_2017 ve is_istanbul değişkenlerini içerir ve üçüncüsü ise (C) is_after_2017, is_istanbul ve is_ipc_A içerir.

A modelinin sonuçlarında, is_after_2017 parametresinin istatistiksel olarak anlamlı olduğu ve patent başvurusunun bir üniversiteye ait olma olasılığını olumlu yönde etkilediği görülmektedir. Öte yandan, marjinal etki de pozitiftir ve istatistiksel olarak anlamlıdır. B modelinde, bağımsız değişkenlere ait her iki parametrenin de istatistiksel olarak anlamlı olduğu görülmektedir. Yine is_after_2017'nin marjinal etkisi pozitiftir; bu nedenle 2017 yılı, bir önceki gerilemeye benzer şekilde olumlu bir etkiye sahiptir. Öte yandan, is_istanbul parametresinin katsayısı ve marjinal etkisi pozitiftir. Dolayısıyla, bölge İstanbul'dan uzaklaştıkça bu olasılığın azaldığı söylenebilir.

Model C'de, parametre ve değişkenin marjinal etkisinin istatistiksel olarak anlamlı olması nedeniyle 2017 yılı pozitif etkisini korumuştur. İkinci regresyona göre bölge değişkeninin olasılığa olumlu etkisi bu modelde de görülmektedir. Benzer şekilde, is_ipc_A değişkeni de olumlu bir etkiye sahiptir. Hem parametre hem de marjinal etki pozitiftir ve istatistiksel olarak anlamlıdır. Bu sonuç, IPC kategorisi A altında sınıflandırılan patentlerin üniversite patenti olma olasılıklarının daha yüksek olduğunu göstermektedir.

Çok Terimli Lojistik Regresyon Sonuçları

Bir önceki alt bölüme benzer şekilde, patent başvurusu sahibi tipini açıklayan kukla değişken olan bağımlı değişken applicant_type ile bu analiz için üç ana farklı çok terimli lojistik regresyon modeli vardır. İlk lojistik regresyon (A) yalnızca is_after_2017 bağımsız değişkenini içerir. İkinci (B) is_after_2017 ve is_istanbul değişkenlerini içerir ve üçüncü (C) ise is_after_2017, is_istanbul ve is_ipc_A değişkenlerini içerir.

Çok terimli A modelinde 2017 mevzuat yılının üniversite dışındaki diğer uygulama sahipliği türlerini olumsuz etkilediği sonucuna varılabilir. Değişkenin parametrelerinin ve marjinal etkilerinin istatistiksel olarak anlamlı olduğu göz önüne alındığında, bu sonuç 2017 mevzuat amaç ve hedefleri ile tutarlıdır. Diğer mülkiyet türleri olan kişi, şirket ve kurumların bu mevzuattan olumsuz etkilendiği görülmektedir.

Bağımsız değişkenleri is_after_2017 ve is_istanbul olan çok terimli B modelinde sonuçlar, daha fazla dikkat gerektiren sahiplik türüne bağlı olarak değişmektedir. Regresyon sonuçlarında marjinal etkiler istatistiksel olarak anlamlıdır; ancak üniversite sahiplik türü dışında is_istanbul'un marjinal etkileri, binom lojistik regresyon sonuçlarının aksine negatif hale gelmektedir. Bu durum patentlerin kişi, şirket ve kurum mülkiyet türlerinin Türkiye'nin diğer bölgelerinde daha yüksek paya sahip olduğu anlamına gelebilir.

Bağımsız değişkenleri is_after_2017, is_istanbul ve is_ipc_A olan çok terimli lojistik model C'de sonuçlar sahiplik türlerine göre değişmektedir. Birinci mülkiyet türü olan üniversite için sonuçlar lojistik regresyonla uyumludur. Değişkenler, bir patentin bir üniversite tarafından uygulanma olasılığı üzerinde olumlu bir etki göstermektedir. Bu, bu değişkenlerin istatistiksel olarak anlamlı marjinal etkileriyle desteklenmektedir.

İkinci mülkiyet türü olan kişi için ise, IPC kategorisi değişkeninin katsayısı istatistiksel olarak anlamlıdır ve olumlu bir etki göstermektedir. Buna karşılık 2017 yılı bu olasılığa olumsuz etki yapmıştır ve bu etki, marjinal etkiden de anlaşılacağı üzere istatistiksel olarak anlamlıdır.

Üçüncü mülkiyet türü olan şirket için ise değişkenlerin tüm katsayıları istatistiksel olarak anlamlıdır ve önceki regresyon ve kişi sahipliği bulgularında gözlemlenen sonuçlara benzer bir etki göstermektedir. Ayrıca tüm değişkenlerin marjinal etkileri istatistiksel olarak anlamlı olup negatif olasılık taşımaktadır.

Son olarak dördüncü sahiplik türü olan kurum için is_after_2017 değişkenine ilişkin üniversite sahipliği sonuçlarında da görüldüğü gibi benzer bir örüntü ortaya çıkıyor. Ancak bu durumda is_ipc_A'nın marjinal etkisinin istatistiksel olarak anlamlı olmadığı dikkat çekmektedir.

Bulguların Tartışılması

Sonuçlar hem lojistik hem de çok terimli lojistik regresyon analizlerinde, 2017 mevzuat değişikliğinin etkisinin üniversite patentlemesi, yani üniversiteler tarafından uygulanan patentler için olumlu olduğunu göstermektedir. Ancak bu etki farklı uygulama türlerinde görülmemektedir. Yıl kukla değişkeninin kurum başvuru türünde marjinal etkisi pozitif olmasına rağmen etki üniversite başvuru türünden çok daha küçüktür. Bu sonuç, 2017 mevzuat değişikliğinin üniversite patentlemesi lehine çalıştığını göstermektedir. Başka bir deyişle, politika değişikliği bu konuda başarılı olmuştur.

Sonuçlara başka parametreler de eklendiğinde bu olumlu etki farklılık göstermektedir. Toplanan verilerde, verilerin büyük çoğunluğu, insani gereklilikler kapsamındaki patentleri tanımlayan A kategorisine aittir. Bu dağılım çok terimli regresyon analizi sonuçlarında da görülmektedir. IPC kategorisi değişkeninin değeri 1'den 8'e çıktıkça değişkenin üniversite başvuru türü üzerindeki marjinal etkisi negatif olmaktadır. Ancak uygulama türü şirket olduğunda bu durum değişmektedir. Bu durum, akademik personelin icatlarının veya patentlerinin çoğunlukla şirketler tarafından patentlenme olasılığının olduğunu düşündürebilir. Bu nedenle, Türk üniversitelerinin tıp ve tarım gibi beşerî ihtiyaçlarda akademik patentlemeyi teşvik etmeye daha yatkın olduğu sonucuna varılabilir.

Öte yandan, bölge parametresi analize eklendiğinde, başvuru türü üniversite olduğunda her iki regresyon negatif marjinal etki göstermektedir. Yani bölgenin değeri arttıkça buluşun bir üniversite tarafından patentlenmesi olasılığı önemli ölçüde azalmaktadır. Buradan üniversite patentlemede bölgesel bir farklılık olduğu söylenebilir. Bu sonuç, Türkiye'nin bölgeleri arasındaki gelişmişlik farklılığından kaynaklanmış olabilir. TÜİK verilerine göre kişi başına düşen GSYİH bu bölgeler arasında farklılık göstermekte olup, kişi başına düşen GSYİH'nin ABD doları bazında en yüksek olduğu bölgenin TR1 yani İstanbul bölgesine ait olduğu görülmektedir. Buna karşılık, ABD doları cinsinden en düşük kişi başına GSYİH, 2021'de TRB

bölgesine, yani Orta Doğu Anadolu'ya aittir. Dolayısıyla bu bölgeler arasındaki gelişmişlik farklılıklarının akademik bir buluşun bir üniversite tarafından patentlenmesi olasılığını etkilediği söylenebilir. Öte yandan diğer başvuru türleri incelendiğinde sadece kişi başvuru türünün marjinal etkisinin anlamlı ve pozitif olduğu ortaya çıkmıştır. Bu, İstanbul dışında farklı bölgelerde görev yapan akademik personelin buluşlarını kişisel olarak veya kendileri tarafından patentleme eğiliminin daha yüksek olabileceği anlamına gelebilir. Ancak bu ilişki şirket ve kurum başvuru türlerinde görülmez; bu uygulama türlerinde bölge parametrelerinin marjinal etkileri pozitiftir ancak istatistiksel olarak anlamlı değildir. Dolayısıyla bölgesel farklılıklar açısından bu tür uygulamalardan bir sonuç çıkarmak mümkün değildir.

Bölüm 6: Sonuç

Bu bölüm tezin ana çalıma konusu olan 2017 mevzuat değişikliğini değerlendirmesini yapmakla birlikte, politika önerisi sunar ve tez çalışmasını bitirir.

Politika değerlendirmesi ve önerileri

Bir önceki bölümde de görüleceği üzere 2017 mevzuat değişikliği, bir akademik personelin icadının üniversitenin başvurusu ile patentlenmesi olasılığını olumlu yönde etkilemiştir. Ancak bu etkinin ancak belirli koşullarda anlamlı olduğu görülüyor. Diğer bir deyişle, bu değişim Türkiye'nin gelişmiş bölgelerinde gelişmekte olan bölgelere göre daha kalıcıdır. Ayrıca, bu patentlerin yüksek bir yüzdesi ana IPC kategorisi A'ya aittir ve diğer kategoriler daha küçük bir yüzdeye sahiptir. Bu nedenle, bir üniversite patenti olma eğiliminin, patentin ana IPC kategorisi A'ya ait olması durumunda çok daha muhtemel olduğu sonucuna varılabilir.

Bu durum için iki politika önerisi sunulmuştur. Birincisi, Türkiye'nin gelişmekte olan bölgelerinde üniversite patentlemesini teşvik etmek için bölgesel/yerel yönetimlerin iş birliği ile devlet teşvikleri verilebilir. İkincisi ise, üniversiteleri yeni teknolojiler üretmeye teşvik etmek ve bu yeni ürünleri farklı IPC kategorilerinde patentleyebilmek için devlet teşvikleri veya ödüller verilebilir. Bu sübvansiyon veya ödül, patent başvurusu veya ticarileştirme sürecinde tazmin edilebilir. Bu iki politika tavsiyesi aynı zamanda yerel bir bakış açısı içinde birleştirilebilir, yani yerel yönetim ve bu gelişmekte olan bölgelerdeki firmalar inovasyon faaliyetlerini geliştirmek için üniversitelerle iş birliği yapabilir.

Çalışmanın Sınırlamaları

2017 nispeten yakın bir yıl olduğundan, değişikliğin ilk etkisi yeni keşfedilmiştir. Tutarlı bir ölçüm yapmak için, ileriki yıllarda da bu konu çalışılmalıdır. Bu çalışmanın bir diğer sınırlılığı ise bu patentlerin ticarileşme etkilerinin ve bürokratik engellerin bu tezin kapsamı dışında kalması nedeniyle incelenmemesidir.

Tezi Sonuçlandırma

Bu tez, 2017 mevzuat değişikliğinin Türkiye'de üniversite patentlemesi üzerindeki etkilerini incelemektedir. Mevzuat, ABD'nin 1980 yılında yürürlüğe giren ünlü Bayh-Dole Yasası'ndan esinlenmiştir. Yasanın çıkarılmasının nedeni, Türkiye'de üniversite patentlemesini teşvik etmek ve teşvik etmektir. Bu etkiyi ölçmek için YÖK Akademik Veri Tabanı ve TÜRKPATENT Patent Araştırması'ndan toplanan verilerle yapılan çalışmada lojistik ve çok terimli lojistik regresyon analizi kullanılmıştır.

Lojistik regresyon analizi sonuçları, bir akademik personelin buluşunun üniversite tarafından patentlenme olasılığının mevzuat değişikliği ile daha yüksek olduğunu göstermiştir. Bu, mevzuatın üniversite patentlemesini olumlu yönde etkilediği anlamına gelmektedir. Benzer şekilde, çok terimli lojistik regresyon analizi bunun da doğru olduğunu öne sürmüştür. Ancak farklı parametreler, bölgesel ve kategorik bilgiler analizlere eklendiğinde, bir üniversite tarafından patent alma olasılığının değiştiği görülmektedir.

Tez, birbirini tamamlayabilecek iki politika önerisiyle sona ermektedir. Sonuç olarak bu tez, 2017 yılında yapılan mevzuat değişikliğinin Türkiye'deki üniversite patentlemesindeki fiili etkisini araştıran ve üniversite patentlemenin olumlu etkisini artırmak için politika önerileri sunan ilk akademik çalışmadır. Bu nedenle ileride yapılacak araştırmalar için yol gösterici olarak değerlendirilebilir.

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YAZARIN / AUTHOR

Soyadı / Surname : Çorum Aktaş
Adı / Name : İrem
Bölümü / Department : İktisat / Economics

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