A VALUATION FRAMEWORK FOR UNIVERSITY PATENTS IN TURKEY FROM UNIVERSITY'S (SELLER) AND INDUSTY'S (BUYER) PERSPECTIVES

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ABSTRACT

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Science and technology policies and policy-making processes in Turkey have been changing. One of such changes is the owner of university patents. Turkey legislated a new patent law similar to Bayh-Dole Act of the U.S and universities become the owner of patents. Being the first research on university patents in Turkey this thesis aims to put a valuation framework for university patents from both the university's (seller) and industy's (buyer) perspectives and show the differences and similarities between the university and industry. The thesis tries to answer how university patents should be valuated from both university and industry perspectives. Patent value indicators are collected from the literature and separate surveys are conducted to universities and firms. Since there is not sufficient data on university patents, the conjoint analysis method is used. The method is novel for patent valuation. 18 hypothetical patents are created and both parties are asked to evaluate these patents. The research results are used for policy recommendations for both industry and university.

Keywords: University Patents, Patent Valuation, Conjoint Analysis

ÖZ

ÜNİVERSİTE PATENTLERİNİN ÜNİVERSİTE (SATICI) ve SANAYİ (ALICI) BAKIŞ AÇISIYLA DEĞERLEME ÇERÇEVESİ

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Türkiye'de bilim ve teknoloji politikaları değişmektedir. Bu değişimlerden bir tanesi de üniversite patentlerinin hak sahipliği ile ilgilidir. Amerika Birleşik Devletleri'ndeki Bayh-Dole yasasının bir benzeri de Türkiye'de uygulanmaya başladı. Patentlerin yönetilmesinin bir boyutu da bu patentlerin değerlermesidir. Bu tezin amacı üniversite patentlerinin değerlemesinde üniversite (satıcı) ve sanayi (alıcı) bakış açılarıyla bir çerçeve ortaya koyabilmek ve iki taraf arasındaki benzerlik ve farklılıkları ortaya koymaktır. Bu tez kapsamında üniversite patentlerinin üniversite ve sanayici bakış açılarıyla nasıl değerlemesinin yapıldığının cevabı aranmaktadır. Patent değerleme ile ilgili kriterler literatürde araştırılmış ve üniversite ile sanayiye iki anket ile sunulmuştur. Bu çalışmada Türkiye'de üniversite patentleri ile ilgili yeterli veri olmaması nedeniyle deneysel tasarıma imkan veren conjoint analiz metodu uygulanmıştır. 18 farazi patent oluşturularak her iki gruba bu patentleri değerlendirmeleri istenilmiştir. Araştırma sonuçları hem üniversite hem de sanayi için politika geliştirmede kullanılmıştır.

Anahtar Kelimeler: Üniversite Patentleri, Patent Değerleme, Conjoint Analiz

So, verily, with every difficulty, there is relief. Verily, with every difficulty there is a relief

To My Little Boy

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LIST OF ABBREVIATIONS

AUTM	Association of University Technology Managers
EPO	European Patent Office
IPA	Institutional Patent Agreement
IPC	International Patent Classification
NIH	National Institutes of Health
OECD	The Organisation for Economic Co-operation and Development
R&D	Research and Development
TTO	Technology Transfer Office
TUBITAK	The Scientific and Technological Council of Turkey
Turkpatent	Turkish Patent and Trademark Office
U.K	United Kingdom
U.S	United States
USPTO	United States Patent and Trademark Office
WIPO	World Intellectual Property Organization
WW-II	World War-II

CHAPTER 1

INTRODUCTION

Science and technology policy in Turkey has been changing since 2012. This policy change also involves a systematic change supported by new boards and organizations as well as new policy tools. One pillar of this shift concerns the management of university patents in Turkey. In 2013, the government started to support university technology transfer offices (TTO) for the management of intellectual property rights in universities. These TTOs aim to commercialise the knowledge created in universities by strengthening the links between the university and the industry. Turkey also changed its patent legislation at the end of 2016. Before the new legislation, university generated patents were owned by the researchers. Today, universities own the patent rights. The main aim of these policy changes in Turkey is to increase the university's involvement in the economy. Universities can contribute to economic development through collaborative research with the industry, academic entrepreneurship, and patent licencing to the industry. Although collaborative research between the industry and entrepreneurship is less than expected, success stories exist in both fields. However, patenting activities in universities are very limited. Both the number of patent applications and the number of granted patents are far less than the government's expectations. Licenced or sold patents and income generated from these patents are very low as well. Patents contain uncertainties and risks by nature. Patenting an invention is a complicated process, and there is no guarantee that every invention can be patented. Even if an invention is patented, the commercial success of patents is uncertain. This risky process makes valuation of patents difficult.

This research aims to propose a framework for the valuation of university patents from both the university's and industry's perspectives. Two main research questions of this thesis are as follows:

1) How should university patents be valuated from the university's (seller) and industry's (buyer) perspectives in Turkey?
2) What are the differences and similarities in the valuation of university patents in Turkey from the buyer's and seller's perspectives?

Before starting the research, the questions below should be briefly answered.

1.1 What Makes Univeristy Patent Valuation Interesting?

Patent management is a new subject for universities in Turkey, and universities have little experience on this subject. One dimension of patent management is valuation. Fisher and Leidinger (2014) claim that the valuation of patents and the identification of the value indicators of patents are complicated and challenging processes. Gambardella, Giuri and Luzzi (2007) suggest that patent valuation has been recognised as a significant topic for various research fields such as economics and technology management. However, the researchers in Turkey have little interest in the topic and as such this the first research on valuation of university patents in Turkey.

Since patent management is a recent topic for universities in Turkey, the low number of licenced patents may be caused by the inaccurate valuation of patents and the different perspectives of sellers and buyers of patents which have not been investigated thoroughly before. Therefore, this research contributes to the literature and may also address the policy discussions on the commercialisation of university patents.

1.2 Why Conjoint Analysis Is Used?

This research investigates the value indicators of university patents and the effect of each indicator to patent value. However, the number of university patents which are either sold or licenced to the industry is very low in Turkey. Thus, data to investigate the patent value indicators in Turkey are insufficient. To investigate the relationship between value indicators and patent value, an experimental setup is needed.

Conjoint analysis, which enables the researchers to design an experimental setup, is used in this thesis. Even though conjoint analysis is generally used in marketing research, in the United States, the method is used for patent valuation in patent infringement cases (Sidak and Skog 2018). In this research, different hypothetical patent profiles are created for valuation. The university is asked to rate their willingness to sell each patent and the industry is asked to rate their willingness to buy each patent.

Conjoint analysis determines how each value indicator has been evaluated by both parties. Therefore, conjoint analysis is used in this study to investigate the valuation of university patents from two different perspectives.

1.3 What Is The Novelty?

Although researchers investigate the value of patent, this study is the first to investigate the valuation of university patents in Turkey.

In the literature, researchers discuss how to evaluate patents. The relationship between patent value and different value indicators and the effect of value indicators to value are examined. However, most of the studies in the literature focus only on either seller or buyer perspective. The present research provides the opinions of both seller and buyer, and these different perspectives are analysed.

The implementation of the methodological tool in this study is also novel. Even though conjoint analysis is used to determine patent damage penalties in the United States, this research uses a different type of conjoint analysis method. In US courts, choice-based conjoint analysis is used. In this thesis, rate-based conjoint analysis is employed.

1.4 What to Expect From The Analysis?

In this research, hypothetical patent profiles which have different value indicators are evaluated from both the university and the industry perspectives. Firstly, the effect of these indicators to patent value for both groups is investigated. Secondly, the differences and similarities between the university's and industry's perspectives on the valuation of university patents are analysed. Policies are recommended for both the university and the industry in the conclusion.
The analysis aim to contribute to strengthening the collaboration between the university and the industry. The results of this research may also assist in the process of knowledge transfer from the university to the industry.

1.5 Synopsis

This thesis consists of five chapters. The first chapter introduces the thesis. In the second chapter, a theoretical framework is provided, and the value indicators in the literature are investigated. Seven hypotheses are developed according to the related literature. The first and main hypotheses is that university and industry have different perspectives in valuation of university patents. The other hypotheses are explained in the second chapter. In the third chapter, the details of conjoint analysis are described, and the hypothetical patent profiles that are evaluated are created. The process of collecting data is also explained in this chapter. In the fourth chapter, the results are analysed. The results are interpreted for both the university and the industry. The final chapter is the conclusion. The policies, which are developed using the results, are also recommended in this chapter.

CHAPTER 2

THEORITICAL FRAMEWORK

The patenting process is a complex issue that involves uncertainties. The subject of university patents in Turkey is new. Before, directly discussing the valuation of university patents, it is beneficial to give background about the recent changes in universities and the role of patents in this change.

In this chapter, firstly, general information about changes in university research trends in the world and in Turkey is provided. Secondly, the basic concepts of patents are explained. Then, the literature on patent valuation is reviewed briefly. Finally, the hypotheses of the thesis are presented.

2.1 Third Mission of Universities

Early universities had only one mission: to educate the people. However, in the early 1800s, in Germany, Wilhelm von Humboldt and his brother claimed the unity of research and education in universities (Nybom 2003). Humboldt's idea advanced in the United States during World War II (WWII). After the war, there was a consensus headed by Vannevar Bush to support basic research in universities to induce economic growth (Carlisle and Kleinman 1997). Research in universities was traditionally funded by governments. However, the origins of university-industry collaborations such as the Silicon Valley computer industry, the Research Triangle Park in North Carolina and Route 128 in Boston emerged different from this tradition. These collaborations acted as alternatives to government funding of the research missions of universities (Scott 2006).

The Research Triangle Park was established in 1951 by the state and local government to foster the economic development of the North Carolina region. In the

1950s, North Carolina ranked the second lowest according to per capita income in the United States. The economy of the state was tied to tobacco, textile, and furniture. The research park was at the heart of three universities: Duke University, North Carolina State University, and University of North Carolina at Chapel Hill. Local firms were also in proximity. The park promised companies cheap land and office spaces near the three universities. At first, companies were not eager to move to the park due to the low economic performance of the North Carolina state. However, in 1965, IBM and the National Institute of Environmental Health Sciences of the United States decided to move to the park. These two institutions were followed by other firms. The firms and the universities created a unique environment in the park which nurtured a culture of innovation and entrepreneurship, fostering the state's economy. Firms benefited from cheap office spaces and funded research in the universities and used the research results in their products. North Carolina had become one of the leading places to live and work in the United States (Smilor et al. 2007).

Silicon Valley has a similar history with a different path from the Research Park Triangle. Stanford University in the United States was always a base for military and commercial inventions. Radio, vacuum tubes, and telegraph industries were located in the region at the beginning of the twentieth century. The graduates of the university had played significant roles in the development of the San Francisco and California region. During the 1940s and 1950s, the university managers encouraged the faculty members and graduates to start their own companies. The support of private corporations created a special linkage between the university and the industry during the 1960s. Hewlett Packard, General Electric, Xerox, Eastman Kodak, and many other companies moved to Silicon Valley. By the early 1970s, there were many computer and semiconductor companies in the Valley.

The interaction between the university and the industry caught the attention of venture capitalists and created a unique atmosphere in the Silicon Valley, where many innovative start-up companies were established and grew. The novel interactions between the university and the industry in the Silicon Valley and the

Research Triangle Park caused a shift to civilian technoscience research from basic research supported by the military to cover the needs of a knowledge-based economy (Slaughter 1998). Companies realised that they have to access knowledge and technology either to reduce the costs of their existing products or services or to introduce new products. Intangible assets such as intellectual property, human capital, and firm's routines are more significant than tangible assets such as machinery and production facility for a knowledge-based economy, and the proportion of knowledge-intensive professions is higher than labour-intensive jobs in the economy (Göksidan, Erdil, and Çakmur 2018).

Traditional universities had two missions: to teach and to do research. After the 1970s, universities started to adopt a third mission: to incorporate economic and social development. In the 1970s, the competitiveness of the US industry was declining, especially against Japan and Germany (Coriat and Orsi 2002). Bremer, Allen, and Latker (2009) claim that by the end of the 1970s, the United States was no longer the leader of traditional sectors such as automotive, electronics, and steel. In this context, the concept of entrepreneurial universities and technology transfer from the university to the industry had attracted attention (Markman et al. 2005). The US government has been investing in research and knowledge creation to generate jobs, to increase the competitiveness of the United States in the global market, and to sustain the welfare of the United States since WWII. However, the government has realised that investment in research and knowledge alone would not directly increase the competitiveness of the US industry. Even though the government invests in science, the research results do not automatically translate to commercial value. The policymakers in the United States were influenced by the success of the Silicon Valley and the collaboration between actors in the Valley. The universities add fostering economic and social development as a new function to their traditional missions by commercialising the knowledge generated by research (Etzkowitz 1998). The interaction between the university and the industry which contributed to economic development shifted the direction of universities and research conducted in universities. The social and economic changes in the 1980s and 1990s created the entrepreneurial university concept and led to transformations in universities where knowledge and technology transfer to the industry were at the heart. Universities were encouraged by governments to transform into entrepreneurial institutions by commercialising research results, licencing technologies, creating spin-offs from university, introducing entrepreneurship programs, and developing university-industry relations (Melorose, Perroy, and Careas 2015).

The famous Bayh–Dole Act of 1980 was accepted as a pillar of the entrepreneurial university concept. The act aimed to foster economic development by commercialising university research (Aldridge and Audretsch 2017). The policymakers believed that the act would introduce science-based technologies which would be the outcomes of research conducted in universities.

2.1.1 The Bayh–Dole Act and University Patents

The US senator Birch Bayh stated in 1980 that:

> *What sense does it make to spend billions of dollars each year on government-supported research and then prevent new developments from benefiting the American people because of dumb bureaucratic red tape?*[1]

Policymakers believed that licencing technologies developed in universities to the industry would strengthen the links between the university and the industry. Technology transfer from the university to the industry would increase the competitiveness of the country. The literature on the Bayh–Dole Act can be classified under two themes: the ones that support the act and find a positive effect on outcome variables, such as patenting activity, patent applications, and commercialisation revenue, and the ones that find no effect (or no significant effect) on outcome variables.

Before the act, the US federal government owned the outcomes of research funded by them. The act permits universities to pursue the ownership of inventions which are the result of government-funded research. The number of patents issued by US universities was fewer than 250 in 1980, most of which were not commercialised.

1. Statement by Birch Bayh, 13 April 1980, on the approval of S. 414 (Bayh–Dole) by the US Senate on a 91–4 vote, cited from AUTM (2004, p. 16).

This number was less than 1 percent of all patent applications in the United States in 1980. However, in 1999, the ratio reached nearly 4 percent (Mowery and Sampat 2005). It remained at 4 percent in 2016 (6,639 university patents among 140,969 patents).

The Bayh–Dole Act enables the commercialisation of research conducted in universities and helps technologies developed in universities to diffuse (Grimaldi et al. 2011). The spillover of knowledge via university patents affects not only science but also the economy. After the Bayh–Dole Act, the economic activity based on university research rose to 30 billion dollars, more than 2,200 spin-off companies were established, and approximately 250,000 jobs were created as a result of licencing of academic patents.[2] University technology transfer offices (TTOs) were established to commercialise patents by licencing or to help create spin-off companies. The private sector is encouraged by policymakers to invest in university research to develop inventions which are market-ready products due to the act (Bremer, Allen, and Latker 2009).

Aldridge and Audretsch (2017) investigate technology transfer activities with the data collected directly from the researchers. They claim that the Bayh–Dole Act significantly affects academic entrepreneurship and licencing. According to OECD (2000), the Bayh–Dole Act was a vital element in the growth of income, employment, and efficiency in the US economy during the late 1990s.

Many researchers argue that the effect of the act on university patenting was exaggerated. Eisenberg (1996) claims that the data about patents owned by the federal government prior to the act were biased since the research contractors had already rejected ownership of the intellectual property right. Mowery et al. (2001) argue that the patenting and licencing activities in US universities are independent of the act but are mostly outcomes of the investment in biotechnology research during the 1960s and 1970s. They suggest that the number of patent applications was already on the rise at the second half of the 1970s. They claim that before the act,

2. https://www.cogr.edu/sites/default/files/The_Bayh-Dole_Act-__A_Guide_to_the_Law_and_Implementing_Regulations.pdf (accessed 22 August 2019).

inventions from public research were often commercialised without patents. On the other hand, Bremer (2008) admits that the number of patent applications was on the rise during the 1970s. However, she also claims that the act was crucial as a shift in science and technology policy in the United States. She argues that the policy change about university patents consists of three phases. The first phase was the Institutional Patent Agreement (IPA), which simplified university patenting of research funded by the National Institutes of Health (NIH). The second phase was the establishment of a professional community of university patent managers, who could foster patenting and licencing activities in universities. The third phase was the change of ownership of patents which were the outcomes of research funded by the federal government. She claims that the Bayh–Dole Act was the final step for changing the patenting policy, which boosted the patenting and licencing activities in US universities.

Bulut and Moschini (2006) suggest that thirty years after the act was implemented, net revenues from patent licencing significantly decreased due to the high costs of patent management. So et al. (2008) argue that believing that the Bayh–Dole Act facilitated commercialisation in the United States is an illusion because of misleading data about the growth of academic patents, licences, and licencing revenues. They conclude that intellectual property rights will not directly foster the commercialisation of research results. Bremer et al. (2009) claim that universities may make poor decisions about technology transfer and licencing of university patents.

Table 1 Critics of Bayh-Dole

Pro-Bayh–Dole		Against Bayh–Dole	
Author(s)	Criticisms	Author(s)	Criticisms
Grimaldi et al. (2011)	Provides diffusion of technology	Eisenberg (1996)	Biased data about patents
Bremer et al. (2009)	Fosters economic development	Movery and Sampat (2005)	Licencing activities are the results of investment in bioscience
Berman (2008)	The final step of policy shift due to more efficient use of patents	So et al. (2006)	Misleading data about patents and technology transfer

Aldridge and Audretsch (2017)	Major impact on entrepreneurship and technology transfer	Bulut and Moschini (2006)	Net revenues from technology transfer are low

However, the act should not be blamed for these poor decisions. They believe that despite the criticisms on the Bayh–Dole Act, it had clearly exceeded the expectations of Birch Bayh and Bob Dole. Table 1 summarises the critics of Bayh-Dole Act.

The contribution of the Act to economic transformation and research in universities cannot be disregarded due to the increase in the patent numbers and revenues. Therefore, the Act imitated by other countries. However, the specific conditions and circumstances of each country should be taken into account when imitating the Act.

2.1.2 Effects of Bayh–Dole and Turkish Case

The success of US universities in patenting and licencing caught the attention of the governments of other developed and developing countries. In Europe, academicians had posed the ownership of inventions which were developed in university laboratories. Academicians had enjoyed the full rights of research results. *Hochschullehrerprivileg* (the professor's privilege) on research outcomes was prevalent, especially in Germany and other European countries. However, the UK and the Netherlands changed their intellectual property law similar to the Bayh–Dole Act during the 1990s. In 2002, *Hochschullehrerprivileg* was abolished by the German government, and Germany revised its patent legislation similar to Bayh–Dole. France, Denmark, Austria, and Norway also revised their patent laws to grant intellectual property rights to universities, in a manner similar to Bayh–Dole (Grimaldi et al. 2011). Not only developed European countries but also developing countries imitated the act. Argentina in 1990, Brazil in 1998, China in 1985, India in 2000, and Indonesia in 2002 changed their intellectual property laws, imitating the Bayh–Dole Act (Giorgio et al. 2007).

Sapsalis et al. (2006) suggest that patent legislation similar to the Bayh–Dole Act has had a crucial and positive effect on European inventive activity. They claim that these laws foster patenting activities in universities and public research centres. Giorgio et al. (2007) claim that technology transfer from universities to the industry fosters economic development. However, effective technology transfer can occur only in an environment with a good national system of innovation. Laws similar to the Bayh–Dole Act provide the basic institutional foundation of a national system of innovation. These laws trigger patenting activities in universities and its spillovers by technology transfer.

Turkey also changed its patent legislation at the end of 2016. The andante legislation allows researchers in universities to enjoy full rights of their inventions. As in many European countries, the new patent law ended the professor's privilege in Turkey, and now Turkish universities have the right to own the intellectual property rights of their inventions.

Before the new patent legislation, the Turkish government set targets for the centenary of the country's establishment, which is called Vision 2023. By 2023, Turkey aims to

1) become a top-ten economy in the world,
2) increase gross domestic product to 2 trillion dollars,
3) increase the annual export to 500 billion dollars with 1 trillion volume of foreign trade,
4) increase the working population to 30 million and reduce the unemployment rate to 5 percent.

Even though these goals are not realistic anymore and revised at the 11th Development Plan, these goals have led the policy shift in Turkey. To achieve the 2023 goals set then, the Science and Technology High Council of Turkey decided to develop policy tools in 2012 to trigger innovation and entrepreneurship in universities by supporting TTOs and incubation centres, developing an entrepreneur and innovative university ranking system, and redesigning the academic promotion criteria to advance entrepreneurship and innovation. Building upon these resolutions, in 2012, the Scientific and Technological Council of Turkey (TÜBİTAK) took steps to support university TTOs to commercialise research results by encouraging university-industry collaboration, licencing academic patents, and promoting academic entrepreneurship. At the beginning of the support program, academicians had full rights over patents which are outcomes of their research. Before the legislation, academicians tended to reveal their research by publishing articles because the promotion criteria were based on publishing articles (and other scientific output), which may act as a barrier to patenting. Some universities added patenting inventions to their promotion criteria. The importance of patenting activity is expected to increase in universities. Both technology transfer intermediaries and new patent legislation are expected to foster the commercialisation of research results and increase the collaboration between the university and the industry. Both parties are expected to benefit from the policy change in Turkey. Universities are expected to have more research funds. The competitiveness level of the Turkish industry is also expected to increase.

2.1.3 University Patents in Turkey

Patents are generally the outcome of research and development (R&D) activities. Based on the data of the Turkish Statistical Institute, 36 percent of R&D spending in Turkey is incurred by universities.[3] The government in Turkey aims to increase the commercialisation of research activities in universities. However, the number of patent applications from universities and the revenue generated from university patents are lower than government expectations.

The government in Turkey wants the diffusion of technology from universities to the industry and wants to turn the research results into economic value. Therefore, the government started to change its policy approach about science and patents.

TÜBİTAK has announced an innovative and entrepreneurial university index each year since 2012. University-industry collaboration, intellectual property capacity, and entrepreneurship are the three dimensions of the index. The aim of the index is to foster the universities involvement in economic development (Gür et al. 2017). This increased awareness and moreover the TTO support program explained below

3. http://www.tuik.gov.tr/PreHaberBultenleri.do?id=24865 (accessed 22 August 2019)

became conditional upon high rankings in the index. As a result, patenting and commercialisation activities became more important for universities.

Before the TTO's and the recent amendment of the law there were no intermediaries for commercialisation and technology transfer. Thus, academicians were alone in the commercialisation of their inventions. They also had to suffer the cost of patents which were not commercialised in a short period.

TÜBİTAK has announced different TTO support programs. The TTO support program which has been in force since 2013 fosters the commercialisation of academic patents. The new Turkish patent law which is similar to the Bayh–Dole Act ended professor's privileges on research results. Academicians do not have to suffer from the costs of patents. Policymakers in Turkey now expect that the number of academic patents will increase due to the technology transfer support program, new Turkish patent law, and entrepreneurial university ranking index.

Patent is an intangible asset which includes knowledge and provides the owner with commercial privilege in a specific period. Understanding the patent basics and how the patenting mechanism works for the commercialisation of research is important. Therefore, in the next section of this chapter, the features of patents will be explained.

2.2 Patent Basics

The World Intellectual Property Organization (WIPO) defines patent as:

> *a set exclusive right granted for an invention by a sovereign state, which is a product or a process that provides, in general, a new way of doing something, or offers a new technical solution to a problem.*[4]

The European Patent Office (EPO) defines patent as:

> *legal title that gives inventors the right, for a limited period (usually 20 years), to prevent others from making, using or selling their invention without their permission in the countries for which the patent has been granted.*[5]

4. http://www.wipo.int/patents/en/ (accessed 22 August 2019)

The United States Patent and Trademark Office (USPTO) defines patent as:

> *the grant of a property right to the inventor, issued by the United States Patent and Trademark Office.*[6]

One of the oddities of knowledge is that even though producing knowledge is very expensive, imitating it is very cheap (Nordhaus 1967). Patents allow the inventor to prevent others from any commercial activity so that the invention cannot be used by others to produce, distribute, sell, and import, among others, without permission. Patent rights are not global rights, but patent provides privileges only in one specific country in accordance with the law of that specific country. However, the invention can be patented in different countries by using priority right. After the first filing of the patent, the applicant can file the application in other countries for a limited time. The collection of patent applications which protect the same invention in different countries is called a patent family. The patents in a patent family are combined through priority right. A patent family describes the geographical scope of the patent where the invention is protected. The date of the first filing is called the priority date. Priority right is limited for one year which begins in the priority date. Patents do not provide protection in perpetuity. The period of patent protection is usually 20 years. However, the protection period can change according to the patent laws of countries.

The invention is described by the patent specification document. The prior art section of the patent document contains information about existing technologies related to the invention. It also refers and cites previous patents and articles about the technology. Patents use previous knowledge about the technology field. Therefore, patents are key elements in the diffusion of knowledge. Usage of previous patents is called backward citation. Citing a later patent is called forward citation. Besides previous patents, a patent can also cite non-patent literature such as peer-reviewed scientific papers, databases, conferences, and other related literature. Patents which are bases with a high number of forward citations for future patents, technological

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5. https://www.epo.org/service-support/glossary.html#p (accessed 22 August 2019)

6. https://www.uspto.gov/patents-getting-started/general-information-concerning-patents#heading-2 (accessed 22 August 2019)

developments, original products, and services are called base patents. Squicciarini et al. (2013) define base patents as breakthrough inventions. Patents with high generality impact are cited by later patents which belong to different technology fields. These patents have a general impact which leads to following innovations in a different technical field (Hall and Harhoff 2001).

Claims of patent determine the scope of patent protection. A patent may have more than one claim. A claim consists of three parts:

1) Preamble: This part of the claim defines the category of the invention, and it should be consistent with the title of the invention.
2) Transitional Phase: This part comprises the open-ended phrase, and any additional unrecited elements are not excluded. It expands the scope of the claim by allowing for other limitations.
3) Body of the Claim: This part describes the elements and limitations of the claim and explains the relationship between the different elements in the claim.

Specification documents, figures, and claims are highlighted in the decision about granting a patent application. The scope of protection provided by the patent can be narrowed or extended by the claims. The breadth of the patent is the amount of information it protects. It is closely related to the scope of patent protection. Substitute inventions may be patented only by inventing around the claims of the patent. Inventing around means not to infringe the patent claims in the court. The strength of patent protection is closely related to the difficulty of inventing around.

Patent authorities use the International Patent Classification (IPC) codes to determine the technical area of invention. Approximately 70,000 IPC codes are used. Lerner (1994) uses the term *patent scope* as the number of distinct four-digit subclasses of IPC. A patent may have more than one IPC class. Patents with a wide range of technical areas are one of the sources of knowledge diffusion, and these patents are expected to guide original results. Patent originality is defined as the wideness of various technical areas on which a patent depends. A patent is called a radical patent when it highly refers to the documents which are different from its own IPC classes (Squicciarini et al. 2013).

Even though the quality of patents is closely related to the scope of patents, claims, breadth of the patent, and citations, various definitions of patent quality exist. According to patent attorneys and engineers, patent quality means a well-written document which protects a major invention rather than an incremental technology. Lawyers generally define quality as the success of a patent in court against oppositions. For economists, patent quality is measured by the financial and technological benefits of the patent (Squicciarini et al. 2013).

Every invention cannot be patented. It should meet three criteria:

1) Novelty: The invention should be new. According to Turkish patent law,

   The invention does not form part of the state of the art. The state of the art consists of anything made available to the public by a written or oral description, use or in any other way before the filing date (priority date), and the contents of certain Turkish, European, and international patent applications with an earlier filing date (priority date) published on or after that date[7]

2) Inventive Step (Obviousness): The invention must be non-obvious. Inventive step is a confusing concept. According to EPO, "an invention is considered as involving an inventive step if, having regard to the state of the art, it is not obvious to a person skilled in the Art".[8] Invention step differentiates design from a patent. To meet the invention step criterion, the invention must not be developed by ordinary people by observing. For instance, a pitcher with a hand holder and a glass are known objects to people. If a person invents a cup for the first time and tries to patent it, he will fail because of lack of inventive step. Inventive step differentiates a design or utility model from a patent.

[7]. http://www.wipo.int/export/sites/www/scp/en/national_laws/novelty.pdf (accessed 22 August 2019)
[8]. https://www.epo.org/law-practice/legal-texts/html/guidelines/e/g_vii_1.htm (accessed 22 August 2019)

3) Industrial Applicability: The invention must be useful in real life. EPO describes the industrial applicability criterion as the capability of exploitation in the industry.[9]

The patent application is granted if and only if the invention fulfils the above-mentioned criteria. Patent authorities such as EPO, Turkish Patent and Trademark Office (Turkpatent), and USPTO prepares two reports about patent applications. The first report is the search report which aims to reveal prior art. The second report is the examination report which ensures the application whether it meets the patentable criteria or not. There is a time lag which is called the grant lag between the application date and the grant date. The grant lag is approximately two to three years. After the patent grant, others have the right to object to a patent in patent courts for violation of another patent. Patent courts hand out a decision about the violation. Patent authorities demand a maintenance fee often called renewal fees for the patent to stay in force. Renewal fees increase by the age of the patent. If renewal fees are not paid, the patent is cancelled. In Turkey and Europe, patent owners have to pay renewal fees each year. However, in the United States, patent owners have to pay renewal fees only in the fourth, eighth, and twelfth year.

Academic knowledge has been identified as one of the most vital elements for technological and economic development (Sterzi 2013). Universities are the main source of new knowledge and technology. Patents are one of the tools of new knowledge and technology creation and diffusion. The knowledge embodied in patents can be exploited by licencing it to others. According to the Association of University Technology Managers (AUTM), technology transfer is transferring scientific research results from the source (university) to the receiver (industry) for further development and commercialisation. The technology transfer process is composed of three steps:

1) Define the new technology
2) Protect the technology by patenting

[9] https://www.epo.org/law-practice/legal-texts/html/guidelines/e/g_vii_1.htm (accessed on 22 August 2019)

3) Commercialise the patented technology by licencing or creating a new start-up company

Pitkethly (1997) argues that patent applicants and patent owners confront four major decisions from invention till the end of the patent life:

1) Whether to apply for a patent for the invention
2) Whether to continue with the application before it is granted according to research and examination reports.
3) Whether to keep the patent in force after the grant
4) How to exploit the patent (selling, licencing, etc.)

2.3 Commercialisation of University Patents

University TTOs spread in the United States after the Bayh–Dole Act. Many universities established TTOs to commercialise their patents (Mowery and Sampat 2005). TTOs that are intermediaries between the university and the industry help to exploit the knowledge embodied in patents by licencing them to others. Licencing enables others to enjoy the privileges of the protected new invention. Patent licences can be either exclusive or non-exclusive. In an exclusive licence, both the patent owner and the licensee confirm that any other person or entity cannot exploit the relevant patent except the licensee. On the contrary, in a non-exclusive licence, the licensee can exploit the patent at the same time that the patent owner can licence the intellectual property to others.

Even though the technology transfer concept is well known in the United States and other developed countries, before 2012, only a few universities in Turkey adopted TTOs. However, after 2012, TÜBİTAK launched a support policy for universities to establish TTOs. At the end of 2016, a new patent legislation was issued, and it ended the professor's privilege on research results. TTOs in Turkey now have to manage the intellectual property of universities beginning with the disclosure of the invention to the end of the protection period.

Table 2 Patent Basics

Term	Definition
Patent	A set of exclusive rights for an invention which prevent others from any commercial activity
Novelty	Invention has to be new
Inventive step	Non-obviousness
Applicable to industry	Must be used in real life
Patent family	The collection of patent applications which protect the same invention in different countries
Priority date	The filing date of the first patent in a patent family
Prior art	The section of the patent document which contains information about existing technologies related to the invention
Claim	The protection scope of the invention
Patent authorities	The patent officials who decide to grant a patent application
Search report	The report issued by patent authorities to reveal prior art
Examination report	The report issued by patent authorities to determine whether the invention is patentable or not
Grant lag	The time lag between the application date and the grant date
Patent renewal fee	The maintenance fee which is paid by the owner to authorities for the patent to stay in force
IPC (International Patent Classification)	Technology fields of patent
Forward citation	Being cited by later patents
Backward citation	To cite previous patents in the patent specification document
Citation to non-patent literature	To cite non-patent literature such as articles, conferences, etc.
Generality impact	Being cited by later patents from various technology fields
Patent originality	The wideness of various technical areas on which a patent depends
Breadth of the patent	The amount of information protected by the patent
Inventing around	Not to infringe the patent claims in the court

As R&D, patents also contain uncertainties by nature. First, the patent application process is complex, and it is not certain whether the patent application will be granted or not. Even if the patent application is granted by authorities, others have the right to file a lawsuit about the patent violation. Patents also contain both technical and commercial uncertainties. The *Economist* magazine in 1851 stated that "patents are like lotteries in which there are a few prizes and a great many blanks". Table-2 shows the basic definitions about patents.

As the patent provides privileges on future usage, there is also considerable uncertainty in its value (Ersnt et al. 2010). Due to the uncertainties and costs of patents, patent valuation becomes more significant to not only universities but also buyers of protected technology. There is also asymmetric information between the buyer and the seller about the patented invention. Buyers usually do not know how the patented technology works, and sellers have less information about the market applications of the patent. Therefore, both sides of patented technology do not have sufficient information about the patent. Valuation is significant in decreasing the level of asymmetric information about patents.

The number of patents is used for measuring R&D performance and research productivity. However, a simple patent count provides biased information about R&D performance (Scherer, Vopel, and Harhoff 2000). Besides the simple patent count, the economic value of the patent is crucial for R&D performance and research productivity.

Only a small proportion of patents turn out to be extraordinarily valuable. Valuating patents is crucial for intellectual property managers since they have a limited budget (Pitkethly 1997). Increase in the number of academic patents will make it difficult for university technology transfer managers to monitor all patents. Therefore, a framework to select valuable patents will make it easier to monitor and manage them.

2.4 General Principles on Patent Valuation

Pitkethly (1997) claims that any decision about the valuation of patents contains speculations since valuation involves judgment about the future. He suggests that before any valuation, these questions should be asked: Who is doing the valuation? For whom? For what purpose? The current research attempts to create a framework about university patent valuation from both the university's and industry's perspectives to commercialise the research results conducted in the university. Patent valuation is a skew business since the patent is meaningful with uncertain future benefits. In this study, the similarities and differences between the university and the industry perspectives in university patent valuation will be revealed.

2.4.1 Review of Related Literature on Patent Valuation

Since different perspectives on university patent valuation are investigated in this study, the literature will be reviewed in two categories: the seller's perspective and the buyer's perspective. The aim of the literature review is to determine the factors of patent valuation and to establish the hypotheses to be tested.

2.4.1.1 Literature about Patent Valuation from the Seller's Perspective

One of the early studies to measure the value of patents was conducted by Nordhaus (1967). According to Nordhaus (1967), the lifetime of a patent is an important indicator of its value. Patents with a longer lifetime are expected to be more valuable than those with a shorter lifetime (Nordhaus 1967).

Pakes (1986) attempts to estimate a model which allows others to recover the distribution of returns from holding patents. He claims that patents which are renewed each year have economic value. Therefore, he attempts to calculate the patent value according to the renewal fees. However, he states that the value distribution of patents is very skewed that conducting more empirical analysis is difficult. The study of Pakes disregards the total costs (R&D costs, patent application costs, etc.) of the invention. Therefore, even if patent renewal costs might not exceed the royalty return, the total cost of holding the patent might exceed the total royalty return. Pakes (1986) also assumes only valuable patents are renewed. He does not consider that patent holders might not renew the patent due to other reasons such as legal conflicts with other patents.

Lanjouw (1998) extends Pakes's (1986) research by adding the legal costs to Pakes's model. He attempts to estimate the private value of patents in different technology areas using renewal and legal costs. Lanjouw (1998) claims that different technology groups have different values. In his research, he suggests that textile patents are the least valuable, computer patents are the second least valuable, engine patents are the second most valuable, and pharmaceutical patents are the most valuable.

Bessen (2006) estimates the patent value by using patent renewal data and by using the same model that Pakes (1986) used. He investigates the relationship between patent value and patent characteristics. He first examines the relationship between applicant type and renewal data. His analysis suggests that patents which are owned by large companies is more valuable than those owned by small companies, individuals, and non-profit organisations. However, the most valuable patents are those owned by small companies at the fourth year and those owned by large companies at the eighth year.

Next, Bessen (2006) examines the relationship between patent renewal and technology fields. He claims that patent value differs with respect to the technology field. He finally investigates the relationship between patent value and other patent characteristics such as winning an opposing suit, number of forward citations, backward citations, and claims. He claims that a patent which won an opposing suit is nearly six times more valuable than a patent with no opposing suit. He suggests even though the number of forward and backward citations and the number of claims positively influence patent value, their effect is very low. He argues that additional citation increases patent value by 1 percent, and an additional claim increases patent value by 2 percent.

Harhoff et al. (2003) examine the relationship between patent value and different patent characteristics. Their data were obtained through a survey of patent owners. They investigate the relationship between patent value and IPC classification codes (technology field), number of forward citations, number of backward citations, number of references to non-patent literature, family size (countries where the patent is protected), and the result of lawsuits. Their econometric analysis showed that the relationship between patent value and IPC classes is insignificant, which is contrary to Lanjouw (1998). Forward citations, backward citations, references to non-patent literature, and family size have a highly significant and positive effect on patent value. Their results also showed that the patent which has won one or more opposition lawsuits is more valuable than a patent which has no lawsuit.

Gambardella, Harhoff, and Verspagen (2008) attempt to estimate the economic value of patents and the relationship between value and the number of forward citations, backward citations, claims, and countries where the patent is applied for. The study conducted by Gambardella et al. (2008) is similar to that by Harhoff et al. (2003). They asked the inventors to value their patents if a potential buyer wants to buy on the day the patent was granted with all information available today. They attempted to establish a model to value patents as an asset, or in other words, they treated the patent as the only asset of the firm. Similar to Bessen (2006), the average value of patents was higher than that calculated by Pakes (1986) and Lanjouw (1998) who used renewals as a valuation method. However, if the most valuable 140 patents are eliminated from the data, Bessen's result is consistent with Pakes (1986) and Lanjouw (1998). The eliminated patents which are valued as the highest among the data set were mostly pharmaceutical patents. Their analysis also shows that the number of forward citations, backward citations, claims, and countries where the patent is protected affects patent value. However, these four determinants only explain the 2.7 percent of the variance of patent value. Forward citations have more impact than the total impact of backward citations, claims, and countries.

Triest et al. (2007) attempt to estimate the value of patents which are owned by a petrochemical company. They suggest that an accurate valuation can only be achieved with accurate information about technology, rivals, and market conditions. They claim that the value of a patent is defined by its benefits and by the cost of its maintenance. They argue that a patent may benefit its owner through either licencing incomes or competitive advantage to others in the market. Patents have an advantage of decreasing production costs within the company. However, this advantage is not directly caused by the patented document but by the technology which the owner invented. The only benefit of the patent is caused by the licencing and royalty income. Thus, they claim that the value of a patent is based on the difference between the licencing income and maintenance fees. Their suggestion is that the licencing income is related to the market conditions, the number of competitors, and the technological advantage of the patented invention.

Reitzig (2003) conducted a study about the value of 127 patents which are owned by a semiconductor company. In his research, he asked the company engineers to value 127 patents. Thereafter, he conducted a survey about the value determinants of these patents. He investigated the relationship between patent value and the following determinants:

1) Technical importance – novelty and inventive activity
2) Inventing around
3) Learning value through disclosure (Benefits of competitors due to disclosure of invention)
4) Forward citations
5) Difficulty of proving infringement

Reitzig's research results suggest that technical importance – novelty and inventive activity, learning value through disclosure, forward citations, and difficulty in inventing around are closely related to patent value. Forward citations is the most dominant determinant for patent value. Patents which serve as a basis for further patents are more valuable than other patents. Technical importance – novelty and inventive activity and difficulty in inventing around have a similar positive effect on patent value. Even though learning value through disclosure has a positive effect on patent value, its effect is less than technical importance – novelty and inventive activity. Reitzig's results also showed that no significant relationship exists between the difficulty of proving potential infringement of the patent and patent value.

Reitzig (2003) surveyed patent owners to value the patent and examine the relationship between patent value and other value indicators. Thus, his study can be regarded as a valuation from the seller's perspective.

Sapsalis et al. (2006) examine the value of academic and industrial patents in biotechnology in Belgium. They attempt to answer whether the value distribution of academic and industrial patents is similar and whether both academic and industrial patents have the same value determinants. They assume that patents which receive forward citations are valuable. Sapsalis et al. (2006) claim that patent value distribution for both academic and industrial patents is parallel. They also argue that despite the small differences, the value determinants of the patents of both institutions are also generally parallel. They tested the effects of the number of non-patent citations, the number of backward patent citations, the number of inventors, and the number of countries in the patent family. Their results show that backward patent citations have a constructive and significant contribution to both academic and industrial patents. The number of inventors of patents also contributes to both patents. The number of inventors of academic patents has a negative and significant effect on patent value. However, the number of inventors of industrial patents has a positive and more significant effect on patent value. According to Sapsalis et al. (2006), scientists tend to limit the number of researchers in their team to eliminate disagreements on the income from the invention. However, in private companies, the aim of the research is targeted by the management. Therefore, the number of inventors of the patent for companies has a positive effect on patent value. In Sapsalis et al.'s (2006) research, the number of countries in the patent family is the last determinant for testing patent value. Their results show that the patent family has no significant or zero effect for both academic and industrial patents.

Sapsalis et al.'s (2006) research on biotechnology patent in Belgium provides a framework about the valuation of both industrial and academic patents. Even though they admitted there is no empirical evidence on the value of their data set, they assume that the valuable patents are the forward-cited patents. Their study was based on this assumption. Indeed, the number of forward citations of a patent clearly shows its social and scientific value.

Sapsalis and van Pottelsberghe (2007) also examine the value of academic patents in Belgium and investigate the relationship between patent value and value indicators. They proximate patent value by using forward citations. After estimating patent values, they investigate value indicators. They hypothesise that scientific knowledge, technical knowledge, and geography where the patent is protected and collaborative research are related to patent value. Sapsalis and van Pottelsberghe (2007) define non-patent citations as the basis of scientific knowledge of patents and backward citations as the basis of technical knowledge of patents. Their results argue that the type of non-patent citations has more impact than the number of non-patent citations. According to their study, patents which applicants' previous studies are more valuable than patents which cite others. Sapsalis and van Pottelsberghe (2007) also claim that patents which cite other academic patents are more valuable than those which cite the patents owned by firms. They also indicate that patents which cite applicants' previous patents are less valuable. They suggest that both self-citation and citation to a firm's patent are signs of incremental innovation. Therefore, the value of these patents is lower. Sapsalis and van Pottelsberghe (2007) claim that the type of co-applicants is an important indicator of patent value rather than the number of applicants. They also report that a patent which is applied by more than one university is more valuable than patents which are applied by a university and a company. Patents which are results of collaborative research within universities are more valuable than those which are results of collaborative research with a university and a company. Their results also show that the number of countries does not affect patent value. However, patents which are in force in the United States or in Japan are more valuable than those which are in force only in Europe.

Deng (2007) examines the relationship between patent value and the patent's geographic coverage. His results show that valuable inventions are protected by EPO applications rather than only a national application. He also claims that patent value changes with the economy of the protected country. Patent value increases with the economic size of the protected country.

Zeebroeck (2011) attempts to establish a method to rank or weight patents rather than the valuation of patents by using different determinants such as forward citations, total number of inventors, patent family size, patent renewals, and oppositions to the patent. However, he admits that ranking patents with patent value indicators is very difficult. He confronts some complications. Patent citations differ during the patent protection time. The longer time the patent is in force increases its probability to be cited by other patents. Citations and the total number of patent applicants also differ from industry to industry. For instance, the number of applicants in biochemistry is much more than that in construction business. The institutional and structural factors of each country make patent valuation by family size difficult to benchmark over time. The problem with valuation by renewals is that in certain industries such as pharmaceuticals, the cost of maintaining a patent may be marginal when compared with the cost of the R&D efforts. Some companies may choose to renew the patent even if the cost of renewal is more than its value. Oppositions to patent applications are rather a stable variable. However, the agreements between patent applicants and opposition are unknown.

Ernst et al. (2010) claim that patent value is determined by the income difference between an R&D project with patent protection and the same R&D project without patent protection. They develop a simulation model which estimates patent value by Monte Carlo simulation and the real options approach. In their model, the project can be finalised before the end product. Therefore, their simulation estimates both benefits and losses of the project. Their results show that patented projects have more cash flow than unpatented ones. On the other hand, patented projects have more losses due to early finalisation. Ernst et al.'s (2010) analysis shows that the total cost of the R&D project has a positive effect on patent value. However, the uncertainties in the market, such as uncertainties in sales and new competitors in the market, among others, have a negative effect on patent value. Ernst et al. (2010) use a simulation which is very hard to apply in the real world. They equalise the value of the patent to the value of the R&D project. However, a project may result in more than one patent. The value distribution between these patents is uncertain in their research.

Lai and Che (2009) use patent lawsuit data to determine patent value from both the seller's and buyer's perspectives. They investigate the relationship between damage value and various indicators. They claim that backward citations and non-patent references have no effect on patent value, whereas forward citations have a positive effect on patent value. The time from the application date to the lawsuit date also has a positive effect on patent value. Even though the larger patent family has higher maintenance costs, patent family size has a negative effect on patent value.

2.4.1.2 Literature about Patent Valuation from the Buyer's Perspective

Klemperer (1990) explores the trade-off between patent lifetime and patent breadth for patent value. He explains that patents with a long lifetime but narrow breadth are preferred when the substitution costs are low between similar products. On the other hand, patents with a very short lifetime but wide breadth are preferred when not buying costs are high. Klemperer (1990) also investigates the buyer's costs on patents. Therefore, his study focuses on the buyer's perspective.

Gilbert and Shapiro (1990) conducted a similar research as Klemperer (1990) about the trade-off between patent lifetime and patent breadth. Even though patent breadth is generally defined as the protection scope of the patent, they define patent breadth as the flow rate of profit available to the patent owner while the patent is in force. In their model, patent breadth has no effect on the substitute products, and patent breadth only affects the price that the patent owner can charge. In contrast to Klemperer (1990), they claim that in any circumstances, patent lifetime generates more revenue regardless of patent breadth. The study of Gilbert and Shapiro (1990) is from a seller's perspective, and their results do not match with Klemperer (1990).

Klemperer (1990) and Gilbert and Shapiro (1990) disregard the market conditions and assume that the patented invention would sell in any case. They ignore the uncertainties of future market conditions.

Green and Scotchmer (1995) suggest that knowledge and technical progress are results of cumulative processes: invention, modification, and improvement. They investigate both the total profits gained from the innovation and the division of profit between the first innovator and the improver. They assume that after the first innovation is made (innovator), it is improved by another firm (improver). In their model, the first innovator can benefit from the invention by licencing the improver after the second invention is achieved (post-ante) or before the improvement is achieved (ex-ante). The roles of patent lifetime and patent breadth are examined in their study. They claim that patent breadth determines the division of profit and patent lifetime determines the total profit of both innovators. A wider patent breadth enables the first innovator to benefit more, and a longer patent lifetime increases the total profit from the product. The study of Green and Scotchmer (1995) investigates the patent value from both buyers' and sellers' perspectives.

Sneed and Johnson (2009) analyse the patent sales on a specific platform for patent transactions called Ocean Tomo. This platform offers periodical patent auctions. Individual inventors, investors, academic institutions, private companies, and government agencies try to sell their patent by using the auctions in the Ocean Tomo platform. In the auctions, patents are sold either in lots or in single patents. Sneed and Johnson (2009) examine the relationship between selling prices and different patent value indicators. Their results show that the number of IPC classes, the number of countries in the patent family, the lag time, and the age of the patent have a significant negative effect on patent value. The age of the patent shows the highest significant negative effect. Even though the number of claims and the number of inventors have negative effects, they both slightly influence the value. Forward citations have the most positive effect on the selling price. The patents with owners who frequently apply for patents are more valuable than those with owners who rarely apply for patents. Backward citations also have a positive effect, although insignificant, on patent value.

Sreekumaran et al. (2011) also study the Ocean Tomo auctions. They examine the relationship between the selling price of patents and patent value determinants:

forward citations, backward citations, generality, originality, age, family size, and technology field. Their analysis shows that only forward citations and patent family size have a positive effect on the selling price of patents. Other value determinants have no positive or negative significant effect on patent value. The combined effect of forward citations and family size is 14.79 percent.

Fischer, Timo, and Leidinger (2014) also studied patent value with Ocean Tomo's auction data. Their results show that the probability of patents being bought increases with increase in the number of forward citations, increase in the number of backward citations, higher generality, and larger family size. On the other hand, their results show that the probability of patents to be bought decreases with patent age. Older patents are sold with a lower probability than younger ones.

Table 3 Ocean Tomo Auctions

Value Indicator	**Sneed and Johnson (2009)**	**Sreekumaran et al. (2011)**	**Fischer et al. (2014)**
Forward citations	High positive effect	High positive effect	High positive effect
Backward citations	Very low positive impact	No significant impact	High positive impact
Age of patent	High negative impact	No significant impact	High negative impact
Patent family size	High negative impact	High positive impact	High positive impact
Number of IPC classes	High negative impact	No significant impact	No significant impact
Lag time	High negative impact	Not applicable	Not applicable
Number of claims	Very low negative impact	Not applicable	Not applicable
Number of inventors	Very low negative impact	Not applicable	Not applicable
Generality of patent	Not applicable	No significant impact	High positive impact
Originality of patent	Not applicable	No significant impact	Not applicable

Table 3 summarises the result of the three studies on the Ocean Tomo auctions. Research valuation is performed in these studies from the buyer's perspective. All three studies agree that buyers tend to purchase patents with a high number of forward citations. Even though the generality of a patent is closely related to the number of forward citations, Sreekumaran et al. (2011) claim that generality has no significant effect on the buyer's decision about patent value. This result actually contradicts itself. According to Sneed and Johnson (2009) and Fischer et al. (2014), the age of the patent has a negative effect on the buyer's decision about patent value. However, Sreekumaran et al. (2011) claim that the age of the patent does not affect the buyer's decision.

Even though Fischer et al. claim that backward citations have a positive effect on buyers, Sneed and Johnson (2009) and Sreekumaran et al. (2011) disagree about the effect of backward citations on patent value. Differences between the three results may be due to the data set they used. The largest data set was used by Fisher et al. (2014). However, they admitted that their data mostly consist of computer and information technology patents. The differences in these data sets might have caused the inconsistencies in the results.

Green and Scotchmer (1995) argue that the "research" and "development" aspects are equally important for commercialisation. They claim that innovation occurs in two stages by different entities: the first innovator and the improver. The improver might have more resources and benefits than the innovator. Therefore, the innovator might not have a sufficient incentive to invest in the invention. The first innovation might not compete with the improved one. Therefore, the first innovator might lose the motivation to research and invent. Loss of motivation might endanger the entire knowledge and technical progress. Green and Scotchmer (1995) investigate the division of profit between the first innovator and the improver. They assume that after the first innovation is made, it is improved by another firm. Each derivative improvement incurs cost which is finally added to the price of the last product. The first innovator can benefit from the invention by licencing the improver. Determining patent value from both the seller's and buyer's perspectives, their results show that the novelty of the first invention determines the value of the patent and the royalty income from the patent.

2.4.1.3 Quantitative Patent Valuation Methods

So far in the literature review, patent quality indicators are used as value indicators. In the literature, researchers attempt to calculate patent value by using different methods.

1) Cost-Based Valuation Method: This simple method defines patent value as the total cost of developing the invention. Since in this study university patents are examined, the total research cost of the patent equals to the total value of the patent. Even though the cost-based valuation method is simpler than other methods, it is not accurate for patents with high-income expectations. This method can be assumed a method which considers the seller's perspective for valuation.
2) Market-Based Valuation Method: This method considers the value of the patent as the value of a similar substitute product. The value of the invention is determined by comparing similar products in the market. However, this method is accurate if there are substitute patents or products. This method can be assumed as a method from the buyer's perspective.
3) Income-Based Valuation Method: This method estimates patent value according to future income. There are several types of income-based valuation methods, such as discounted cash flow valuation method and option-based valuation, among others.

Even though quantitative patent valuation methods provide a more precise value for patents, none of them are accurate. The cost-based method disregards future benefits. The market-based method works only if substitute patents or products are available in the market. The income-based valuation method is actually based on an estimation of future income. If at first the estimation is not accurate, the entire valuation will be inaccurate. Market conditions are also disregarded in the income-based valuation.

2.4.1.4 General Overview of the Literature

Various value indicators listed in Table 4 are reviewed in the literature from both the seller's and buyer's perspectives. The indicators are grouped into five:

Table 4 List of value indicators

Indicator	Group	Seller's Perspective	Buyer's Perspective
Lifetime	Age related	Nordhaus (1967), Pakes (1986), Green and Scotchmer (1995)	Fischer, Timo, and Leidinger (2014), Klemperer (1990), Gilbert and Shapiro (1990), Green and Scotchmer (1995)
The time from application date to lawsuit date		Lai and Che (2009)	
Age of patent			Sneed and Johnson (2009)
Technology field	Technology related	Lanjouw (1998), Bessen (2006)	Sneed and Johnson (2009)
Technological advantage, technical importance – novelty and inventive activity		Triest et al. (2007), Reitzig (2003)	
Forward citations		Harhoff et al. (2003), Gambardella et al. (2008), Reitzig (2003), Sapsalis et al. (2006), Sapsalis and van Pottelsberghe (2007), Lai and Che (2009)	Sneed and Johnson (2009), Sreekumaran et al. (2011), Fischer, Timo, and Leidinger (2014),
Backward citations		Harhoff et al. (2003), Gambardella et al. (2008),Sapsalis et al. (2006)	Fischer, Timo, and Leidinger (2014)
Reference to non-patent literature – Number of non-patent citations		Harhoff et al. (2003), Sapsalis et al. (2006)	
Type of citations		Sapsalis and van Pottelsberghe (2007)	
Patent scope	Patent Scope	Green and Scotchmer (1995)	Klemperer (1990), Green and Scotchmer (1995)
Number of claims		Gambardella et al. (2008)	
Inventing around		Reitzig (2003)	
Winning an opposing suit		Bessen (2006), Harhoff et al. (2003)	
Geographic protection	Geographic protection	Harhoff et al. (2003), Gambardella et al. (2008), Deng (2007)	Sreekumaran et al. (2011), Fischer, Timo, and Leidinger (2014), Sneed and Johnson (2009)
Applicant type	Applicant type	Bessen (2006),Sapsalis and van Pottelsberghe (2007)	Sneed and Johnson (2009)
Number of inventors		Sapsalis et al. (2006)	
Market conditions	Others	Triest et al. (2007), Ernst et al. (2010)	
Number of competitors		Triest et al. (2007)	
Learning value through disclosure		Reitzig (2003)	
Total development cost		Ernst et al. (2010)	

Age-related indicators: Since universities in Turkey just recently started to own the patent rights, the age of university patents does not make a difference at present. Therefore, age-related indicators are not used for hypothesis building.

Technology-related indicators: Technology fields and citations are considered as technology-related indicators. A high number of forward citations indicates patents that are based on other patents and shows the specific technology field of the patent is developing. A high number of backward citations indicates that the technology field is widespread and has already developed.

Geography-related indicators: These indicators are related to the geographic coverage of the patent.

Protection scope–related indicators: The number of claims and winning an opposing suit are considered in this group. Increase in the number of claims extends the protection scope. Winning an opposing suit also indicates broad patent protection. Therefore, these indicators are considered in this group.

Applicant-related indicators: The applicant type and the number of applicants are considered in this group. However, since university patents are investigated, the applicant type in this research does not change.

The literature is reviewed according to seller's and buyer's perspectives. The most common value indicator in the literature is forward citations. Forward citations refer to the technology behind the invention. Therefore, it is expected that the technology is the most important value indicator for university patents.

Beside forward citations, patent scope shows the strength of patent protection. Thus, a broad protection indicates a more valuable patent. The geographic scope is another important value indicator in the literature. However, enlargement of geographic scope increases the patent costs. Therefore, there is a trade-off between market and the cost of invention.

Therefore, it is expected that technology, protection scope and geographic coverage of patents are most important value indicators for both university and industry.

2.5 Hypothesis Building

This thesis explores the university and industry perspectives for valuation of university patents in Turkey. In the literature, patent values are estimated by using either the different characteristics of patents or quantitative methods. Both qualitative and quantitative methods for valuation of patents contain a certain degree of uncertainty and need estimation. In this research, a framework for valuation of university patents will be established for both university and industry perspectives. This study will show the similarities and differences in the valuation perspectives of university and industry, which is its main hypothesis.

> Hypothesis 1: University and industry have different perspectives on the valuation of university patents in Turkey.

To build sub-hypotheses, the literature on patent valuation will be used. Patent value indicators are grouped in Table 4.

As it is explained in Section 2.3, age-related and applicant-related indicators are not connected to this research because of the fact that all university patents are very young and applicant type is only university.

In the literature, citations are the most common value indicators. Both forward and backward citations of patents are related to the diffusion level of the invented technology. In the early stages of technology, the patents are cited by other patents. The patent that is subjected to protect an invention for a niche technology field gets more citations from other patents. To get more forward citations means that the adaptation of the technology which is embodied on the patent is low. The more citations a patent gets, the more it becomes the basis for other innovations and technologies. Therefore, the forward citation of the patent is an indicator of the early stage for the diffusion of technology.

On one hand, at the late stages of diffusion, the patent that is subjected to protect an invention for an existing technology field cites previous patents. The adaptation of the technology embodied on the patent is high. Thus, the increase in the number of backward citations means the invention is related to a previous invention.

Technology field is another indicator for patent valuation. However, university patents are in various different fields. It is beneficial to investigate technology field with respect to its adaptation rate and diffusion level rather than a specific technology field. Therefore, the second hypothesis is about the diffusion of technology:

> Hypothesis 2a: The diffusion level of technology has significant impact on the value of university patents from a seller's perspective.

> Hypothesis 2b: The diffusion level of technology has significant impact on the patent value from a buyer's perspective.

In the literature, the number of claims in a patent is assumed as a patent valuation indicator. The number of claims determines the protection scope of the patented technology. The number of claims of a patent is directly related to patent protection scope.

To win an opposing suit, the protection of the patent must be very solid. Thus, the third hypothesis is about patent protection scope.

> Hypothesis 3a: Patent protection scope has significant impact on the value of university patents from a seller's perspective in Turkey.

> Hypothesis 3b: Patent protection scope has significant impact on the value of university patents from a buyer's perspective in Turkey.

The geographic coverage of a patent is also another value indicator in the literature. The geographic scope of a patent is related to potential markets for the patented invention. Therefore, the fourth hypothesis in this study is about the geographic scope of the patent.

> Hypothesis 4a: The geographic coverage of the patent has significant impact on the value of university patents from a seller's perspective in Turkey.

> Hypothesis 4b: The geographic coverage of the patent has significant impact on the value of university patents from a buyer's perspective in Turkey.

Since university patents are investigated, the applicant type of patent does not change. Therefore, in this study, applicant type does not affect the value.

Market conditions, learning value through disclosure, and total development costs may also be important for patent valuation. In this study, market conditions are assumed stable. Learning value through disclosure is related to competitors in the market. As university patents are researched and university is not in the market, this indicator is out of our scope. The development cost is final indicator in this group. Valuation through the total development cost of the technology is also one of the quantitative valuation methods for valuation of the patent. The development cost of the patent is directly related to the quality of the research behind the patent. It is expected that higher development cost leads to increase in the quality of research output. Therefore, the fifth hypothesis is about the development cost of patents. However, since in the literature total development cost is assumed only from the seller's perspective, this indicator effects only the seller's perspective.

> Hypothesis 5a: The total development cost of university patents has significant impact on the value of university patents from the seller's side in Turkey.
>
> Hypothesis 5b: The total development cost of university patents has no significant impact on the value of university patents from the buyer's side in Turkey.

As mentioned in the section 2.2, industrial applicability is one of the patentable criteria of an invention. The patented invention should be able to be used in real life. To use the patent in real life, the patent should be commercialised. Commercialisation of the patent may lead to additional costs for the firm. The additional costs might be for new machinery, employees, additional working space, etc.

Besides additional financial costs to use, produce, or sell the patented technology, the company may need to increase its technology absorption capacity. It may need to modify its meso processes, such as increasing the quality of human resources and changing the firm routines and internal and external processes.

Therefore, the last hypotheses in this research are about the additional investment cost and technology absorption capacity of the company for commercialisation of the patent. Both are related to buyers.

> Hypothesis 6a: The additional investment cost for the company of a patent has no significant impact on the value of the university patents from the seller's side in Turkey.
>
> Hypothesis 6b: The additional investment cost for the company of a patent has significant impact on the value of university patents from buyer's side in Turkey.
>
> Hypothesis 7a: The technology absorption capacity of the company has no significant impact on the value of university patents from the seller's side in Turkey.
>
> Hypothesis 7b: The technology absorption capacity of the company has significant impact on the value of university patents from the buyer's side in Turkey.

Table 5 Value indicators and hypotheses

Indicator	**Hypothesis**	**Seller's Perspective**	**Buyer's Perspective**
Diffusion of technology	The diffusion level of technology has significant impact on the value of university patents.	Covered in the literature	Covered in the literature
		Positive impact	Positive impact
Patent protection scope	Patent protection scope has significant impact on the value of university patents.	Covered in the literature	Covered in the literature
		Positive impact	Positive impact
Geographic coverage	The geographic coverage of the patent has significant impact on the value of university patents.	Covered in the literature	Covered in the literature
		Positive impact	Positive impact
Total development cost	Total development cost has significant impact on the value of university patents.	Covered in the literature	Not in the literature
		Positive impact	No impact
Additional investment for the company	The additional investment for the company has significant impact on the value of university patents.	Not in the literature	Covered in the literature
		No impact	Negative impact
Absorption capacity of the company	The absorption capacity of the company has significant impact on the value of university patents.	Not in the literature	Covered in the literature
		No impact	Positive impact

Table 5 presents a summary of the hypotheses. To test these hypotheses, conjoint analysis will be used in this thesis. In the literature, conjoint analysis for valuation of patents is used mostly in the United States for patent infringement cases to determine the royalty penalties. The end consumers are asked through a survey about the patented product, and the penalty is determined according to the end consumers' answers. However, in this research, conjoint analysis is applied to the seller's and buyer's perspectives. The details of the conjoint analysis will be explained in the chapter 3.

This is the first research about the valuation of university patents in Turkey. It offers an approach that considers both the seller's and the buyer's opinions about university patents. The outcome of the research may help develop new policies about patenting activities and commercialisation of research outputs in universities in Turkey.

CHAPTER 3

METHODOLOGY AND DATA

In this thesis, conjoint analysis will be used for valuation of university patents in Turkey. Conjoint analysis is a multivariable data analysis method which is commonly used in market research to determine the contribution of different attributes to the value of a product or a service for different industries. Even though the method is commonly used for market research, it can be applied to various sectors (Rao, 2014). Ijzerman et al. (2011) applied conjoint analysis to product development, Baarsma (2003) applied it to environment economics and Poortinga et al. (2003) investigated energy savings by applying it. Conjoint analysis enables us to isolate the impact of different features of a product or service to the value of the product or service. It estimates the trade-offs among the different specifications of a product or service to its value.

Conjoint analysis is also used for valuation of patent damages in the courts in the United States. For instance, the patent damage was calculated by using conjoint analysis for the following patent damage cases: Apple versus Samsung in 2012, Oracle versus Google in 2011, Microsoft versus Motorola in 2012, and TV Interactive Data versus Sony in 2013 (Sidak et al., 2018).

In Turkey, universities have recently started to own academic patents, and there is not enough licensing data for valuation of university patents. Therefore, conjoint analysis is selected as the research method to set up experimental design to preferences.

3.1 Basics of Conjoint Analysis

Conjoint analysis is used to understand the impact of certain characteristics of a product or a service on customer preferences in terms of the value or worth of the product or service and its specification. It also enables the researchers to understand the effect of the varieties of certain characteristics. The respondents judge a real or a hypothetical product or service, which is a combination of different features of a product or service. The different features of a product or service are called attributes. The factor is the independent variable which represents a specific attribute of the product or service. The level is the specific value of which describes a factor. A factor should be represented by more than one level. A profile, which is evaluated by the respondent, is created by selecting one level from each factor. Utility is the personal opinion of the respondent about a certain profile. Utility is shaped by a mixture of part-worth estimates for a specified profile. Part-worth is the utility associated with each level of each factor. The total utility is the sum of the part-worth utilities of each level of each factor (Hair et al., 2009). It can be formulated as shown in Equation 1:

$$U(Total) = U(T) = c + \left(\sum_{i=1}^{m} \sum_{j=1}^{k} Part - Worth\ Utility_{mk} \right)$$

U(Profile) = U(P) = c + (Part-worth of $level_{k1}$ *of* $factor_1$ + Part-worth of $level_{k2}$ *of factor2*+……Part-worth of $level_{mn}$ *of* $factor_n$)

where:

c = constant

k = the levels of attributes

m = attributes

Equation 1 The utility function

The basic concept of conjoint is better understood by an illustration. Assume that a car company is preparing to promote a new car model. The company wants to specify some features of the car and analyse the consumers' interests. The car has two types of bodies, sedan and hatchback, and two types of engines, gasoline and diesel. In this example, the car only differs in engine and body. Therefore, the factors are engine and body. The levels of the engine are gasoline engine and diesel engine. The levels of the body are sedan and hatchback.

The profiles are as follows:

P1 = Sedan and gasoline

P2 = Sedan and diesel

P3 = Hatchback and gasoline

P4 = Hatchback and diesel

U(Total) = c + (Part-worth of sedan + Part-worth of hatchback + Part-worth of gasoline + Part-worth of diesel)

Total worth of P1 = Utility P1 = U P1 = c + Part-worth sedan + Part-worth gasoline

Total worth of P2 = U P2 = c + Part-worth sedan + Part-worth diesel

Total worth of P3 = U P3 = c + Part-worth hatchback + Part-worth gasoline

Total worth of P3 = U P4 = c + Part-worth hatchback + Part-worth diesel

Conjoint analysis enables us to calculate the part-worth of each level and each factor to get the value of a product or service.

Hair et al. (2009) claim that a successful conjoint analysis has seven stages. These stages will be used in this thesis and are listed below:

1) Objectives of conjoint analysis
2) Design of conjoint analysis
3) Assumptions
4) Selecting an estimation technique
5) Interpreting the results
6) Validating the results
7) Applying the conjoint results

In Chapter 3, the objectives of conjoint analysis, its design, and its assumptions are discussed, as well as the selection of the estimation technique. Chapter 4 includes the interpretation, validation, and application of the conjoint results.

3.1.1 Objectives of Conjoint Analysis

According to Hair et al. (2009), the first stage of conjoint analysis is to define the research question and objective of the research clearly. After defining the research question and the objective of the research, researchers should define the determinants.

As it is explained in the previous chapters, the objective of this research is to establish a framework for valuation of the university patents in Turkey from the seller’s and buyer’s perspectives. Therefore, the main research question is ‘How should university patents be valuated from the university’s (seller) and industry’s (buyer) perspectives in Turkey?’ Based on the research question, a second question aroused: ‘What are the differences and similarities about valuation of university patents in Turkey between buyer’s and seller’s perspectives?’ The output of this research may be used by technology transfer offices in universities, which are responsible for commercialising the university patents. The results will demonstrate the similarities and differences between seller’s and buyer’s perspectives on the valuation of university patents. These results, which are obtained from different perspectives, will also be valuable for policy makers.

After defining the research question and objective of the research, it is beneficial to define some key terms about conjoint analysis. The different features of a product or service are called attributes. The factor is the independent variable which represents a specific attribute of the product or service. The level is the specific value of which describes a factor. A factor should be represented by more than one level (Hair et al. 2009).

The second step in the first stage of a conjoint analysis is to define factors. In Chapter 2, seven hypotheses are defined. The factors of the conjoint is related to six of these hypotheses. The first hypothesis is about the different perspectives of university and industry. The objective of this research is related to the first hypothesis. Therefore, it is not a factor.

On the other hand, hypotheses 2, 3, 4, 5, and 6 are related to part-worth of the total utility. Thus, in this research, the factors of the conjoint is related to the thesis hypothesis (see Table 6). To investigate the relationship between the patent value and the factors defined above, the patent value is the seventh factor in the conjoint analysis.

Table 6 Factors of conjoint analysis

Hypothesis	**Factor**
The diffusion level of technology has significant impact on the value of university patents.	Diffusion level of technology
Patent protection scope has significant impact on the value of university patents.	Patent protection scope
The geographic coverage of the patent has significant impact on the value of university patents.	Geographic coverage
The total development cost of university patents has significant impact on the value of university patents.	Total development cost of patent
The additional investment cost for the company has significant impact on the value of university patents.	The additional investment costs for commercialisation of the patent
The technology absorption capacity of the company has significant impact on the value of university patents.	Absorption capacity of company
Value	Price of patent

3.1.2 Design of Conjoint Analysis

According to Hair et al. (2009), after defining the objective, the second stage of the conjoint analysis is its design. In this stage, the type of conjoint analysis, the levels of each factors, and the design of the profiles and the data collection methods are determined.

3.1.2.1 Selecting the Conjoint Analysis Methodology

Hair et al. (2009) defines three types of conjoint analysis:

1) Traditional Conjoint Analysis: The respondents are asked to evaluate profiles which consist of all factors by ranking or rating. The maximum number of factors is nine. There is no specific data collection format.
2) Adaptive Conjoint Analysis: It is designed for evaluating a large number of factors. The respondents are asked to evaluate profiles which consist of a subset of factors. The data collection is generally computer based.
3) Choice-Based Conjoint Analysis: The respondents are asked to select a profile from different profiles rather than ranking or rating profiles. The upper limit of level is generally six. There is no specific data collection format.

The objective of this thesis is to measure the value of university patents in Turkey from both university's (buyer) and industry's (seller) perspectives. The respondents are surveyed about the hypothetical patents. The respondents are asked to rate these patents. The hypothetical patents have seven specific factors. Therefore, in this research, the traditional conjoint analysis will be used.

3.1.2.2 Defining the Levels of Factors and Designing the Profiles

As explained in Section 3.1.1, seven different factors will be used in the conjoint analysis. In this section, the levels of each factor will be explained.

The first level in the conjoint analysis is the diffusion level of patented technology. The patent may be in a field of emerging technology and is cited by other patents. It may have potential to be pioneer technology. The technology may be in the early stages of diffusion, and the adaptation rate of technology may be low.

On the other hand, a patented invention may be developed by heavily using the existing technologies. The patent may cite a large number of previous patents. The patent may be in a matured technology field. There may be similar technologies in the market. The technology may be in the late stages of diffusion and highly adopted in the market.

Thus, there are two levels of technology diffusion:

1) The patent is in the field of a developing technology. The patent has potential to be a basis for latter patents. Latter patents are likely to refer to this patent in the future.
2) The patent is in the field of a diffused technology. The patent heavily refers to previous patents. It is an incremental invention. The patent has heavily cited previous patents.

The second factor of the conjoint is the patent protection scope. The patent protection scope may be either broad or narrow. Therefore, the levels of this factor are as follows:

1) The scope of patent protection is broad.
2) The scope of patent protection is narrow. It is expected that the part-worth of the first level of this factor has a positive impact to both seller's and buyer's preferences. It is also expected that the part-worth of the second level of this factor has negative impact to both seller's and buyer's preferences.

The third factor of the conjoint is about the geographic coverage of patent. The patented invention may be protected only in Turkey, or it may be protected in other countries. Thus, the levels of this factor are as follows:

1) The patented invention is only protected in Turkey.
2) The patented invention is protected in Turkey and other countries.

The part-worth of the second level is expected to be higher than the first level for both seller's and buyer's perspectives.

The fourth factor is the total development cost of the patent. In Turkey, university researchers generally benefit from several funds, such as university funds which have low and limited budget, TÜBİTAK's funds and other public funds, and European Union's funds which have an average level of budgets in Turkey's conditions. Researchers also may develop the patents by using more than one fund. For instance, TÜBİTAK's funds and European Union's fund might be used for developing the patent. In that case, the total development cost will be higher than the general research budgets. Therefore, the levels for total development cost are

1) Low
2) Medium
3) High

It is expected that the part-worths of total development cost increase as the total development cost increases.

The fifth factor in the conjoint is additional investment cost for the company. There are three levels for additional investment costs:

1) No need for additional investment
2) Low investment costs such as minor changes in production line, purchase of low-cost machinery, etc.
3) High investment costs such as additional production facility, renewal of machinery with high costs, etc.

It is expected that the part-worths of levels in this factor are higher as the additional investment cost for commercialisation decreases.

The sixth factor in the conjoint is the technology absorption capacity of the company. This factor has two levels:

1) The companies need to increase their technology absorption capacity to use the patented invention for any commercial activity.
2) The companies have technology absorption capacity to use the patented invention for any commercial activity.

Patent value is the seventh factor in the conjoint analysis. To determine the stages in this factor, opinions were taken from the most experienced 10 TTOs which have been supported by TUBİTAK since 2013. They were asked about the average patent value of their patent portfolio. Eight TTOs replied for the average value. The maximum and minimum patent values were eliminated, and the average value and the standard deviation of the average value of the patents in the portfolios were calculated. The average value of patents is 850.000 TL and the standard deviation is 700.000 TL. In order to determine meaningful intervals, the average value and standard deviation is used. Even though the difference between average value and standard deviation covers 65 percent of the whole values, the difference is high and does not allow us to set meaningful intervals. Therefore, the average value and half of the standard deviation are used for determining the levels of value. The difference between the average value and half of the standard deviation is the first level. The second level is the average value. The third value is the sum of the average value and half of the standard deviation. So the levels are as follows:

1) (The average value of average patent portfolio values) - (Standard deviation of the average patent portfolio values)/2
2) The average value of average patent portfolio values
3) (The average value of average patent portfolio values) + (Standard deviation of the average patent portfolio values)/2

The average patent value of 10 TTOs is 850.000 TL, and the standard deviation is 350.000 TL. Therefore, the values are 500.000 TL, 850.000 TL, and 1.200.000 TL.

The levels of all factors are defined. Hair et al. (2009) claims that researchers can create a profile by selecting one level from each factor. Profiles can be created using factorial design. Full factorial design is the usage of all possible combinations of levels in conjoint analysis. For instance, a conjoint analysis with two different factors and each factor having three different levels has nine (3 x 3) different profiles. Researchers can use a full factorial design for a small number of total profiles. However, an increase in the number of factors or an increase in the number of the level leads to an increase in the number of profiles. For instance, a conjoint analysis with five different factors and five different levels for each factor has 625 (5 x 5 x 5 x 5) different profiles. It is impossible for respondents to evaluate all 625 profiles. Therefore, a subset of full factor design should be selected for measuring the impact of different factors. To select an orthogonal subset from a full factorial design enables researchers to measure the effect of the changing level of each factor.

Table 7 The orthogonal design

#row in full factorial design	**Factor1**	**Factor2**	**Factor3**	**Factor4**	**Factor5**	**Factor6**	**Factor7**
11	Level-1	Level-2	Level-1	Level-3	Level-1	Level-1	Level-1
48	Level-2	Level-2	Level-2	Level-2	Level-3	Level-1	Level-1
49	Level-1	Level-1	Level-1	Level-1	Level-2	Level-1	Level-1
76	Level-2	Level-2	Level-1	Level-1	Level-1	Level-2	Level-1
106	Level-2	Level-1	Level-1	Level-3	Level-3	Level-2	Level-1
141	Level-1	Level-1	Level-2	Level-2	Level-2	Level-2	Level-1
150	Level-2	Level-1	Level-2	Level-1	Level-1	Level-1	Level-3
171	Level-1	Level-2	Level-1	Level-1	Level-3	Level-1	Level-3
210	Level-2	Level-1	Level-1	Level-2	Level-2	Level-1	Level-3
229	Level-1	Level-1	Level-2	Level-3	Level-1	Level-2	Level-3
259	Level-1	Level-2	Level-1	Level-2	Level-3	Level-2	Level-3
280	Level-2	Level-2	Level-2	Level-3	Level-2	Level-2	Level-3
312	Level-2	Level-2	Level-2	Level-2	Level-1	Level-1	Level-2
325	Level-1	Level-1	Level-2	Level-3	Level-3	Level-1	Level-2
348	Level-2	Level-2	Level-1	Level-3	Level-2	Level-1	Level-2
377	Level-1	Level-1	Level-1	Level-2	Level-1	Level-2	Level-2
386	Level-2	Level-1	Level-1	Level-1	Level-3	Level-2	Level-2
415	Level-1	Level-2	Level-2	Level-1	Level-2	Level-2	Level-2

In this research, there are 432 (2 x 2 x 2 x 3 x 3 x 2 x 3) profiles. It is not feasible to evaluate all profiles of the respondents. Therefore, an orthogonal subset is going to be selected. According to Hair et al. (2009), the number of profiles that must be evaluated is equal to the total number of levels of all factors—the number of factors + 1. In this thesis, the total number of levels of all factors is 17. The number of factors is 7. So the number of profiles must be more than 11 (17-7+1). To find the most suitable orthogonal subset which reflects the full factorial design, the software R Studio is used. First, a full factorial design is created in R studio. Then the optimal orthogonal design which reflects the full fraction design is searched. R studio creates an orthogonal design with a random number. The number of profiles to create an orthogonal design is also selected by users. To find the most suitable random number and the number of profiles which reflect optimal orthogonal design, different random numbers between 1 and 10.000 is tried 1.000 times.

In the trial, the number of profiles is between 12 and 40. Twelve is the least number that should be used for orthogonal design. It is assumed that evaluation of more than 40 profiles is not accurate for the respondents. In the trial, R created the optimal orthogonal design with 18 profiles with 138 different random numbers. The R codes are shown in Appendix A. The orthogonal design is controlled for inconsistencies, and no inconsistency was found. The design is shown in Table 7 (see Appendix B for R codes of design) (seed:1459).

3.1.2.3 Selecting a Measure of Respondent Preference

There are two methods for measuring the respondents' preferences in traditional conjoint analysis:

1) Rank-Order Measure: In this measure, respondents rank each profile. Even though rank-order measure is more reliable, it is hard to manage, and the data can be collected only in personal interview settings.
2) Measuring Preference by Rating: Rating is easier to analyse and manage. Multivariate regression can be performed. The data can be collected by interviews, telephone, or e-mail surveys, etc.

Since it enables to collect data in any forms and enables multivariate regression analysis to be performed, respondent preferences are collected by rating. A 7-point Likert preference scale will be used in the survey. The respondents will rate the profiles from 1 to 7. One point is the minimum preferences of to sell or buy, and 7 points is the maximum preferences to sell or buy. The respondents' preferences are collected by using an online survey. There are two groups of respondents:

1) University (Seller): The TTOs of universities will be surveyed.
2) Industry (Buyer): The companies which have an R&D centre, the companies which have conducted R&D projects, and spin-off companies will be surveyed.

For universities, the difficulty level of selling the patents is asked. For industries, the preference level of buying the patents is asked.

3.1.3 Assumptions

Conjoint analysis does not require statistical tests for normality, homoscedasticity, and independence. Thus, the conjoint analysis has fewer assumptions than other multivariable data analysis. In this research, it is assumed that all factors are independent. Since the research is an experimental design, all respondents are unbiased to patent profiles. It is also assumed that the orthogonal design reflects the characteristics of the full factorial design.

In the research, it is assumed that

5) the market conditions are stable, and there are no financial problems for buyers; the demonstrations and tests are completed for all patents; and
6) the patent is sold to only one company with exclusive licence, and other companies are not able to use the patent.

The conjoint analysis has four more stages. However, these stages are related with the results. Therefore, they will be explained in the results chapter.

3.2 Data

To compare the perspectives of both university and industry, a survey with 18 hypothetical patents are sent to these two groups. Even though two groups are asked to evaluate the same patents, different questions are asked. For university, the difficulty level of selling is asked. For industry, the preference of buying is asked.

Both of the surveys are created on an online platform. The web links of surveys are sent by e-mail to the respondents.

3.2.1 University Perspective

The survey is sent to 45 university TTOs which have been supported by TÜBİTAK. Twenty-five of them are more experienced than the others. The annual budget of 25 TTOs is higher than others. Thirty of these universities are public universities, and 15 of them are private universities. TTO managers are asked to answer the survey. Sixty answers are collected from TTOs. The patent profiles are given to the respondents, and they are asked to evaluate whether they agree that the patent can be sold easily or not by rating from 1 point to 7 points:

Table 8 Profiles of university respondents

Level of Education	Bsc	Msc	Phd	
	12	25	16	
Educational Background	Basic Sciences	Engineering	Social Sciences	
	13	27	13	
Experience in TTO	0-1 Years	2-3 Years	4-5Years	More than 5 years
	12	13	7	21
Experience before TTO	None	Less than 3 Years	3-5 Years	More than 5 years
	12	13	7	21
Age	25-30	31-35	36-40	More than 40 years
	11	14	13	15
Gender	Male	Female		
	22	31		

1 Point: Definitely not agree

2 Points: Not agree

3 Points: Somewhat not agree

4 Points: Indecisive

5 Points: Somewhat agree

6 Points: Agree

7 Points: Definitely agree

The questionnaire for the university is in Appendix C and the responses of the university is in Appendix E. The details of the university respondent's profiles are presented in Table 8. Even though seven of the respondents evaluated all profiles, they did not answer the questions about themselves.

3.2.2 Industry Perspective

To measure the industry's perspective, the same patent profiles which are asked for university are used. However, for industry, respondents are asked to rate their willingness to buy the patents from 1 point to 7 points:

1 Point: Definitely not prefer to buy

2 Points: Not prefer to buy

3 Points: Somewhat not prefer to buy

4 Points: Indecisive

5 Points: Somewhat prefer to buy

6 Points: Prefer to buy

7 Points: Definitely prefer to buy

Table 9 Profiles of industry respondents

Level of education	Bsc	Msc	Phd	
	10	20	10	
Educational background	Basic Sciences	Engineering	Social Sciences	
	9	30	1	
Experience in the current company	0–1 Years	2–3 Years	4–5Years	More than 5 years
	4	7	5	24
Experience at other companies	None	Less than 3 Years	3-5 Years	More than 5 years
	6	9	2	23
Age	25–30	31–35	36–40	More than 40 years
	6	8	6	20
Gender	Male	Female		
	11	29		

A survey is sent to companies with R&D centres or companies with R&D projects supported by TUBITAK. It is also sent to R&D managers, intellectual property managers, or company managers. The questionnaire for industry is in Appendix D and the responses of the industry is available in Appendix F. The details of the respondents are shown in Table 9. Forty-two respondents evaluated all patent profiles. However, two of them did not give their personal information. Analysis of the data is given in Chapter 4.

CHAPTER 4

RESULTS

The first three stages of conjoint analysis involve defining the objective of the research, the design of conjoint analysis, and assumptions. These stages are defined in Chapter 3. In the first stage, the objective of the research is defined. In the second stage, the factors effecting the value is explained. The properties of these factors are also defined as levels. Patent profiles which are evaluated by the respondents are determined. The assumptions are explained as the third stage. The questionnaire design explained in Chapter 3 is sent to both universities and industry and responses are collected from both groups.

In this chapter, the questionnaire results are analysed. Eighteen different patent profiles are rated by university TTOs and industry. The results are analysed by the stages defined by Hair et al. (2009). These stages are as follows:

4) Selecting an estimation technique.
5) Interpreting the results.
6) Validating the results.
7) Applying the conjoint results.

4.1 Selecting an Estimation Technique

In conjoint analysis, the utility, part-worth of each factor, and levels are estimated. Hair et al. (2009) claim that for the ranking base, conjoint analysis nonmetric estimation techniques are used. However, for the rate base, conjoint analysis metric estimation techniques are used. They also suggest that the most common metric estimation technique used for rate-based conjoint analysis is regression model with dummy variables. Since our research design is based on rating patents, the part-worths in this thesis are estimated using regression model with dummy variables. The software R is used for the analysis. The codes used to estimate the part-worths are presented in Appendix G. The results of conjoint analysis for both the university and the industry are shown in the Section 4.2.

After defining the estimation technique, goodness-of-fit should be evaluated to determine the accuracy of the conjoint analysis. For rate-based conjoint analysis, the goodness-of-fit can be evaluated using Pearson correlation. The researchers should calculate the adjusted R^2 value to estimate Pearson correlation (Hair et al., 2009). The goodness-of-fit tests for both groups are presented in Section 4.3.

4.2 Interpreting the Results

The aim of the research is to reveal the similarities and differences between the perspectives of university and industry in the evaluation of university patents. Therefore, the survey results are interpreted between two groups for each factor that is described in Chapter 3. These factors are diffusion level of technology, patent protection scope, geographic protection scope of the patent, total development cost, additional investment for the company, and technology absorption capacity of the company. Each factor is analysed first for the whole respondents and then for each group separately.

4.2.1 Estimations

The results for all respondents are presented in Table 10. The coefficient column presents the levels of factors which are estimated regressions with dummy level. For instance, developing technology is estimated with widespread technology. The second column (estimation) is the result of the estimated part-worth utility for the coefficients. The third column is the standard error, and fourth is the associated t-value. The fifth column is the p-value. If p-value is smaller than 0,001, it means that the level has a statistically significant impact on the utility.

Patent protection scope, geographic protection, additional investment for the company, and absorption capacity of the company have significant impact on the valuation of patents for all respondents. If the price of the patent is 1.200.000 TL, the price has negative impact, which indicates that the respondents tend to not buy or sell. There is no significant impact if the price is 850.000 TL or 500.000 TL.

Table 10 Estimations for all respondents

Coefficients:					
	Estimate	Std. Error	t-value	Pr(>|t|)	
Intercept	3,988411	0,032117	124,182	p<0.001	***
Technology-Developing	0,040821	0,032263	1,265	0,206	
Scope-Broad	0,471646	0,032263	14,619	p<0.001	***
Geography-Turkey and other	0,40042	0,033377	11,997	p<0.001	***
Total Dev. Cost- High	-0,00052	0,045723	-0,011	0,991	
Total Dev. Cost- Medium	0,043952	0,045269	0,971	0,332	
Add. Investment-High	-0,53857	0,045269	-11,897	p<0.001	***
Add. Investment-Low	0,223563	0,045269	4,939	p<0.001	***
Absorption cap.-Enough	0,513791	0,032263	15,925	p<0.001	***
Price-1.200.000 TL	-0,22221	0,045723	-4,86	p<0.001	***
Price-850.000 TL	0,050424	0,045269	1,114	0,265	
Significance codes: 0 '***' 0,001 '**' 0,01 '*' Residual standard error: 1,374 on 1843 degrees of freedom Multiple R-squared: 0,2924 Adjusted R-squared: 0,2886 F-statistic (10, 1843): 76,17 p-value: < 0,001					

Estimations from the university perspective is given in Table 11. Broader patent protection, geographic scope, additional investment for the company, and absorption capacity of the company have significant impact on the valuation of patent. The price of the patent has less significant impact from the university perspective.

In the literature, most of the researchers claim that citations and technology are significant value indicators. However, in this research, data show that the diffusion level of technology is not a significant value indicator from the university perspective. Patent protection scope and geographic protection of patent are expected to be significant indicators before the analysis was conducted. Therefore, data results are parallel to expectations. The patent gives the owner commercial privileges on the invention. Broader patent protection secures the owner from any violations. Broader patent protection also means the patent is strong against any opposition and a solid case in the court. Therefore, it is expected to be a significant value indicator. Geographic coverage determines where the patent gives commercial privileges to the owner. Even though patent protection in different countries increases the maintenance cost of the patent, it increases the chance of commercial success of the patent in different markets. The findings above is consistent with the expectations.

Table 11 Estimations for university

Coefficients:	Estimate	Std. Error	t value	Pr(>|t|)	
Intercept	4,03600	0,04199	96,107	p<0.001	***
Technology-Developing	0,03220	0,04219	0,763	0,445	
Scope-Broad	0,41761	0,04219	9,900	p<0.001	***
Geograhy-Turkey and other	0,35101	0,04364	8,043	p<0.001	***
Total Dev. Cost- High	-0,06689	0,05978	-1,119	0,263	
Total Dev. Cost- Medium	0,03345	0,05919	0,565	0,572	
Add. investment-High	-0,57211	0,05919	-9,665	p<0.001	***
Add. investment-Low	0,21678	0,05919	3,662	p<0.001	***
Absorption cap.-Enough	0,56572	0,04219	13,410	p<0.001	***
Price-1.200.000 TL	-0,17523	0,05978	-2,931	0,003	**
Price-850.000 TL	0,02789	0,05919	0,471	0,637601	
Significance codes: 0 ‘***’ 0,001 ‘**’ 0,01 ‘*’ Residual standard error: 1,371 on 1069 degrees of freedom Multiple R-squared: 0,2899 Adjusted R-squared: 0,2832 F(10,1069)=43,63, p-value: < 0,001					

Total development cost shows the patent's scientific background. Higher development cost is a sign of strong scientific research. So it is expected that the patent's value increases as the total development cost of the patent increases from university perspective. However, strong scientific research does not always mean good commercial performance. Total development cost also ignores positive or negative future uncertainties. A patent with low costs may have good commercial performance. The contrary is also possible. Therefore, universities may not consider total development cost as a significant value indicator. Additional investment for the company and absorption capacity are not expected to be significant from the university perspective. However, survey results indicate that these two value indicators have significant impact on value from the university perspective. So far in Turkey, both the number of licenced university patents and the income generated from these patents are very low. Universities have experienced considerable amount of unsuccessful licencing negotiations. Therefore, the company's routines, capacity, and additional investment may be reasons for unsuccessful licencing negotiations, which may explain why these two value indicators are significant for universities.

The estimation results of the industry perspective are shown in Table 12. Broader patent protection, geographic scope, additional investment for the company, and absorption capacity of the company have significant impact on the valuation of patents from the industry perspective. The diffusion level of technology has no significant impact on the value from the industry perspective. There is no significant impact if the price is 500.000 TL or 850.000 TL. However, price has negative impact if it is 1.200.000 TL, which means that the industry is not willing to buy the patents with higher prices.

In the literature review, the diffusion level of technology, patent protection scope, geographic coverage of the patent, absorption capacity of the company, and additional investment for the company are significant value indicators from the industry perspective. Total development cost has no significant impact on the value as it is expected. The survey results are coherent with the related literature, except the findings on the diffusion level of technology.

Industry is expected to evaluate the patents from a more commercial perspective. Licencing a widespread technology from the university has low commercial risks. On the other hand, widespread technology is expected to generate limited income. However, licencing a developing technology from the university has high commercial risks. Technology may not be as widespread as it is expected in the future. The risks are high compared with a widespread technology. However, if it is commercially successful, the developing technology has potential to generate more income.

Table 12 Estimations for industry respondents

Coefficients	Estimate	Std. Error	t-value	Pr(>|t|)	
Intercept	3,92201	0,04949	79,243	p<0.001	***
Technology-Developing	0,05285	0,04972	1,063	0,288	
Scope-Broad	0,54704	0,04972	11,003	p<0.001	***
Geography-Turkey and other	0,46936	0,05144	9,125	p<0.001	***
Total Dev. Cost- High	0,09208	0,07046	1,307	0,192	
Total Dev. Cost- Medium	0,05861	0,06976	0,84	0,401	
Add. Investment-High	-0,49178	0,06976	-7,049	p<0.001	***
Add. Investment-Low	0,23303	0,06976	3,34	p<0.001	***
Absorption cap.-Enough	0,44133	0,04972	8,877	p<0.001	***
Price-1.200.000 TL	0,28776	0,07046	-4,084	p<0.001	***
Price-850.000 TL	0,08187	0,06976	1,174	0,241	
Significance codes: 0 '***' 0,001 '**' 0,01 '*' Residual standard error: 1,368 on 763 degrees of freedom Multiple R-squared: 0,3143, Adjusted R-squared: 0,3053 F(10,763)=34,97, p-value: < 0,001					

The survey results show that there is a balance between the high benefits of risky technology and the low income of less risky technology from the industry perspective.

4.2.2 Utility

In this research, utility is defined as the value of willingness to sell or willingness to buy a university patent. As mentioned in Chapter 3, the utility function is

$$U(Total) = U(T0) = c + \left(\sum_{i=1}^{m} \sum_{j=1}^{k} Part - Worth\ Utility_{mk} \right)$$

U(Profile) = U(P) = c + (Part-worth of $level_{k1}$ *of factor*$_1$ + Part-worth of $level_{k2}$ *of factor2*+……Part-worth of $level_{mn}$ *of factor*$_n$)

where:

c = constant

k = the levels of attributes

m = attributes

The respondents rated the patents from 1 to 7. Therefore, the maximum utility of a patent can be 7, and the minimum utility of patent can be 1. To estimate utility, first, the constant is added to the utility. Then factors are added according to their levels, and the utility of a patent is calculated. One level of factor is selected, and the other levels become zero. For instance, the average utility function for the university respondents is shown below:

$U_{(Uni)}$ = 4,036 + [0,0322 (Developing Technology) + (-0,0322) (Widespread Technology)] + [0,4176 (Broad Protection)+ (-0,4176) (Narrow Protection)] +[0,351 (Protection in Turkey and Abroad) + (-0,351) (Protection in Turkey)] + [(-0,0669) (Total Development Cost-High) + (0,0334) (Total Development Cost-Medium) + (0,0334) x Total Development Cost-Low)] + [(-0,5721) (Add. investment-high) + (0,2168) (Add. investment-low) + (0,3553) (No add. investment)] + [(0,5657) (Abs. Cap.-Enough) + (-0,5657) (Abs.Cap.-Not Enough)]4] + [(-0,1752) (Price-1.200.000 TL) + (0,0279) (Price-800.000 TL) + (0,1473) (Price-500.000 TL)]

Table 13 Total part-worth utilities

Part-worth utilities	All Respondents	University	Industry
Intercept	3,9884	4,0360	3,9220
Developing technology	0,0408	0,0322	0,0529
Widespread technology	-0,0408	-0,0322	-0,0529
Broad Protection	0,4716	0,4176	0,5470
Narrow Protection	-0,4716	-0,4176	-0,5470
Protection in Turkey and abroad	0,4004	0,3510	0,4694
Protection only Turkey	-0,4004	-0,3510	-0,4694
Total development cost is high	-0,0005	-0,0669	0,0921
Total development cost is medium	0,0440	0,0334	0,0586
Total development cost is low	-0,0434	0,0334	-0,1507
High additional investment for industry	-0,5386	-0,5721	-0,4918
Low additional investment for industry	0,2236	0,2168	0,2330
Additional investment is not needed for industry	0,3150	0,3553	0,2587
Absorption capacity of company is enough	0,5138	0,5657	0,4413
Absorption capacity of company is not enough	-0,5138	-0,5657	-0,4413
Selling price is 1200000 TL	-0,2222	-0,1752	-0,2878
Selling price is 850000 TL	0,0504	0,0279	0,0819
Selling price is 500000 TL	0,1718	0,1473	0,2059

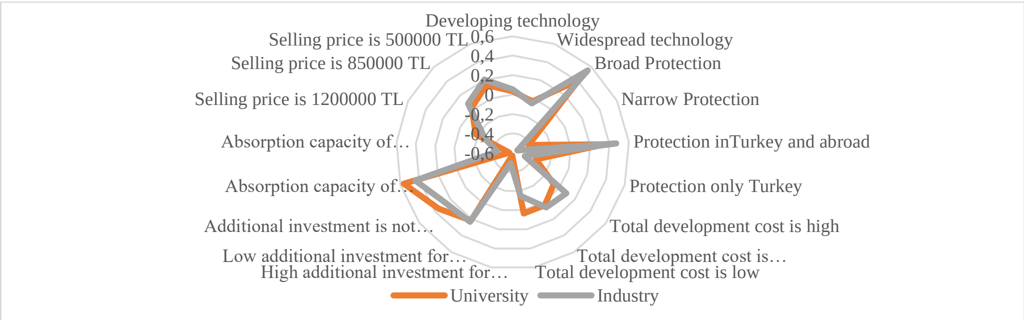

Figure 1 Part-worth utilities of levels for university and industry

The part-worths of all levels for all respondents, university, and industry are shown in Table 13 and it is also illustrated in Figure 1. The part-worth values are obtained using R.

The properties of the patent which maximise the utility from both perspectives are shown in Table 14.

Table 14 Properties of patent which maximises the utility from both perspectives

Technology	Developing technology
Patent protection	Broad
Geographic protection	Turkey and abroad
Total development cost	Medium
Additional investment for company	No additional investment is need
Absorption capacity of company	Enough
Price	500.000 TL

The part-worth utilities for industry respondents are given in Appendix H and for university respondents given in Appendix I. To get a deeper interpretation of part-worth utilities, it is better to consider part-worth utilities with the important results.

For all respondents, the most important factor that affects the utility is additional investment for the industry. On the other hand, the absorption capacity of the company is the most important factor from a university perspective, while the protection scope of the patent is the most important factor from industry perspective. The adaptation of technology is the least important factor from both the university and industry perspectives. The highest difference between the two groups in terms of importance is in absorption capacity. The lowest difference between the two groups in terms of importance is in price.

4.2.3 Importance Values

Table 15 Importance of factors

Factor	All respondents	University	Industry	Difference	p=Pr(|T| > |t|)
Technology	6,53	5,88	7,43	-1,55	0,127
Protection scope	16,62	15,17	18,65	-3,48	0,202
Geographic scope	14,3	13,06	16,03	-2,97	0,144
Total development cost	12,02	12,75	11	1,75	0,173
Additional investment for company	18,52	19,06	17,77	1,29	0,532
Absorption capacity of company	18,35	20,09	15,93	4,16	0,136
Price	13,65	13,99	13,19	0,8	0,596

Even though the diffusion level of technology is the most common value indicator in the literature, in Turkey, both university and industry consider it as the least important factor that impact the value. Technology contains commercial risks in the early stages of diffusion. The industry seems to not take any risks; which patent contains by nature. To decrease any risks, patent protection scope, which broader protection decreases the risks, is the most important factor that impacts patent value. Additional investment for the company is the second most important factor from the industry perspective. The industry avoids taking any risks because of the licencing of the patent. Therefore, the importance value shows that the industry tries to minimise any potential risks because of the nature of the patent. The patent is an important tool for universities to disclose and transfer the knowledge technology. Therefore, it is expected that universities prioritise the transfer of a developing technology, which may have the potential for radical innovation. However, the results show that in Turkey universities consider the industry's technological infrastructure the most important factor for licencing patents. Even though the geographic protection has significant impact on the valuation of patents from the university perspective, it is the fifth most important factor. The universities are primarily focused on licencing the patent in the domestic market. Since the geographic protection is less important than the firm's infrastructure, higher development cost indicates stronger research, which may have potential to be a radical innovation in the developing technology field. Radical innovation has potential to be licenced in both domestic and foreign markets. However, it seems universities miss the opportunity to licence in the foreign market or do not have the means and resources to do so.

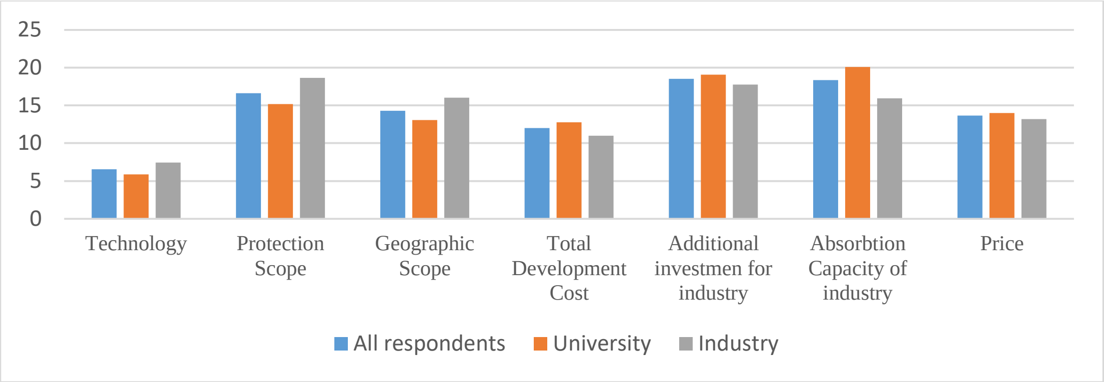

Figure 2 Importance of factors

According to t-test results, the difference in importance values between two groups are not statistically significant. Universities seem to be focused on marketing it first at home. The industry tries to avoid any patent risk. Since university primarily focus on firm's infrastructure, both groups are similar to each other. Both groups are avoiding radical innovations, which are more likely to be in developing technology fields with strong scientific background. Figure 2 shows the importance of each factor for all respondents, university and industry. The details of importance values for industry and university respondents are given in Appendices J and K.

4.2.4 Comparison of University and Industry Perspectives

To compare the validation of two groups, two-sided t-test with different variances is calculated according to the respondent's type for 18 patents. The mean values, differences in mean values, and p-values are shown in Table 16. The statistically significant results at least at the 10 percent level are presented in bold.

Table 16 Difference in valuation of patents

Patent	Mean Value of Industry	Mean Value of University	Difference	p=Pr(|T| > |t|)
Patent 1	**3,19048**	**3,76667**	**-0,57619**	**0,05673**
Patent 2	**3,26191**	**4,01667**	**-0,75476**	**0,02703**
Patent 3	5,64286	5,58333	0,05953	0,77010
Patent 4	2,83333	2,70000	0,13333	0,66120
Patent 5	4,33333	4,33333	0,00000	1,00000
Patent 6	3,42857	3,46667	-0,03810	0,89220
Patent 7	3,97619	3,98333	-0,00714	0,98140
Patent 8	4,92857	4,91667	0,01190	0,96440
Patent 9	5,88095	5,78333	0,09762	0,55080
Patent 10	3,28571	3,18333	0,10238	0,71700
Patent 11	4,04762	4,00000	0,04762	0,85520
Patent 12	**2,61905**	**3,23333**	**-0,61429**	**0,01720**
Patent 13	3,16667	3,36667	-0,20000	0,46740
Patent 14	**4,76191**	**5,28333**	**-0,52143**	**0,04840**
Patent 15	4,38095	4,61667	-0,23571	0,37950
Patent 16	4,02381	3,78333	0,24048	0,43630
Patent 17	4,71429	4,50000	0,21429	0,45350
Patent 18	2,90476	2,83333	0,07143	0,78260

Even though it is expected that university (seller) rates are higher than industry (buyer), the results show that this is not valid for every patent. The reason for this result may be due to the failures in licencing.

Patents 1, 2, 12, and 14 have differences in terms of mean values. Table 17 shows the properties of three patents which have the highest difference in terms of mean.

Table 17 Properties of patent which have highest mean difference

Factor	Patent 2	Patent 12	Patent 14
Technology	Widespread	Widespread	Developing
Patent Scope	Narrow	Narrow	Broad
Geography	Only Turkey	Only Turkey	Only Turkey
Total Development Cost	Medium	Low	Low
Additional investment	No additional investment	Low	No additional investment
Absorption capacity	Enough	Not enough	Enough
Price	1.200.000 TL	500.000 TL	1.200.000 TL
Mean Values(Industry vs university)	3,26191 vs 4,01667	2,61905 vs 3,2333	4,76191 vs 5,28333

The patents with similar mean values for the industry and the university are shown in Table 18.

Table 18 Properties of patents with similar means for both the industry and university

Factor	Patent 5	Patent 7	Patent 8
Technology	Widespread	Widespread	Developing
Patent Scope	Broad	Broad	Narrow
Geography	Turkey and other countries	Only Turkey	Turkey and other countries
Total Development Cost	Low	High	High
Additional investment	No additional investment	High additional investment	No additional investment
Absorption capacity	Not enough	Enough	Enough
Price	1.200.000 TL	500.000 TL	500.000 TL
Mean Values(Industry vs university)	4,33333 vs 4,33333	3,97619 vs 3,98333	4,92857 vs 4,91667

4.3 Validating the Results

The goodness-of-fit test is used for validation of the results. As mentioned in Section 4.1, Pearson r correlation value is used. The Adjusted R^2 are estimated in Section 4.2.1. Table 19 shows for all respondents, university, and industry Pearson r correlation values.

Table 19 R correlation values

Group	Adjusted R^2	Pearson r correlation
All Respondents	0,3053	0,55
University	0,2832	0,53
Industry	0,2886	0,54

The model explains the 55 percent of value of the university patents for all respondents, 53 percent for university, and 54 percent for industry.

4.4 Applying the Conjoint Results

Conjoint results are commonly used for segmentations or profitability analysis (Hair et al., 2009). However, the results are used for policy recommendations in chapter 5.

The results tell us that both university and industry have similar perspectives on the valuation of university patents. Technology is the most emphasised value indicator in the literature. However, in this research, technology has no significant impact on patent value from both the university's and industry's perspectives. These results can be used to recommend policies about university patents.

4.5 Evaluation of Hypotheses

In this thesis, seven hypotheses are built in Chapter 2. The evaluation of each hypotheses is done according to the conjoint results.

The first hypothesis is 'University and industry have different perspectives on the valuation of university patents in Turkey'.

The results in Section 4.2.4 show that we do not have enough evidence to say that university and industry have different perspectives for most of the patents rated. On the other hand, for only four patents we have enough evidence to say university andindustry have different perspectives where the difference is statistically significant at least at the 10 percent level.

The results in section 4.2.3 show that we do not have enough evidence to say university and industry have different perspectives in valuing patents when all factors are taken into consideration.

Table 20 Hypothesis

Hypothesis	University	Industry
Diffusion level of technology has significant impact the value	Reject	Reject
Patent protection scope has significant impact the value	Do not reject	Do not reject
Geographic coverage has significant impact the value	Do not reject	Do not reject
Total development cost has significant impact the value	Reject	Reject
Additional investment of company has significant impact the value	Do not reject	Do not reject
Absorption capacity has significant impact the value	Do not reject	Do not reject

Other hypotheses are tested using the results shown in Tables 11 and 12. According to these result patent scope, geographic protection scope, additional investment needed by company and absorption capacity of company have significant impact on the patent value from both perspectives. Adoption of technology and total development cost have no significant impact on the patent value from both perspectives. Therefore, hypotheses 2a, 2b, 5a, and 5b are rejected. Table 20 presents all the hypotheses and the corresponding results of the analysis. Even though both groups have similar valuation indicators, the motives of these groups are different.

The university focuses on to sell the patent as soon as possible and seeks for the companies which have enough infrastructure to use the patent. However, the industry expects to minimise any potential risks of patents. Therefore, both groups disregard any potential radical innovations with strong scientific background.

CHAPTER 5

CONCLUSION

Patents give economic privileges to the owner of the invention. Beside economic privileges, patents are an important way for the diffusion of knowledge and technology. The patent legislation in Turkey is changed at the end of 2016. Before the new legislation, patents which are the outcome of university research are owned by researchers. However, the new legislation enables the universities to own the patents.

Universities have to value invention disclosure of the researchers. After patent application, universities may either sell or licence to industry otherwise patents are put to shelves and become useless. However, selling or licencing the patents can make university research available to society and generate income. The generated income can be used for further research. Beside patents' benefits, it is also costly business, and the patent contains uncertainties because of its nature. So in this study, the valuation of university patents from both university (seller) and industry (buyer) perspectives are investigated. The similarities and differences of both perspectives are explained. This study is novel in ways: the topic and the method. This is the first research in Turkey to value university patents. Moreover, even though there are studies about value of patents in the literature, these studies considers only either seller or buyer perspectives. The contribution of this research is considering both perspectives at the same time. Additionally, the conjoint analysis applied in the thesis is generally used for marketing and it is applied for valuation of patents for the first time. Therefore, the method is novel for the subject of this thesis.

The main findings of the research and the policy recommendations are described in this chapter. Finally, concluding remarks are proposed.

5.1 Summary and Main Findings

To determine which indicators can be used for valuation, the literature is reviewed. In the literature both seller's and buyer's perspectives are considered. As a result of literature review, six indicators are determined as value indicators:

1) The diffusion level of technology
2) Patent protection scope
3) Geographic coverage of patent
4) Total development cost of patent
5) The additional investment of company
6) The technology absorption capacity of company

In Turkey, the number of licenced or transferred patent is very low. Therefore, there is not enough data to test whether these value indicators are significant for patent valuation or not. Thus, conjoint analysis, which enables to design an experimental set up, is used. In conjoint analysis, the value indicators are defined as factors, and the properties of these factor are defined as levels. The beauty of conjoint analysis is that it shows the impact of each factor and levels of these factors.

Table 21 Impacts of each factor

Factor	University	Industry
Diffusion level of technology	No significant impact	No significant impact
Patent protection scope	Significant impact	Significant impact
Geographic coverage	Significant impact	Significant impact
Total development cost	No significant impact	No significant impact
Additional investment	Significant impact	Significant impact
Technology absorption capacity	Significant impact	Significant impact

In this research, 18 hypothetical patents which have different levels of each factor are created. These patents are rated by both university TTO's as sellers and industry as buyers. The factors which have significant impact on the value is shown in Table 21.

The results show that both groups have similar value indicators. In the literature, the diffusion level of technology is one of the most highlighted value indicator

(Lanjouw, 1998; Bessen, 2006; Sneed & Johnson, 2009; Triest et al., 2007; Reitzig, 2003). However, the results indicate that both university and industry disregard the technology diffusion level. Forward citation, which is a sign of developing technology, is a significant value indicator in the literature (Harhoff et al., 2003; Gambardella et al., 2008; Reitzig, 2003; Sapsalis et al., 2006; Sapsalis & van Pottelsberghe, 2007; Lai & Che 2009; Sneed & Johnson, 2009; Sreekumaran et al., 2011; Fischer, Timo, & Leidinger, 2014). However, in Turkey, there is no data about forward citation, and both university and industry are unaware of its significance.

Even though both groups have similar value indicators, the motivations behind the preferences of these indicators are different. Industry tries to minimise the risks and uncertainties of patents. University tries to sell the patent immediately to the most suitable company as soon as possible. Even though universities have the opportunity to export the patent to companies located in other companies, this opportunity is missed by universities. According to these results, a patent, which is in a field of developing technology with strong scientific background, is disregarded by both groups. Thus, patents which are the outcome of radical innovations are assumed insignificant. The absence of radical innovations leads to a decrease in the competitiveness of the country in science and technology.

5.2 Policy Recommendations

The main findings of this research are as follows: (1) University seeks the most suitable company for licencing the patents, which are almost all the cases a domestic company. Universities miss the opportunity to licence the patents (or at least do not try) to foreign companies. (2) Industry tries to minimise the risk and uncertainties due to patent.

These two findings show both groups are targeting quick wins. However, radical innovations with strong scientific background are disregarded from both university and industry perspectives. So, the current TTO model under the university-industry relations have failed on this specific issue, which prevents radical innovations in Turkey. The solution to this failure may be government intervention. To fix the failure, policies which cover government, university, and industry are recommended. The aim of policy, policy tools, the application period of policy tools, outputs, and long-term impacts of the policies are explained in detail.

The first policy aims to encourage the universities to sell or licence their patents to foreign countries. To implement this policy, TÜBİTAK may develop a policy tool. The policy tool is a support programme, which enables universities to sell or licence the patents, which are in a field of developing technology to foreign companies. As the results show that the capabilities of companies are more important than patent properties. Besides domestic companies, developing technologies can be sold or licence to foreign companies. To accelerate to export technology, TÜBİTAK should start a patent exporting programme for universities. For each patent that is licenced or exported to foreign companies, TÜBİTAK should support the universities according to licence or selling price of patent. For selling patent, the support should be given at one time, for licence agreement the support should be given for three years to universities. The total support for each patent should not exceed the total development cost. The support may be added to university's research budget and it should only be used for further research for patented technology. So universities are encouraged to develop and licence patent in developing technologies.

The second policy aims to reduce the risk of industry due to licence a patent in developing technology field. As mentioned earlier, industry tends to minimise the risks and uncertainties of patents. The policy tool for this aim may be a support programme that the government take incentives to reduce the risk. TÜBİTAK may launch a licence support programme to licencing university patent which is in a developing technology field. The biggest risk is the high additional investment costs. Therefore, TÜBİTAK may support industry's additional investment costs. The support programme may have limited budget for every licence agreement. The support rate for the agreement should change according to the size of company. Small and medium enterprises (SME) may have higher support rate than big companies. The programme aims to reduce the risks of industry. However, it may be effective until industry become aware of the benefits of developing technologies. So, the programme should be effective at least for 10 years. The additional costs generally occur in the first years after licencing. Therefore five years may be enough for duration of support to each licence agreement. This programme may encourage the industry to licence developing technologies and in the long-term radical innovations will be adopted by industry.

The results of this research show that developing technologies are overlooked by both universities and industries in Turkey. Both policy tools target the patents in a field of developing technologies. The policy tools may increase both the number of licenced patents and the revenues from these patents and they may also create new links and strengthen the collaboration between university and industry.

Table 22 Polices

	University	Industry
Policy Aim	To encourage the universities to sell or licence their patents to foreign countries	To reduce the risk of industry due to patent licencing
Policy Tool	Support program for licencing patents to foreign countries.	Support program for additional investment.
Sector	Patents which are in a field of developing technology	Patents which are in a field of developing technology
Implementing Institution	TÜBİTAK	TÜBİTAK
Duration of Policy Tool	5 Years	5 Years
Limitations	The total support for each patent should not exceed the total development cost.	Different support rates for SMEs and big companies. The total support should not exceed the total development cost
Impact	Emergence of radical innovations	Emergence of radical innovations

The policy tool recommended above for university may increase the research budget of universities. The highest revenue from patent licencing agreement is with Prof. Dr. Erdal Arıkan and Huawei a Chinese telecommunication company.[10] The invention of Prof. Dr. Arıkan is about 5th generation telecommunication services which is a developing technology. The support programme may lead to increase such agreements in developing technologies.

[10] https://w3.bilkent.edu.tr/www/prof-arikanin-basarisi/ accessed on 22.08.2018

Industry avoids the risks of patents. The policy tool recommended above for industry reduces the risks of industry. The low risks of industry may lead to create new collaborations between university and industry and strengthen the links between them. The policies that are recommended are summarized in Table 22. In the long run the policies which targets the developing technologies may lead to emergence of new technologies and radical innovations in Turkey.

5.3 Concluding Remarks and Further Research

This research introduces university and industry perspectives on valuation of university patents in Turkey. The impact of different value indicators are estimated for both sides. In this regard, the research makes a significant contribution to the valuation of university patents. Even though patent valuation has been an issue for a long time, in the literature, the value indicators of university patents in Turkey have not be research. Both buyers and seller's opinions are considered in the study. Besides the subject of the research, the method used in the research is also novel. Even though in the US conjoint analysis, which enables experimental design for researchers, is used for valuation of patent in the patent infringement cases, the conjoint analysis is used to measure the impact of different value indicators from university and industry perspectives. The research shows the similarities and differences of both perspectives on the valuation of university patents. The results show that both sides have similar opinions on valuation of university patents. However, the motivation of university and the industry is different. Industry focuses on to minimise the risks and uncertainties due to patents. On the other hand, university focuses on to sell or licence the patents to as fast as possible. University seeks for the most suitable companies to sell or licence the patents. Therefore, both sides miss the opportunities and benefits of commercialisation of radical innovations. Radical innovations contain risks and uncertainties, and they take more time to commercialise. However, radical innovations have potential to generate more income than incremental innovations.

In Turkey, the number of licenced patents are very low and at present there is not enough data to research different value indicators. So this research is based on experimental set up and hypothetical patents are used to estimate the impact of different value indicators. In the future, the number of licenced patents will increase, and the impacts of these value indicators should be research on real patents.

REFERENCES

Association of University Technology Managers, 2004. Recollections: Celebrating the History of AUTUM and the Legacy of Bayh-Dole.

Baarsma, Barbara E. 2003. “The Valuation of the IJmeer Nature Reserve Using Conjoint Analysis.” Environmental and Resource Economics. https://doi.org/10.1023/A:1024447503683.

Bessen, James. 2008. “The Value of U.S. Patents by Owner and Patent Characteristics.” Research Policy. https://doi.org/10.1016/j.respol.2008.02.005.

Branscomb, L.M., Brooks, H. (Eds.), 1993. Empowering Technology: Implementing a U.S. strategy. MIT Press, Boston, pp. 202–234.

Bremer, Howard, Joseph Allen, and Norman J. Latker. 2009. “The US Bayh–Dole Act and Revisionism Redux.” Industry and Higher Education. https://doi.org/10.5367/000000009789711873.

Bulut, H., and G. Moschini. 2009. “US Universities’ Net Returns from Patenting and Licensing: A Quantile Regression Analysis.” Economics of Innovation and New Technology. https://doi.org/10.1080/10438590701709025.

Carlisle, Rodney P., and Daniel Lee Kleinman. 1997. “Politics on the Endless Frontier: Postwar Research Policy in the United States.” The Journal of American History. https://doi.org/10.2307/2952873.

Coriat, Benjamin, and Fabienne Orsi. 2002. “Establishing a New Intellectual Property Rights Regime in the United States Origins, Content and Problems.” Research Policy. https://doi.org/10.1016/S0048-7333(02)00078-1.

Deng, Yi. 2007. “Private Value of European Patents.” European Economic Review. https://doi.org/10.1016/j.euroecorev.2006.09.005.

Economist. 1851. “The right of property in inventions” Economist.

Economist. 2002. “Innovation’s Golden Goose.” Economist.

Eisenberg, Rebecca S. 1996. “Public Research and Private Development: Patents and Technology Transfer in Government-Sponsored Research.” Virginia Law Review.

Ernst, Holger, Sebastian Legler, and Ulrich Lichtenthaler. 2010. “Determinants of Patent Value: Insights from a Simulation Analysis.” Technological Forecasting and Social Change. https://doi.org/10.1016/j.techfore.2009.06.009.

Fischer, Timo, and Jan Leidinger. 2014. “Testing Patent Value Indicators on Directly Observed Patent Value - An Empirical Analysis of Ocean Tomo Patent Auctions.” Research Policy. https://doi.org/10.1016/j.respol.2013.07.013.

Gambardella Alfonso., Harhoff Dietmar, Verspagen Bart. 2008. "The Value of European Patents". European Management Review (2008) 5:69-84.

Göksidan, Hadi Tolga, Erkan Erdil, and Barış Çakmur. 2018. “Catching-up and the Role of University-Industry Collaboration in Emerging Economies: Case of Turkey.” In Innovation and the Entrepreneurial University, 83–113. Springer International Publishing. https://doi.org/10.1007/978-3-319-62649-9_5.

Giorgio, R.C., a. Krattiger, Rt Mahoney, Lita Nelsen, Ja Thomson, Ab Bennett, K. Satyanarayana, et al. 2007. “From University to Industry: Technology Transfer at Unicamp in Brazil.” Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices.

Green, Jerry R., and Suzanne Scotchmer. 1995. “On the Division of Profit in Sequential Innovation.” The RAND Journal of Economics. https://doi.org/10.2307/2556033.

Grimaldi, Rosa, Martin Kenney, Donald S. Siegel, and Mike Wright. 2011. “30 Years after Bayh-Dole: Reassessing Academic Entrepreneurship.” Research Policy. https://doi.org/10.1016/j.respol.2011.04.005.

Gür, Ufuk, İkbal Sinemden Oylumlu, and Özlem Kunday. 2017. “Critical Assessment of Entrepreneurial and Innovative Universities Index of Turkey: Future Directions.” Technological Forecasting and Social Change 123 (October). Elsevier Inc.: 161–68. doi:10.1016/j.techfore.2016.09.008.

Hair, Joseph, William Black, Barry Babin, and Rolph Anderson. 2010. “Multivariate Data Analysis: A Global Perspective.” In Multivariate Data Analysis: A Global Perspective.

Hall, Bronwyn H., and Dietmar Harhoff. 2012. “Recent Research on the Economics of Patents.” SSRN. https://doi.org/10.1146/annurev-economics-080511-111008.

Harhoff, Dietmar, Frederic M. Scherer, and Katrin Vopel. 2003. “Citations, Family Size, Opposition and the Value of Patent Rights.” Research Policy. https://doi.org/10.1016/S0048-7333(02)00124-5.

https://w3.bilkent.edu.tr/www/prof-arikanin-basarisi accessed on 22.08.2019

https://www.epo.org/law-practice/legal-texts/html/guidelines/e/g_vii_1.htm accessed on 22.08.2019

https://www.cogr.edu/sites/default/files/The_Bayh-Dole_Act-__A_Guide_to_the_Law_and_Implementing_Regulations.pdf accessed on 22.08.2019

https://www.epo.org/service-support/glossary.html#p accessed on 22.08.2019

http://www.tuik.gov.tr/PreHaberBultenleri.do?id=24865 accessed on 22.08.2019

https://www.uspto.gov/patents-getting-started/general-information-concerning-patents#heading-2 accessed on 22.08.2019 http://www.wipo.int/export/sites/www/scp/en/national_laws/novelty.pdf accessed on 22.08.2019

http://www.wipo.int/patents/en/ accessed on 22.08.2019

Ijzerman, Maarten J., and Lotte M.G. Steuten. 2011. "Early Assessment of Medical Technologies to Inform Product Development and Market Access: A Review of Methods and Applications." *Applied Health Economics and Health Policy*. https://doi.org/10.2165/11593380-000000000-00000.

Klemperer, Paul. 1990. "How Broad Should the Scope of Patent Protection Be?" *The RAND Journal of Economics*. https://doi.org/10.2307/2555498.

Krattiger A, Mahoney RT, Nelsen L, Thompson JA, Bennett AB, 2007.Echoes of Bayh-Dole? A survey of IP and technology transfer policies in emerging and developing economies.Intellectual property management in health and agricultural innovation: A handbook of best practices. Oxford (UK): MIHR, and Davis(CA): PIPRA. pp. 169–195.

Lai, Yi Hsuan, and Hui Chung Che. 2009. "Modeling Patent Legal Value by Extension Neural Network." *Expert Systems with Applications*. https://doi.org/10.1016/j.eswa.2009.01.027.

Lerner, Joshua. 1994. "The Importance of Patent Scope: An Empirical Analysis." *The RAND Journal of Economics*. https://doi.org/10.2307/2555833.

Markman, Gideon D., Phillip H. Phan, David B. Balkin, and Peter T. Gianiodis. 2005. “Entrepreneurship and University-Based Technology Transfer.” *Journal of Business Venturing*. https://doi.org/10.1016/j.jbusvent.2003.12.003.

Melorose, J., R. Perroy, and S. Careas. 2015. “Universities in Transition: Developing Entrepreneurial Universities for Organizing Third Mission.” *Statewide Agricultural Land Use Baseline 2015*. https://doi.org/10.1017/CBO9781107415324.004.

Mowery, David C., Richard R. Nelson, Bhaven N. Sampat, and Arvids A. Ziedonis. 2001. “The Growth of Patenting and Licensing by U.S. Universities: An Assessment of the Effects of the Bayh-Dole Act of 1980.” *Research Policy*. https://doi.org/10.1016/S0048-7333(99)00100-6.

Mowery, David C., and Bhaven N. Sampat. 2005. “The Bayh-Dole Act of 1980 and University-Industry Technology Transfer: A Model for Other OECD Governments?” In *Essays in Honor of Edwin Mansfield: The Economics of R&D, Innovation, and Technological Change*. https://doi.org/10.1007/0-387-25022-0_18.

Nybom, Thorsten. 2003. “The Humboldt Legacy: Reflections on the Past, Present, and Future of the European University.” *Higher Education Policy*. https://doi.org/10.1057/palgrave.hep.8300013.

OECD. 2000. “The Changing Role of Innovation and Information Technology in Growth.” *OECD*.

Olson Lanjouw, Jean. 1998. “Patent Protection in the Shadow of Infringement: Simulation Estimations of Patent Value.” *The Review of Economic Studies*. https://doi.org/10.1111/1467-937X.00064.

Pakes, Ariel. 1986. “Patents as Options: Some Estimates of the Value of Holding European Patent Stocks.” *Econometrica*. https://doi.org/10.2307/1912835.

Pitkethly, Robert. 1997. “THE VALUATION OF PATENTS : A Review of Patent Valuation Methods with Consideration of Option Based Methods and the Potential for Further Research.” *New Developments in Intellectual Property : Law and Economics*.

Poortinga, Wouter, Linda Steg, Charles Vlek, and Gerwin Wiersma. 2003. “Household Preferences for Energy-Saving Measures: A Conjoint Analysis.” *Journal of Economic Psychology*. https://doi.org/10.1016/S0167-4870(02)00154-X.

Popp Berman, Elizabeth. 2008. “Why Did Universities Start Patenting?: Institution-Building and the Road to the Bayh-Dole Act.” *Social Studies of Science*. https://doi.org/10.1177/0306312708098605.

Rao, Vithala R. 2014. *Applied Conjoint Analysis*. *Applied Conjoint Analysis*. https://doi.org/10.1007/978-3-540-87753-0.

Reitzig, Markus. 2003. “What Determines Patent Value?: Insights from the Semiconductor Industry.” *Research Policy*. https://doi.org/10.1016/S0048-7333(01)00193-7.

Sapsalis, Elefthérios, and Bruno van Pottelsberghe de la Potterie. 2007. "THE INSTITUTIONAL SOURCES OF KNOWLEDGE AND THE VALUE OF ACADEMIC PATENTS." *Economics of Innovation and New Technology*. https://doi.org/10.1080/10438590600982939.

Sapsalis, Elefthérios, Bruno van Pottelsberghe de la Potterie, and Ran Navon. 2006. "Academic versus Industry Patenting: An in-Depth Analysis of What Determines Patent Value." *Research Policy*. https://doi.org/10.1016/j.respol.2006.09.014.

Scott, John C. 2006. "The Mission of the University: Medieval to Postmodern Transformations." *The Journal of Higher Education*. https://doi.org/10.1353/jhe.2006.0007.

Sidak, J. Gregory, and Jeremy Skog. 2018. "Using Conjoint Analysis to Apportion Patent Damages." *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.3176717.

Slaughter, S. (1998). National higher education policies in a global economy. In J. Currie & J. Newson (Eds.), Universities and globalization: Critical perspectives (pp. 45–69). Thousand Oaks, CA: Sage.

Smilor, Raymond, Niall O'Donnell, Gregory Stein, and Robert S. Welborn. 2007. "The Research University and the Development of High-Technology Centers in the United States." *Economic Development Quarterly*. https://doi.org/10.1177/0891242407299426.

Sneed, Katherine A., and Daniel K N Johnson. 2009. “Selling Ideas: The Determinants of Patent Value in an Auction Environment.” *R and D Management*. https://doi.org/10.1111/j.1467-9310.2008.00540.x.

So, Anthony D., Bhaven N. Sampat, Arti K. Rai, Robert Cook-Deegan, Jerome H. Reichman, Robert Weissman, and Amy Kapczynski. 2008. “Is Bbayh-Dole Good for Developing Countries? Lessons from the Us Experience.” *PLoS Biology*. https://doi.org/10.1371/journal.pbio.0060262.

Squicciarini, Mariagrazia, Hélène Dernis, and Chiara Criscuolo. 2013. “在读 Measuring Patent Quality: Indicators of Technological and Economic Value.” *OECD Science, Technology and Industry Working Papers*. https://doi.org/10.1787/5k4522wkw1r8-en.

Sreekumaran Nair, Shyam, Mary Mathew, and Dipanjan Nag. 2011. “Dynamics between Patent Latent Variables and Patent Price.” *Technovation*. https://doi.org/10.1016/j.technovation.2011.07.002.

Statement by Birch Bayh, April 13, 1980, on the approval of S. 414 (Bayh-Dole) by the U.S. Senate on a 91-4 vote, cited from AUTM (2004, p. 16).

Sterzi, Valerio. 2013. “Patent Quality and Ownership: An Analysis of UK Faculty Patenting.” Research Policy. https://doi.org/10.1016/j.respol.2012.07.010.

Taylor Aldridge, T., and David Audretsch. 2017. “The Bayh-Dole Act and Scientist Entrepreneurship.” In *Universities and the Entrepreneurial Ecosystem*. https://doi.org/10.1016/j.respol.2011.04.006.

Trajtenberg, Manuel, Rebecca Henderson, and Adam Jaffe. 1997. “University Versus Corporate Patents: A Window On The Basicness Of Invention.” *Economics of Innovation and New Technology*. https://doi.org/10.1080/10438599700000006.

Triest, Sander van, and Wim Vis. 2007. “Valuing Patents on Cost-Reducing Technology: A Case Study.” *International Journal of Production Economics*. https://doi.org/10.1016/j.ijpe.2006.04.019.

Zeebroeck, Nicolas van. 2011. “The Puzzle of Patent Value Indicators.” *Economics of Innovation and New Technology*. https://doi.org/10.1080/10438590903038256.

APPENDICES

A. R SYNTAX FOR DECIDING THE NUMBER OF PROFILES

```
# call the necesseary libraries of R
library(AlgDesign)
library(dplyr)
#design levels
var.list=expand.grid(f.1=c("-1","1"),
                     f.2=c("-1","1"),
                     f.3=c("-1","1"),
                     f.4=c("-1","0","1"),
                     f.5=c("-1","1"),
                     f.6=c("-1","0","1"),
                     f.7=c("-1","0","1"))
#Defining the file where Ge value is kept
    ge.df=data.frame(matrincol=11,nrow=1000))
    colnames(ge.df)=c("s12","s14","s16","s18","s20","s22","s24","s26","s28","s3
    0","seed")
#Estimating the Ge value for different seed numbers for 1000 times between 12-40
    for (i in 1:1000){
      seed=i+12345
      ge.df[i,11]=seed
      for (ntr in 1:10){
        set.seed(seed)
        dummy.design=optFederov( ~ ., data = var.list, nTrials = 2*(5+ntr))
        ge.df[i,ntr]=dummy.design$Ge
        print(c(seed,i,ntr,dummy.design$Ge))
      }
    }
```

```
#ntr=18 maGe)=0.957
seed.list=filter(ge.df,s18==0.957)[,11]
row.list=matrincol=18,nrow=0)
for (i in 1:length(seed.list)){
  set.seed(seed.list[i])
  design=optFederov( ~ ., data = var.list, nTrials=18)
  row.list=rbind(row.list,design$rows)
}
#deleting the repeating lines
row.list=unique(row.list)
```

B. R SYNTAX FOR ORTHOGONAL DESIGN

```
library(AlgDesign) #Calling the design library
levels.design=c (2,2,2,3,3,2,3) # The number of levels for each factor
var.list=expand.grid= f.1= c("1","2")
f.2= c("1","2")
f.3 =c("1","2")
f.4=c("1","2", "3")
f.5=c("1","2", "3")
f.6=c("1","2")
f.7=c("1","2","3") #Defining the factors
set.seed (1459) #defining the seed number found in Appendix A
optFederov( ~ ., data = var.list, nTrials = 18) #Orth0gonal Design
```

C. THE QUESTIONNAIRE FOR UNIVERSITIES

This research is done due to put a framework for valuation of university patents from perspectives of university and industry. The results of this research will assist commercialization of university research and policy recommendations.

The research is conducted under the supervision of Associated Prof. İ. Semih Akçomak who is an academician in METU Science and Technology Policy Studies Department and Dr. Alp Eren Yurtseven who is the Coordinator of Technology Transfer Mechanism

Ethics Committee Approval Certificate dated 12.06.2019 and numbered 309 was obtained for the research, METU Science and Technology Policy Studies Main Science Research. If you request the Ethics Committee Approval document, you may send an e-mail to hamit.tas@tubitak.gov.tr.

18 different patents are defined in the research. The characteristics of patent are:

1) Diffussion level of technology
    a. Patent is in a field of developing technology. It has potential to be base for other patents. It possibility of being cited by other patents is high.
    b. Patent is in a field of widespread technology. The patent cites previous patents and there are various patents in the field.
2) Protection scope of patent
    a. Broad: It is difficult to invent around by other patents.
    b. Narrow: It is easy to invent around by other patents.
3) Geographic coverage of patent
    a. Protection in only Turkey
    b. Protection in Turkey and other countries
4) Total development cost: It refers to the total amount of money spent for the development of patent.
    a. Low: For instance, it is developed only by using university research funds.
    b. Medium: For instance, it is developed only by using TUBİTAK or EU funds.
    c. High: For instance, it is developed by using more than one research funds.
5) The additional investment amount required by the company in order to sell in the market
    a. No additional investment needed
    b. Low: For instance, minor changes in production lines, machinery acquisition with low prices.

c. High: For instance, additional production facility, renewal of machineries with high prices

6) Technology absorption capacity of companies
    a. Enough
    b. Not enough

The selling prices of patents are 1.200.000 TL, 850.000 TL and 500.000 TL. It is assumed that market conditions are stable, there is no financial problem for the buyers. It is accepted that the system for technology is completed and tests and demonstrations are performed for performance evaluation. Patents will be licenced to only one company.

Please rate the easiness of selling the patents which are developed in your university.

Patent No	Properties of Patents	Rate
Patent-1	- Developing technology - Narrow protection - Protection in Turkey and other countries - Low total development cost - High additional investment cost for company - Enough absorption capacity - 1.200.000 TL	
Patent-2	- Widespread technology - Narrow protection - Protection only in Turkey - Medium level total development cost - No additional investment cost for company - Enough absorption capacity - 1.200.000 TL	
Patent-3	- Developing technology - Broad protection - Protection in Turkey and other countries - Medium level total development cost - Low additional investment cost for company - Enough absorption capacity - 1.200.000 TL	
Patent-4	- Widespread technology - Narrow protection - Protection in Turkey and other countries - High total development cost - High additional investment cost for company	

	- Not enough absorption capacity - 1.200.000 TL	
Patent-5	- Widespread technology - Broad protection - Protection in Turkey and other countries - Low total development cost - No additional investment cost for company - Not enough absorption capacity - 1.200.000 TL	
Patent- 6	- Developing technology - Broad protection - Protection only in Turkey - Medium level total development cost - Low additional investment cost for company - Not enough absorption capacity - 1.200.000 TL	
Patent- 7	- Widespread technology - Broad protection - Protection only in Turkey - High total development cost - High additional investment cost for company - Enough absorption capacity - 500.000 TL	
Patent- 8	- Developing technology - Narrow protection - Protection in Turkey and other countries - High total development cost - No additional investment cost for company - Enough absorption capacity - 500.000 TL	
Patent-9	- Developing technology - Broad protection - Protection in Turkey and other countries - Medium level total development cost - Low additional investment cost for company - Enough absorption capacity - 500.000 TL	
Patent-10	- Developing technology - Broad protection - Protection only in Turkey - Low total development cost - High additional investment cost for company	

	- Not enough absorption capacity - 500.000 TL	
Patent-11	- Developing technology - Narrow protection - Protection in Turkey and other countries - Medium level total development cost - No additional investment cost for company - Not enough absorption capacity - 500.000 TL	
Patent-12	- Widespread technology - Narrow protection - Protection only in Turkey - Low total development cost - Low additional investment cost for company - Not enough absorption capacity - 500.000 TL	
Patent-13	- Widespread technology - Narrow protection - Protection only in Turkey - Medium level total development cost - High additional investment cost for company - Enough absorption capacity - 850.000 TL	
Patent-14	- Developing technology - Broad protection - Protection only in Turkey - Low total development cost - No additional investment cost for company - Enough absorption capacity - 850.000 TL	
Patent-15	- Widespread technology - Narrow protection - Protection in Turkey and other countries - Low total development cost - Low additional investment cost for company - Enough absorption capacity - 850.000 TL	
Patent-16	- Developing technology - Broad protection - Protection in Turkey and other countries - Medium total development cost - High additional investment cost for company	

	- Not enough absorption capacity - 850.000 TL	
Patent-17	- Widespread technology - Broad protection - Protection in Turkey and other countries - High total development cost - No additional investment cost for company - Not enough absorption capacity - 850.000 TL	
Patent-18	- Developing technology - Narrow protection - Protection only in Turkey - Low total development cost - Low additional investment cost for company - Not enough absorption capacity - 850.000 TL	

D. THE QUESTIONNAIRE FOR INDUSTRY

This research is done due to put a framework for valuation of university patents from perspectives of university and industry. The results of this research will assist commercialization of university research and policy recommendations.

The research is conducted under the supervision of Associated Prof. İ. Semih Akçomak who is an academician in METU Science and Technology Policy Studies Department and Dr. Alp Eren Yurtseven who is the Coordinator of Technology Transfer Mechanism

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    a. Low: For instance, it is developed only by using university research funds.
    b. Medium: For instance, it is developed only by using TUBİTAK or EU funds.
    c. High: For instance, it is developed by using more than one research funds.
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    a. No additional investment needed
    b. Low: For instance, minor changes in production lines, machinery acquisition with low prices.

c. High: For instance, additional production facility, renewal of machineries with high prices

12) Technology absorption capacity of companies

a. Enough
b. Not enough

The selling prices of patents are 1.200.000 TL, 850.000 TL and 500.000 TL. It is assumed that market conditions are stable, there is no financial problem for the buyers. It is accepted that the system for technology is completed and tests and demonstrations are performed for performance evaluation. Patents will be licenced to only your company.

Please rate from the willingness of buying patents which are developed in universities from 1-7.

Patent No	Properties of Patents	Rate
Patent-1	- Developing technology - Narrow protection - Protection in Turkey and other countries - Low total development cost - High additional investment cost for company - Enough absorption capacity - 1.200.000 TL	
Patent-2	- Widespread technology - Narrow protection - Protection only in Turkey - Medium level total development cost - No additional investment cost for company - Enough absorption capacity - 1.200.000 TL	
Patent-3	- Developing technology - Broad protection - Protection in Turkey and other countries - Medium level total development cost - Low additional investment cost for company - Enough absorption capacity - 1.200.000 TL	
Patent-4	- Widespread technology - Narrow protection - Protection in Turkey and other countries - High total development cost	

	- High additional investment cost for company - Not enough absorption capacity - 1.200.000 TL	
Patent-5	- Widespread technology - Broad protection - Protection in Turkey and other countries - Low total development cost - No additional investment cost for company - Not enough absorption capacity - 1.200.000 TL	
Patent- 6	- Developing technology - Broad protection - Protection only in Turkey - Medium level total development cost - Low additional investment cost for company - Not enough absorption capacity - 1.200.000 TL	
Patent- 7	- Widespread technology - Broad protection - Protection only in Turkey - High total development cost - High additional investment cost for company - Enough absorption capacity - 500.000 TL	
Patent- 8	- Developing technology - Narrow protection - Protection in Turkey and other countries - High total development cost - No additional investment cost for company - Enough absorption capacity - 500.000 TL	
Patent-9	- Developing technology - Broad protection - Protection in Turkey and other countries - Medium level total development cost - Low additional investment cost for company - Enough absorption capacity - 500.000 TL	
Patent-10	- Developing technology - Broad protection - Protection only in Turkey - Low total development cost	

	- High additional investment cost for company - Not enough absorption capacity - 500.000 TL	
Patent-11	- Developing technology - Narrow protection - Protection in Turkey and other countries - Medium level total development cost - No additional investment cost for company - Not enough absorption capacity - 500.000 TL	
Patent-12	- Widespread technology - Narrow protection - Protection only in Turkey - Low total development cost - Low additional investment cost for company - Not enough absorption capacity - 500.000 TL	
Patent-13	- Widespread technology - Narrow protection - Protection only in Turkey - Medium level total development cost - High additional investment cost for company - Enough absorption capacity - 850.000 TL	
Patent-14	- Developing technology - Broad protection - Protection only in Turkey - Low total development cost - No additional investment cost for company - Enough absorption capacity - 850.000 TL	
Patent-15	- Widespread technology - Narrow protection - Protection in Turkey and other countries - Low total development cost - Low additional investment cost for company - Enough absorption capacity - 850.000 TL	
Patent-16	- Developing technology - Broad protection - Protection in Turkey and other countries - Medium total development cost	

	- High additional investment cost for company - Not enough absorption capacity - 850.000 TL	
Patent-17	- Widespread technology - Broad protection - Protection in Turkey and other countries - High total development cost - No additional investment cost for company - Not enough absorption capacity - 850.000 TL	
Patent-18	- Developing technology - Narrow protection - Protection only in Turkey - Low total development cost - Low additional investment cost for company - Not enough absorption capacity - 850.000 TL	

E. RESPONSES OF UNIVERSITY

Respondent	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18
U-1	3	6	6	5	5	4	3	6	6	3	5	6	3	6	6	3	3	4
U-2	2	2	5	4	5	5	5	4	5	4	2	3	3	6	5	5	5	6
U-3	3	5	4	4	5	4	5	5	5	6	6	5	2	5	5	5	4	4
U-4	2	3	6	2	6	3	5	3	6	2	3	3	2	6	3	2	5	2
U-5	2	2	3	3	2	2	3	5	5	3	5	2	2	3	3	2	3	2
U-6	2	2	6	5	5	1	1	4	7	5	5	2	2	4	3	6	5	4
U-7	5	4	5	4	4	3	5	6	5	3	3	3	5	5	5	4	3	3
U-8	6	2	7	3	6	5	5	4	5	4	5	3	4	5	5	6	6	1
U-9	3	3	6	1	6	5	7	3	6	3	5	2	6	6	3	6	6	5
U-10	4	3	6	4	5	4	4	6	6	5	5	2	5	6	5	6	6	4
U-11	5	2	6	2	6	2	6	4	7	2	4	2	3	5	5	2	5	4
U-12	3	5	6	2	5	5	3	5	4	3	4	5	3	5	5	2	4	3
U-13	5	5	6	2	3	5	5	6	6	2	3	5	5	6	5	3	3	3
U-14	3	5	6	6	7	3	5	2	6	2	6	2	2	5	5	6	5	2
U-15	4	2	6	2	3	2	5	5	6	2	3	2	4	6	6	3	4	2
U-16	3	4	6	3	3	5	5	6	5	3	3	3	4	6	6	5	6	3
U-17	3	3	5	1	3	2	2	4	7	2	4	2	3	5	5	4	7	2
U-18	2	6	5	6	2	5	5	5	5	2	4	4	3	7	5	2	6	3
U-19	5	4	5	4	7	4	2	4	6	5	4	5	4	5	4	2	4	4
U-20	5	6	6	2	4	4	3	6	7	2	3	4	3	6	5	3	4	2
U-21	6	6	6	2	3	2	5	6	6	2	2	2	5	5	6	2	3	3
U-22	6	6	5	2	2	2	6	6	6	2	3	2	6	6	5	2	3	2
U-23	3	4	4	3	5	3	3	4	4	2	3	4	3	6	5	3	5	3
U-24	5	6	6	2	2	2	5	6	6	3	2	2	5	3	5	3	3	2
U-25	3	4	6	2	6	5	2	7	7	1	5	3	2	4	4	2	6	3
U-26	6	6	6	2	2	2	3	6	6	2	2	2	6	3	6	2	2	2
U-27	4	5	7	3	3	2	5	6	7	3	3	3	3	6	6	2	5	3
U-28	2	5	6	1	3	3	3	6	5	2	3	3	2	6	5	2	2	2
U-29	5	3	7	1	5	5	3	6	7	5	6	3	2	7	6	5	5	3
U-30	2	4	6	3	5	4	4	5	6	4	3	2	3	5	3	4	6	3
U-31	3	5	5	1	2	2	2	7	6	2	4	5	2	6	5	3	4	2
U-32	3	2	5	2	4	2	5	6	6	4	2	2	2	3	2	3	3	2
U-33	3	4	6	3	5	4	5	6	7	5	6	6	2	6	5	3	5	5
U-34	5	3	6	2	6	2	2	6	4	5	5	3	2	5	5	6	2	2
U-35	5	5	7	6	6	5	6	7	7	6	6	5	3	6	6	6	6	2
U-36	6	6	6	3	5	6	5	5	6	5	4	6	4	7	5	6	5	5
U-37	6	6	5	2	2	2	5	6	6	2	3	5	5	6	6	2	3	2
U-38	2	5	6	1	5	3	3	6	7	5	6	5	2	5	5	3	5	1
U-39	3	3	5	5	2	2	3	5	3	4	3	2	3	2	2	4	4	3
U-40	2	5	6	1	6	3	5	5	7	1	4	2	1	6	5	2	6	2
U-41	5	5	6	3	6	5	3	5	5	3	6	5	5	6	6	5	5	3
U-42	3	5	6	1	6	3	4	6	6	2	6	2	2	6	5	4	5	2
U-43	3	2	5	1	6	5	7	2	5	5	4	4	3	6	3	7	6	2
U-44	4	1	6	4	5	3	2	6	6	2	5	2	3	4	5	4	5	1
U-45	2	3	5	1	2	3	3	4	7	4	5	2	2	3	5	3	4	2
U-46	6	5	6	5	6	4	5	6	6	4	6	5	5	6	6	6	5	5
U-47	2	2	3	1	3	2	3	3	5	2	3	3	1	5	2	2	2	2
U-48	3	3	7	2	5	5	5	2	6	6	4	3	3	5	3	6	6	4
U-49	5	1	7	1	3	5	4	6	5	2	5	3	6	7	5	3	7	2
U-50	5	4	7	1	5	2	5	4	7	1	2	2	2	6	5	2	3	1
U-51	6	5	4	2	4	2	6	5	6	3	3	1	6	6	2	3	2	2
U-52	5	7	5	6	4	4	4	4	4	4	4	6	4	6	4	5	6	6
U-53	6	5	2	2	5	5	5	2	7	5	6	6	5	6	5	7	7	2
U-54	2	3	7	3	5	6	3	5	5	2	3	1	3	6	5	7	5	4
U-55	2	3	5	4	4	5	2	4	5	3	5	3	3	5	5	3	4	2
U-56	4	6	7	5	7	6	3	4	6	5	4	3	5	7	7	5	5	4
U-57	2	1	6	1	1	1	1	6	6	1	4	2	2	5	1	2	2	2
U-58	3	6	6	1	5	3	2	5	6	2	2	2	4	2	6	3	3	3
U-59	3	2	5	2	3	2	5	2	5	3	2	2	3	5	2	3	5	2
U-60	5	5	3	4	4	3	3	4	5	4	4	5	4	4	4	5	6	4

F. RESPONSES OF INDUSTRY

Respondent	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18
I-1	4	6	5	3	4	3	3	5	7	4	3	2	3	3	5	5	6	3
I-2	3	2	5	5	3	3	6	4	6	4	3	2	3	5	4	5	6	2
I-3	4	2	6	2	5	2	4	5	5	2	5	2	2	5	2	5	3	2
I-4	3	1	6	1	6	3	3	3	6	3	4	2	2	4	2	6	6	2
I-5	4	3	6	2	1	5	4	5	7	2	5	2	1	6	4	2	4	3
I-6	5	3	6	1	5	4	5	7	6	2	3	3	2	5	4	5	3	5
I-7	2	2	6	5	2	2	2	2	6	2	2	2	5	5	2	2	4	2
I-8	2	2	7	2	6	2	2	6	6	2	3	2	2	2	5	4	5	2
I-9	1	1	7	1	4	5	7	1	6	7	2	1	3	7	1	7	7	1
I-10	2	2	6	6	5	2	2	6	6	2	4	2	2	2	5	6	6	2
I-11	1	1	6	2	1	2	3	7	5	2	2	2	3	6	5	2	2	2
I-12	2	3	6	2	4	5	5	3	6	5	4	3	2	6	2	5	5	3
I-13	2	2	3	1	3	2	3	4	6	3	4	4	2	4	5	1	2	2
I-14	2	5	5	5	6	6	6	4	6	6	6	6	4	6	5	4	6	6
I-15	5	5	4	3	3	4	6	5	6	3	3	4	4	5	6	4	5	3
I-16	4	2	4	3	4	3	3	3	4	2	4	2	4	4	3	4	4	2
I-17	2	1	6	1	5	2	3	5	5	2	6	1	1	1	5	5	5	2
I-18	5	6	6	2	6	2	5	6	6	2	6	2	5	5	6	6	5	2
I-19	2	2	5	5	6	5	6	4	5	5	4	3	4	4	5	5	6	4
I-20	5	3	6	3	3	4	5	6	6	5	4	3	3	4	4	5	3	5
I-21	3	5	6	2	5	5	6	6	6	5	5	5	6	6	6	5	6	5
I-22	6	6	7	3	6	4	4	5	6	3	2	2	5	6	6	4	4	1
I-23	5	4	6	5	2	1	4	5	6	2	3	2	5	4	5	2	3	2
I-24	2	2	6	2	5	2	2	5	6	4	3	3	3	5	5	3	5	3
I-25	5	5	4	2	4	3	4	6	4	2	4	2	5	6	3	3	4	2
I-26	2	2	6	4	5	5	5	6	6	3	5	3	4	5	5	5	6	5
I-27	5	3	6	1	6	4	6	5	6	4	4	2	2	6	4	3	5	3
I-28	1	5	5	4	5	4	2	6	6	2	5	3	2	4	5	2	3	3
I-29	2	1	4	2	4	2	3	4	5	3	4	2	3	4	4	4	4	2
I-30	2	5	7	2	5	5	4	4	6	4	5	2	2	7	5	4	5	4
I-31	5	2	6	5	4	2	3	6	7	4	2	2	3	4	5	2	2	2
I-32	5	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
I-33	2	2	6	3	3	2	3	5	6	2	4	2	2	5	4	5	6	2
I-34	2	5	7	2	3	5	1	5	6	3	4	3	2	7	6	4	6	3
I-35	2	5	6	2	6	2	2	6	6	2	5	3	2	5	5	2	2	3
I-36	2	1	5	2	6	5	7	3	7	6	4	1	1	5	2	6	6	2
I-37	5	6	6	1	2	5	5	6	5	3	3	2	5	4	4	4	5	2
I-38	2	5	7	5	7	5	4	6	7	4	6	3	4	5	4	5	6	4
I-39	2	2	5	2	3	3	3	5	6	3	5	3	3	3	3	2	6	2
I-40	6	2	4	4	3	2	2	6	5	4	6	2	5	5	6	4	6	6
I-41	3	5	6	2	6	4	5	6	7	2	6	3	3	6	5	3	6	3
I-42	5	4	5	3	4	2	3	4	6	2	2	4	3	3	6	3	3	2

G. THE R CODES USED TO ESTIMATE THE CONJOINT ANALYSIS

```
#required libraries
library(conjoint)
#load data
all.pref=read.csv("c:/data/hamit_tez/patent_all_pref.csv",header=TRUE,sep=";")
ind.pref= read.csv("c:/data/hamit_tez/patent_ind_pref.csv",header=TRUE,sep=";")
uni.pref= read.csv("c:/data/hamit_tez/patent_uni_pref.csv",header=TRUE,sep=";")
patent.prof=read.csv("c:/data/hamit_tez/patent_prof.csv",header=TRUE,sep=";")
patent.lev=read.csv("c:/data/hamit_tez/patent_lev.csv",header=TRUE,sep=";")
#conjoint_model
conjoint.pop=Conjoint(y=all.pref,x=patent.prof,z=patent.lev) #conjoint for all
conjoint.popind= Conjoint(y=ind.pref,x=patent.prof,z=patent.lev) #conjoint for ind.
conjoint.popuni= Conjoint(y=uni.pref,x=patent.prof,z=patent.lev) #conjoint for uni.
caPartUtilities(y=ind.pref, x=patent.prof, z=patent.lev) #Part-worth for industry
caPartUtilities(y=uni.pref, x=patent.prof, z=patent.lev) #Part-worth for university
caImportance (y=ind.pref, x=patent.prof) #importance for industry
caImportance (y=uni.pref, x=patent.prof) #importance for university
```

H. PART-WORTHS FOR EACH INDUSTRY RESPONDENTS

	Intercept	Developing technology	Widespread technology	Broad	Narrow	Turkey and abroad	Only Turkey	High	Medium	Low	High	Low	No additional investment	Enough	Not enough	1200000 TL	850000 TL	500000 TL
1	4,038	-0,216	0,216	0,409	-0,409	0,655	-0,655	-0,09	0,462	-0,372	-0,372	0,128	0,243	0,466	-0,466	-0,09	0,128	-0,038
2	3,885	-0,227	0,227	0,898	-0,898	0,534	-0,534	0,604	-0,218	-0,385	0,448	-0,218	-0,23	0,352	-0,352	-0,563	0,282	0,282
3	3,417	0,489	-0,489	0,614	-0,614	0,75	-0,75	0	0,083	-0,083	-0,25	-0,25	0,5	0,511	-0,511	-0,167	-0,25	0,417
4	3,396	0,136	-0,136	1,261	-1,261	0,932	-0,932	-0,207	0,27	-0,063	-0,396	0,104	0,293	-0,011	0,011	-0,374	0,27	0,104
5	3,628	0,602	-0,602	0,477	-0,477	0,345	-0,345	0,257	0,205	-0,462	-1,128	0,872	0,257	0,898	-0,898	-0,243	-0,295	0,538
6	4,065	0,591	-0,591	0,466	-0,466	0,412	-0,412	0,297	-0,232	-0,065	-0,732	0,601	0,131	0,784	-0,784	-0,203	-0,065	0,268
7	3,027	-0,273	0,273	0,477	-0,477	0,257	-0,257	0,387	0,14	-0,527	-0,027	0,306	-0,279	0,523	-0,523	0,054	0,306	-0,36
8	3,304	-0,136	0,136	0,614	-0,614	1,264	-1,264	0,275	-0,137	-0,137	-0,971	0,696	0,275	0,386	-0,386	-0,225	0,029	0,196
9	3,842	0,136	-0,136	2,511	-2,511	-0,081	0,081	0,185	0,158	-0,342	0,491	-0,342	-0,149	0,239	-0,239	-0,649	0,491	0,158
10	3,604	-0,273	0,273	0,352	-0,352	1,568	-1,568	0,541	0,063	-0,604	-0,27	0,23	0,041	-0,102	0,102	-0,293	0,23	0,063
11	2,959	0,432	-0,432	0,307	-0,307	0,365	-0,365	0,586	-0,459	-0,126	-0,793	0,707	0,086	1,193	-1,193	-0,914	0,374	0,541
12	3,95	0,261	-0,261	1,261	-1,261	-0,054	0,054	0,068	0,216	-0,284	-0,45	0,216	0,234	0,114	-0,114	-0,266	-0,117	0,383
13	2,91	-0,125	0,125	0,125	-0,125	0,311	-0,311	-0,514	-0,077	0,59	-0,91	0,757	0,153	0,5	-0,5	-0,847	-0,243	1,09
14	5,266	-0,318	0,318	0,432	-0,432	-0,392	0,392	0,198	-0,099	-0,099	-0,766	0,401	0,365	-0,432	0,432	-0,302	-0,099	0,401
15	4,32	-0,273	0,273	0,227	-0,227	0,122	-0,122	-0,027	0,014	0,014	-0,153	0,18	-0,027	0,773	-0,773	-0,36	0,18	0,18
16	3,223	0,045	-0,045	0,295	-0,295	0,493	-0,493	-0,221	0,277	-0,056	0,11	-0,223	0,113	0,205	-0,205	-0,054	0,277	-0,223
17	3,059	0,17	-0,17	0,545	-0,545	1,473	-1,473	0,117	0,275	-0,392	-0,725	0,441	0,284	0,08	-0,08	-0,716	0,108	0,608
18	4,514	-0,091	0,091	0,284	-0,284	0,878	-0,878	-0,473	0,653	-0,18	-0,347	-0,514	0,86	0,966	-0,966	-0,306	0,32	-0,014
19	4,412	-0,341	0,341	0,784	-0,784	0,291	-0,291	0,491	-0,245	-0,245	0,088	0,088	-0,176	-0,284	0,284	-0,342	0,255	0,088
20	4,243	0,636	-0,636	0,261	-0,261	0,311	-0,311	0,32	-0,077	-0,243	0,09	0,423	-0,514	0,489	-0,489	-0,347	-0,243	0,59
21	5,182	-0,057	0,057	0,443	-0,443	-0,142	0,142	0,032	0,151	-0,182	-0,682	0,318	0,365	0,432	-0,432	-0,802	0,484	0,318
22	4,394	-0,148	0,148	0,602	-0,602	0,453	-0,453	-0,545	0,106	0,439	-0,227	-0,061	0,288	1,273	-1,273	0,788	-0,061	-0,727
23	3,601	-0,182	0,182	-0,182	0,182	0,588	-0,588	0,369	-0,101	-0,268	0,232	0,065	-0,297	1,182	-1,182	0,036	-0,101	0,065
24	3,597	-0,023	0,023	0,602	-0,602	0,628	-0,628	0,027	-0,43	0,403	-0,93	0,57	0,36	0,398	-0,398	-0,64	0,403	0,236
25	3,775	0,205	-0,205	0,08	-0,08	0,027	-0,027	-0,117	0,225	-0,108	-0,275	-0,775	1,05	0,92	-0,92	0,05	0,059	-0,108
26	4,502	0,057	-0,057	0,557	-0,557	0,48	-0,48	0,671	-0,002	-0,669	-0,669	0,498	0,171	0,068	-0,068	-0,662	0,498	0,164
27	4,133	0,25	-0,25	1	-1	0,304	-0,304	0,099	-0,466	0,367	-0,633	0,034	0,599	0,75	-0,75	-0,068	-0,3	0,367
28	3,676	-0,136	0,136	-0,011	0,011	0,419	-0,419	0,018	0,324	-0,342	-1,509	0,658	0,851	0,261	-0,261	0,185	-0,509	0,324
29	3,09	0,023	-0,023	0,523	-0,523	0,689	-0,689	-0,153	0,077	0,077	-0,257	0,077	0,18	0,227	-0,227	-0,82	0,41	0,41
30	4,322	0,284	-0,284	0,909	-0,909	0,101	-0,101	-0,023	0,178	-0,155	-1,322	0,511	0,811	0,466	-0,466	-0,023	0,178	-0,155
31	3,572	0,08	-0,08	0,205	-0,205	0,851	-0,851	0,144	-0,572	0,428	0,095	0,428	-0,523	0,92	-0,92	0,144	-0,572	0,428
32	5,95	-0,068	0,068	0,057	-0,057	-0,054	0,054	0,068	0,05	-0,117	-0,117	0,05	0,068	-0,057	0,057	-0,099	0,05	0,05
33	3,45	0,08	-0,08	0,705	-0,705	0,946	-0,946	0,401	0,05	-0,45	-0,617	0,216	0,401	0,42	-0,42	-0,766	0,55	0,216
34	4,068	0,33	-0,33	0,58	-0,58	0,392	-0,392	-0,198	0,266	-0,068	-1,734	0,932	0,802	0,545	-0,545	-0,198	0,599	-0,401
35	3,61	0,068	-0,068	0,068	-0,068	0,507	-0,507	-0,279	0,056	0,223	-1,61	0,556	1,054	0,682	-0,682	0,054	-0,444	0,39
36	3,896	0,057	-0,057	1,932	-1,932	0,432	-0,432	0,126	0,104	-0,23	0,104	-0,23	0,126	-0,057	0,057	-0,541	-0,23	0,77
37	4,056	0,25	-0,25	0,375	-0,375	-0,007	0,007	0,113	0,61	-0,723	-0,223	-0,056	0,279	1,125	-1,125	0,113	-0,056	-0,056
38	4,89	-0,125	0,125	0,625	-0,625	0,493	-0,493	0,279	0,444	-0,723	-0,89	0,11	0,779	0	0	0,113	-0,223	0,11
39	3,327	-0,08	0,08	0,42	-0,42	0,561	-0,561	0,32	0,173	-0,493	-0,827	0,34	0,486	0,205	-0,205	-0,68	-0,16	0,84
40	4,241	0,523	-0,523	-0,477	0,477	0,831	-0,831	0,149	-0,241	0,092	-0,074	-0,074	0,149	0,227	-0,227	-1,018	1,092	-0,074
41	4,45	-0,159	0,159	0,591	-0,591	0,446	-0,446	0,068	0,216	-0,284	-1,45	0,216	1,234	0,659	-0,659	-0,266	-0,117	0,383
42	3,48	-0,364	0,364	0,011	-0,011	0,682	-0,682	-0,374	-0,146	0,52	-0,313	0,687	-0,374	0,739	-0,739	0,126	-0,146	0,02

I. PART-WORTHS FOR EACH UNIVERSITY RESPONDENTS

	Inter cept	Developin g technolog y	Widespr ead technolo gy	Broad	Narrow	Turkey and abroad	Only Turkey	High	Medium	Low	High	Low	No additional investment	Enough	Not enough	1200000 TL	850000 TL	500000 TL
1	4,595	-0,102	0,102	-0,227	0,227	0,149	-0,149	-0,144	-0,095	0,239	-1,261	0,739	0,523	0,352	-0,352	0,189	-0,428	0,239
2	4,225	0,023	-0,023	0,773	-0,773	-0,027	0,027	0,617	-0,559	-0,059	-0,392	0,608	-0,216	-0,023	0,023	-0,383	0,775	-0,392
3	4,547	0,068	-0,068	0,193	-0,193	0,074	-0,074	-0,239	-0,047	0,286	-0,381	-0,047	0,428	-0,193	0,193	-0,405	-0,381	0,786
4	3,538	-0,398	0,398	1,102	-1,102	0,155	-0,155	0,243	-0,372	0,128	-1,038	0,295	0,743	0,523	-0,523	0,077	-0,205	0,128
5	2,836	0,136	-0,136	0,011	-0,011	0,48	-0,48	0,171	0,164	-0,336	-0,336	-0,002	0,338	0,239	-0,239	-0,662	-0,336	0,998
6	3,707	0,182	-0,182	0,557	-0,557	1,135	-1,135	0,081	0,126	-0,207	-0,207	0,126	0,081	-0,307	0,307	-0,586	0,293	0,293
7	4,137	0,034	-0,034	0,034	-0,034	0,264	-0,264	0,108	-0,137	0,029	0,196	-0,137	-0,059	0,841	-0,841	-0,059	0,029	0,029
8	4,457	0,159	-0,159	0,909	-0,909	0,885	-0,885	-0,419	0,043	0,376	0,209	-0,124	-0,086	0,341	-0,341	0,081	0,043	-0,124
9	4,561	0,023	-0,023	1,148	-1,148	-0,047	0,047	0,122	0,606	-0,727	-0,227	-0,061	0,288	0,352	-0,352	-0,545	0,773	-0,227
10	4,709	0,307	-0,307	0,557	-0,557	0,615	-0,615	0,086	0,124	-0,209	-0,043	-0,209	0,252	0,318	-0,318	-0,581	0,624	-0,043
11	3,928	-0,205	0,205	0,67	-0,67	0,649	-0,649	0,356	-0,595	0,239	-0,595	0,405	0,189	0,83	-0,83	-0,311	0,072	0,239
12	4,011	0,023	-0,023	0,148	-0,148	-0,101	0,101	-0,144	-0,178	0,322	-1,345	0,655	0,689	0,352	-0,352	0,356	-0,345	-0,011
13	4,349	0,114	-0,114	0,114	-0,114	-0,142	0,142	-0,135	0,151	-0,016	-0,682	0,651	0,032	1,136	-1,136	0,032	-0,182	0,151
14	4,234	-0,523	0,523	0,727	-0,727	0,892	-0,892	-0,198	0,432	-0,234	-0,234	-0,234	0,468	0,023	-0,023	0,468	-0,068	-0,401
15	3,655	0,023	-0,023	0,523	-0,523	0,601	-0,601	0,144	-0,322	0,178	-0,322	0,345	-0,023	1,227	-1,227	-0,689	0,511	0,178
16	4,365	0,068	-0,068	0,568	-0,568	0,216	-0,216	0,396	-0,032	-0,365	-0,532	0,302	0,23	0,682	-0,682	-0,437	0,635	-0,198
17	3,455	-0,114	0,114	0,636	-0,636	0,905	-0,905	-0,257	0,378	-0,122	-0,955	0,378	0,577	0,614	-0,614	-0,923	0,878	0,045
18	4,309	-0,352	0,352	0,148	-0,148	-0,277	0,277	0,784	-0,142	-0,642	-0,975	0,191	0,784	0,477	-0,477	0,117	0,025	-0,142
19	4,315	-0,125	0,125	0,125	-0,125	0,162	-0,162	-0,536	-0,315	0,851	-0,649	0,351	0,297	0	0	0,464	-0,482	0,018
20	4,131	0,034	-0,034	0,284	-0,284	0,324	-0,324	-0,405	0,203	0,203	-1,131	0,536	0,595	1,091	-1,091	0,261	-0,297	0,036
21	3,98	-0,034	0,034	-0,034	0,034	0,182	-0,182	0,126	-0,146	0,02	-0,313	0,187	0,126	1,659	-1,659	0,126	0,02	-0,146
22	4,002	-0,023	0,023	-0,023	0,023	-0,02	0,02	0,005	0,164	-0,169	-0,002	-0,336	0,338	1,773	-1,773	-0,162	-0,002	0,164
23	3,707	-0,273	0,273	0,227	-0,227	0,135	-0,135	-0,086	-0,374	0,459	-0,874	0,126	0,748	0,273	-0,273	-0,086	0,459	-0,374
24	3,75	-0,068	0,068	0,057	-0,057	0,25	-0,25	0,167	0,25	-0,417	0,083	0,083	-0,167	1,443	-1,443	0	-0,25	0,25
25	3,919	0	0	0,375	-0,375	0,73	-0,73	0,171	0,248	-0,419	-1,919	0,748	1,171	0,375	-0,375	0,171	-0,419	0,248
26	3,622	0	0	-0,375	0,375	0,405	-0,405	-0,257	0,378	-0,122	-0,122	0,378	-0,257	1,625	-1,625	0,243	-0,122	-0,122
27	4,182	-0,125	0,125	0,375	-0,375	0,358	-0,358	0,532	-0,516	-0,016	-0,849	0,484	0,365	1,25	-1,25	-0,302	-0,016	0,318
28	3,383	0,261	-0,261	0,261	-0,261	0,054	-0,054	-0,068	-0,05	0,117	-1,383	0,617	0,766	1,114	-1,114	-0,068	-0,216	0,284
29	4,579	0,761	-0,761	0,761	-0,761	0,791	-0,791	-0,676	0,088	0,588	-1,079	0,588	0,491	0,614	-0,614	-0,509	0,088	0,421
30	3,975	-0,068	0,068	0,932	-0,932	0,223	-0,223	0,45	0,025	-0,475	-0,642	0,025	0,617	0,318	-0,318	-0,05	0,025	0,025
31	3,624	0,216	-0,216	-0,034	0,034	0,385	-0,385	-0,252	0,043	0,209	-1,457	0,543	0,914	0,909	-0,909	-0,752	0,043	0,709
32	3,178	0,102	-0,102	0,727	-0,727	0,399	-0,399	0,523	-0,345	-0,178	-0,011	-0,011	0,023	0,648	-0,648	-0,311	-0,678	0,989
33	4,764	0,091	-0,091	0,341	-0,341	0,128	-0,128	0,194	-0,43	0,236	-1,264	0,736	0,527	0,159	-0,159	-0,64	-0,43	1,07
34	3,842	0,739	-0,739	0,239	-0,239	0,919	-0,919	-0,815	-0,176	0,991	-0,176	-0,176	0,351	0,386	-0,386	-0,149	-0,176	0,324
35	5,477	-0,034	0,034	0,591	-0,591	0,703	-0,703	-0,045	-0,144	0,189	-0,144	-0,144	0,288	0,284	-0,284	-0,045	-0,644	0,689
36	5,297	0,273	-0,273	0,398	-0,398	-0,176	0,176	-0,405	0,036	0,369	-0,464	0,369	0,095	0,352	-0,352	0,095	0,036	-0,131
37	4,108	-0,136	0,136	-0,261	0,261	0,027	-0,027	-0,284	-0,108	0,392	-0,441	0,225	0,216	1,511	-1,511	-0,284	-0,108	0,392
38	4,11	-0,068	0,068	0,557	-0,557	0,507	-0,507	-0,613	0,223	0,39	-1,444	0,39	1,054	0,443	-0,443	-0,613	-0,61	1,223
39	3,185	0,227	-0,227	-0,023	0,023	0,338	-0,338	0,869	-0,185	-0,685	0,482	-0,351	-0,131	0,023	-0,023	0,036	-0,185	0,149
40	3,782	-0,398	0,398	0,977	-0,977	0,466	-0,466	0,23	-0,115	-0,115	-1,782	0,385	1,396	0,898	-0,898	-0,104	-0,115	0,218
41	4,786	0,08	-0,08	0,08	-0,08	0,426	-0,426	-0,761	0,381	0,381	-0,786	0,214	0,572	0,295	-0,295	0,072	0,214	-0,286
42	4,036	0,125	-0,125	0,625	-0,625	0,676	-0,676	-0,261	0,297	-0,036	-1,369	-0,036	1,405	0,75	-0,75	-0,261	-0,036	0,297
43	4,214	-0,068	0,068	1,557	-1,557	0,074	-0,074	-0,405	0,119	0,286	0,119	-0,214	0,095	-0,057	0,057	-0,572	0,286	0,286
44	3,624	0,114	-0,114	0,364	-0,364	1,385	-1,385	-0,086	0,043	0,043	-0,457	0,209	0,248	0,386	-0,386	-0,252	0,043	0,209
45	3,261	0,114	-0,114	0,489	-0,489	0,649	-0,649	-0,311	0,572	-0,261	-0,761	0,739	0,023	0,511	-0,511	-0,811	-0,095	0,905
46	5,336	0,091	-0,091	-0,034	0,034	0,48	-0,48	-0,162	-0,002	0,164	-0,169	-0,002	0,171	0,284	-0,284	-0,162	0,164	-0,002
47	2,547	0,102	-0,102	0,477	-0,477	0,074	-0,074	-0,239	-0,047	0,286	-0,714	0,286	0,428	0,398	-0,398	-0,405	-0,214	0,619
48	4,32	0,182	-0,182	1,307	-1,307	0,122	-0,122	-0,027	0,18	-0,153	-0,153	0,347	-0,194	-0,057	0,057	-0,194	0,18	0,014
49	4,223	0,432	-0,432	0,557	-0,557	0,493	-0,493	0,113	-0,056	-0,056	-0,723	0,277	0,446	0,943	-0,943	-0,721	0,777	-0,056
50	3,493	-0,148	0,148	0,852	-0,852	0,561	-0,561	-0,18	-0,327	0,507	-0,827	0,507	0,32	1,523	-1,523	0,32	-0,327	0,007
51	3,791	0,114	-0,114	0,364	-0,364	-0,115	0,115	-0,252	0,376	-0,124	0,543	-0,957	0,414	1,386	-1,386	0,081	-0,291	0,209
52	4,926	-0,102	0,102	-0,227	0,227	-0,331	0,331	0,351	-0,259	-0,092	-0,259	-0,092	0,351	-0,148	0,148	0,351	0,241	-0,592
53	4,86	-0,409	0,409	0,591	-0,591	0,257	-0,257	-1,613	0,973	0,64	0,14	-0,36	0,221	-0,091	0,091	-0,779	0,473	0,306
54	4,106	0,432	-0,432	0,932	-0,932	0,547	-0,547	0,212	0,394	-0,606	-0,773	0,561	0,212	0,318	-0,318	0,045	0,894	-0,939
55	3,676	0,034	-0,034	0,284	-0,284	0,419	-0,419	-0,315	0,324	-0,009	-0,842	0,491	0,351	0,091	-0,091	0,018	-0,009	-0,009
56	5,142	-0,08	0,08	0,545	-0,545	0,223	-0,223	-0,55	0,191	0,358	-0,642	0,358	0,284	0,33	-0,33	0,617	0,358	-0,975
57	2,489	0,739	-0,739	0,239	-0,239	0,601	-0,601	0,311	0,178	-0,489	-0,989	0,511	0,477	0,886	-0,886	-0,689	-0,155	0,845
58	3,502	-0,25	0,25	0,125	-0,125	0,48	-0,48	-0,329	0,498	-0,169	-1,002	0,831	0,171	0,875	-0,875	0,338	-0,002	-0,336
59	3,101	-0,159	0,159	0,966	-0,966	0,088	-0,088	0,369	-0,268	-0,101	0,065	-0,101	0,036	0,534	-0,534	-0,297	0,232	0,065
60	4,196	-0,227	0,227	-0,102	0,102	0,236	-0,236	-0,275	0,137	0,137	-0,029	-0,196	0,225	-0,148	0,148	-0,275	0,304	-0,029

J. IMPORTANCE OF EACH FACTOR FOR EACH INDUSTRY RESPONDENT

	Technology	Scope	Geography	Total Dev. Cost	Additional Investment	Absorption Capaticiy	Price
1	0,0837	0,1586	0,2539	0,1617	0,1192	0,1807	0,0423
2	0,0695	0,2749	0,1635	0,1514	0,1038	0,1077	0,1293
3	0,1550	0,1946	0,2377	0,0263	0,1188	0,1619	0,1057
4	0,0419	0,3886	0,2872	0,0735	0,1062	0,0034	0,0992
5	0,1469	0,1164	0,0842	0,0877	0,2440	0,2191	0,1016
6	0,1728	0,1363	0,1205	0,0774	0,1949	0,2293	0,0689
7	0,1045	0,1826	0,0984	0,1749	0,1120	0,2002	0,1275
8	0,0373	0,1682	0,3463	0,0564	0,2284	0,1058	0,0577
9	0,0323	0,5954	0,0192	0,0625	0,0988	0,0567	0,1352
10	0,0808	0,1042	0,4640	0,1694	0,0740	0,0302	0,0774
11	0,1005	0,0714	0,0849	0,1216	0,1745	0,2776	0,1693
12	0,1001	0,4838	0,0207	0,0959	0,1312	0,0437	0,1245
13	0,0366	0,0366	0,0911	0,1616	0,2441	0,1464	0,2836
14	0,1197	0,1626	0,1475	0,0559	0,2196	0,1626	0,1323
15	0,1474	0,1226	0,0659	0,0111	0,0899	0,4174	0,1458
16	0,0264	0,1730	0,2891	0,1460	0,0985	0,1202	0,1466
17	0,0442	0,1417	0,3829	0,0867	0,1516	0,0208	0,1721
18	0,0241	0,0751	0,2322	0,1489	0,1816	0,2554	0,0828
19	0,1365	0,3138	0,1165	0,1473	0,0528	0,1137	0,1195
20	0,2181	0,0895	0,1067	0,0966	0,1607	0,1677	0,1607
21	0,0237	0,1840	0,0590	0,0692	0,2175	0,1795	0,2671
22	0,0372	0,1511	0,1137	0,1235	0,0646	0,3196	0,1902
23	0,0650	0,0650	0,2100	0,1138	0,0945	0,4221	0,0296
24	0,0069	0,1803	0,1881	0,1247	0,2246	0,1192	0,1562
25	0,0855	0,0333	0,0113	0,0713	0,3804	0,3835	0,0348
26	0,0190	0,1859	0,1602	0,2237	0,1948	0,0227	0,1936
27	0,0681	0,2725	0,0828	0,1135	0,1678	0,2044	0,0909
28	0,0493	0,0040	0,1520	0,1208	0,4281	0,0947	0,1511
29	0,0095	0,2170	0,2858	0,0477	0,0906	0,0942	0,2551
30	0,0899	0,2877	0,0320	0,0527	0,3376	0,1475	0,0527
31	0,0227	0,0580	0,2410	0,1416	0,1346	0,2605	0,1416
32	0,1372	0,1150	0,1090	0,1867	0,1867	0,1150	0,1504
33	0,0214	0,1883	0,2527	0,1137	0,1360	0,1122	0,1758
34	0,0844	0,1483	0,1002	0,0593	0,3407	0,1393	0,1278
35	0,0205	0,0205	0,1525	0,0755	0,4006	0,2051	0,1254
36	0,0163	0,5537	0,1238	0,0510	0,0510	0,0163	0,1878
37	0,0906	0,1359	0,0025	0,2416	0,0910	0,4078	0,0306
38	0,0442	0,2209	0,1743	0,2063	0,2950	0,0000	0,0594
39	0,0259	0,1360	0,1816	0,1316	0,2125	0,0664	0,2460
40	0,1529	0,1395	0,2430	0,0570	0,0326	0,0664	0,3085
41	0,0422	0,1567	0,1183	0,0663	0,3558	0,1747	0,0860
42	0,1251	0,0038	0,2344	0,1536	0,1823	0,2540	0,0467

K. IMPORTANCE OF EACH FACTOR FOR EACH UNIVERSITY RESPONDENT

	Technology	Scope	Geography	Total Dev. Cost	Additional Investment	Absorption Capacity	Price
1	0,0433	0,0964	0,0633	0,0813	0,4246	0,1495	0,1416
2	0,0091	0,3071	0,0107	0,2336	0,1986	0,0091	0,2318
3	0,0380	0,1078	0,0413	0,1466	0,2259	0,1078	0,3326
4	0,1124	0,3111	0,0438	0,0868	0,2514	0,1476	0,0470
5	0,0595	0,0048	0,2099	0,1109	0,1474	0,1045	0,3630
6	0,0616	0,1886	0,3843	0,0564	0,0564	0,1039	0,1488
7	0,0226	0,0226	0,1753	0,0813	0,1106	0,5584	0,0292
8	0,0537	0,3070	0,2989	0,1343	0,0562	0,1152	0,0346
9	0,0073	0,3641	0,0149	0,2114	0,0817	0,1116	0,2090
10	0,1098	0,1992	0,2199	0,0595	0,0824	0,1137	0,2154
11	0,0569	0,1859	0,1801	0,1319	0,1387	0,2303	0,0763
12	0,0103	0,0660	0,0451	0,1115	0,4537	0,1570	0,1564
13	0,0459	0,0459	0,0572	0,0576	0,2685	0,4577	0,0671
14	0,1593	0,2214	0,2717	0,1014	0,1069	0,0070	0,1323
15	0,0065	0,1470	0,1689	0,0703	0,0937	0,3449	0,1687
16	0,0237	0,1981	0,0753	0,1327	0,1454	0,2378	0,1869
17	0,0268	0,1495	0,2128	0,0747	0,1801	0,1444	0,2117
18	0,1183	0,0497	0,0931	0,2396	0,2955	0,1603	0,0435
19	0,0601	0,0601	0,0779	0,3337	0,2406	0,0000	0,2276
20	0,0107	0,0893	0,1019	0,0956	0,2715	0,3432	0,0878
21	0,0140	0,0140	0,0749	0,0559	0,1028	0,6824	0,0559
22	0,0092	0,0092	0,0080	0,0665	0,1345	0,7076	0,0651
23	0,1070	0,0889	0,0529	0,1632	0,3178	0,1070	0,1632
24	0,0269	0,0226	0,0990	0,1320	0,0495	0,5711	0,0990
25	0,0000	0,1016	0,1977	0,0903	0,4185	0,1016	0,0903
26	0,0000	0,1164	0,1257	0,0985	0,0985	0,5043	0,0566
27	0,0346	0,1039	0,0992	0,1452	0,1847	0,3464	0,0859
28	0,0840	0,0840	0,0174	0,0298	0,3458	0,3585	0,0805
29	0,1567	0,1567	0,1628	0,1301	0,1716	0,1264	0,0957
30	0,0255	0,3490	0,0835	0,1732	0,2357	0,1191	0,0140
31	0,0585	0,0092	0,1043	0,0625	0,3212	0,2463	0,1979
32	0,0323	0,2300	0,1262	0,1373	0,0054	0,2050	0,2637
33	0,0313	0,1173	0,0440	0,1146	0,3440	0,0547	0,2941
34	0,1998	0,0646	0,2484	0,2441	0,0712	0,1043	0,0676
35	0,0128	0,2221	0,2642	0,0626	0,0812	0,1067	0,2505
36	0,1290	0,1881	0,0832	0,1829	0,1969	0,1664	0,0534
37	0,0462	0,0887	0,0092	0,1148	0,1131	0,5132	0,1148
38	0,0160	0,1313	0,1195	0,1182	0,2943	0,1044	0,2163
39	0,1151	0,0117	0,1714	0,3941	0,2113	0,0117	0,0847
40	0,0853	0,2093	0,0999	0,0370	0,3405	0,1924	0,0357
41	0,0336	0,0336	0,1789	0,2398	0,2852	0,1239	0,1050
42	0,0303	0,1517	0,1640	0,0677	0,3366	0,1820	0,0677
43	0,0252	0,5773	0,0274	0,1281	0,0617	0,0211	0,1591
44	0,0394	0,1257	0,4782	0,0223	0,1217	0,1333	0,0796
45	0,0299	0,1283	0,1702	0,1158	0,1967	0,1340	0,2250
46	0,0657	0,0245	0,3466	0,1177	0,1227	0,2051	0,1177
47	0,0426	0,1990	0,0309	0,1095	0,2383	0,1661	0,2136
48	0,0794	0,5702	0,0532	0,0726	0,1180	0,0249	0,0816
49	0,1124	0,1449	0,1283	0,0220	0,1521	0,2454	0,1949
50	0,0330	0,1897	0,1249	0,0928	0,1485	0,3391	0,0720
51	0,0346	0,1105	0,0349	0,0954	0,2278	0,4209	0,0759
52	0,0540	0,1201	0,1752	0,1614	0,1614	0,0783	0,2495
53	0,1150	0,1661	0,0722	0,3635	0,0817	0,0256	0,1760
54	0,1002	0,2161	0,1268	0,1159	0,1547	0,0737	0,2125
55	0,0186	0,1554	0,2293	0,1748	0,3647	0,0498	0,0074
56	0,0273	0,1861	0,0762	0,1551	0,1708	0,1127	0,2719
57	0,1686	0,0545	0,1372	0,0913	0,1712	0,2022	0,1750
58	0,0736	0,0368	0,1413	0,1217	0,2698	0,2576	0,0992
59	0,0659	0,4003	0,0365	0,1320	0,0344	0,2213	0,1096
60	0,1600	0,0719	0,1663	0,1452	0,1483	0,1043	0,2040

L. HUMAN SUBJECT ETHICS COMMITTEE PERMISSION

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12 Haziran 2019

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Doç.Dr. İ.Semih AKÇOMAK

Danışmanlığını yaptığınız **Hamit TAŞ'ın "Üniversite Patentlerinin Üniversite (satıcı) ve Sanayi (Alıcı) tarafından değerlenmesi"** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **290-ODTÜ-2019** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

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Başkan

Prof. Dr. Tolga CAN
Üye

Doç.Dr. Pınar KAYGAN
Üye

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Dr. Öğr. Üyesi Şerife SEVİNÇ
Üye

M. TURKISH SUMMARY/TÜRKÇE ÖZET

2012 yılından itibaren Türkiye'de bilim ve teknoloji politikalarında gözle görülür bir değişim yaşanmaktadır. Bu değişiklikler sadece bir politika değişimi değil aynı zamanda Türkiye'de bilim ve teknoloji ekosisteminin de değişimini kapsamaktadır. Bu değişiklikler sonucunda üniversitenin sanayi ile daha etkin işbirlikleri yaparak sağladığı ekonomik katkıyı artırmak ve nihayetinde ise Türkiye'nin kalkınmışlık seviyesini artırması beklenilmektedir. Bu politika değişikliklerinin birkaç farklı boyutu bulunmaktadır. İlk boyutu üniversitelerde üretilen bilginin ticarileşmesi için üniversite bünyesinde kurulacak olan teknoloji transfer ofislerine TÜBİTAK tarafından destek olunmasıdır. Temel misyonu üniversite ve sanayi arasında köprü görevi görmek olan teknoloji transfer ofisleri faaliyetlerinin 3 ana faaliyet alanında görev yapmaktadır:

1) Sanayinin Ar-Ge ihtiyacına yönelik olarak ortak proje geliştirmek
2) Üniversitede yürütülen araştırma sonucunda oluşan fikri mülkiyet hakların yönetimi ve lisanslanmasını sağlamak
3) Üniversite tabanlı girişimcilik faaliyetlerine destek olmak.

Politika değişiminin diğer bir ayağı ise üniversite patentleriyle ilgilidir. 2016 yılının sonunda değişen patent kanunuyla patentlere yönelik hak sahipliği yapısı değiştirildi. Daha önce serbest buluş niteliğinde olan akademik patentlerin hak sahipliği akademisyenlerde iken yeni yasa ile üniversite patentlerinin hak sahipliği üniversitelere ait olmaya başladı. Amerika Birleşik Devletleri'nde (ABD) 1980'lerden beri yürürlükte olan Bayh-Dole yasası benzeri bu yeni yasa ile fazla patentin ticarileşmesi ve üniversitenin ekonomik katkısının artırılması hedeflenmektedir. Bayh-Dole yasasının ABD'de etkisi benzeri yasaların birçok ülkede kopyalanmasını sağlanmıştır. Türkiye ise bu yasayı geç kopyalayan ülkelerden biridir. Fakat üniversitelerde henüz patent lisanslama alanında henüz yeteri kadar başarı hikâyesi yoktur. Patentlerin ticarileşmesinin önemli bir boyutu da bu patentlerinin değerinin belirlenmesidir. Bu tez çalışmasında üniversite patentlerinin üniversite (satıcı) ve sanayi (alıcı) bakış açısıyla değerlenmesine yönelik bir çerçeve çizilmektedir. Bu kapsamsa ilk olarak: "Üniversite patentleri üniversite ve sanayi bakış açılarıyla nasıl değerlenmektedir?" sorusunun cevabı aranmaktadır. İkinci olarak da "Üniversite ve sanayinin üniversite patentlerine bakış açılarında farklılıklar ve benzerlikler nelerdir?" sorusuna cevap aranmaktadır.

Gambardella, Giuri ve Luzzi (2007) patent değerlemenin literatürde önemli bir yere sahip olduğunu ve ekonomi, teknoloji yönetimi gibi farklı disiplinler tarafından ele alındığını belirtmektedir. Fakat patent değerleme özellikle üniversite patentlerine yönelik değerleme çalışmaları konusunda Türkiye'de fazla çalışma bulunmamaktadır.

Türkiye'de yeteri kadar lisanslanan veya satılan üniversite patenti olmaması nedeniyle bu çalışmada deneysel tasarıma imkân veren conjoint analiz metodu kullanılmıştır. Literatür taraması sonucunda patent değer ölçütleri belirlenerek, bu patent değer ölçütlerinin özellikleri belirlenmiştir. Bu özellikler ile 18 farklı farazi patent oluşturularak bir anket vasıtasıyla üniversite ve sanayinin 18 patenti değerlemesi istenilmiştir. Conjoint analiz yöntemi, her bir değer ölçütünün ve ölçüt özelliklerinin patent değerine katkısını hesaplamasına ve değer ölçütlerinin birbiri arasında önemlerinin belirlenmesine imkân vermektedir. Bu nedenle bu çalışmada conjoint analiz metodu kullanılmıştır. Conjoint analiz yöntemi literatürde her ne kadar pazarlama, reklamcılık gibi alanlarda kullanılsa da, bu yöntemi ABD'de fikri haklar mahkemeleri patent ihlal davalarında kullanmaktadır.

Bu çalışma Türkiye'de üniversite patentlerinin değerlemesi hakkında yapılan ilk çalışmadır. Ayrıca literatürdeki çalışmaların çoğu ya alıcı veyahut da satıcı bakış açısıyla yapılmıştır. Bu tezde ise her iki tarafın bakış açıları göz önüne alınmış patent değerine etki eden faktör çift taraflı bakış açısıyla yorumlanmıştır.

Patent değerleme gayet karmaşık bir konu olup bu konuda literatürdeki çalışmalar daha çok patent değerine etki eden faktörlerin belirlenmesine yöneliktir. Literatürde fazlaca patent değer ölçüsü bulunmaktadır. Patent değerleme ile ilgili ilk çalışmalarda patentin koruma süresi ve yaşının patent değerine etkisi araştırılmıştır.

Fakat sonrası çalışmalarda patentin aldığı ve yaptığı atıfların değere etkisi, koruma kapsamı, patentin coğrafi kapsamı gibi başka değer ölçütleri araştırılmıştır. Literatür taraması sonucu ortaya çıkan değer ölçütleri hipotezlerin oluşturulmasında kullanılmıştır.

Literatürdeki çalışmalar genellikle tek taraflı bir bakış açısıyla yürütülmüştür. Bu çalışmada literatürdeki diğer çalışmaların aksine gerek üniversite gerek sanayi bakış açısı göz önünde bulundurulmuştur.

Literatürde bulunan patent değer ölçütleri aşağıda belirtildiği şekilde gruplandırılmıştır:

1) Teknolojinin yaygınlığı
2) Patent koruma kapsamı
3) Patentin coğrafi koruma kapsamı
4) Patentin toplam geliştirme maliyeti
5) Patentin firma tarafından kullanılması için gerekli ilave yatırım miktarı
6) Patenti kullanacak firmanın teknoloji özümseme kapasitesi,

Bu çalışmada 7 hipotez test edilmiştir. İlk hipotez üniversite ve sanayinin değerlemeye bakış açılarıyla ilgilidir. Diğer 6 hipotez ise yukarıda belirtilen değer ölçütleri doğrultusunda oluşturulmuştur.

Hipotez 1: hipotez üniversite ve sanayi üniversite patentlerinin değerlemesinde farklı bakış açılarına sahiptir.

Diğer altı hipotez ve ilişki değer ölçütü aşağıdaki tabloda verilmiştir.

Tablo-1 Hipotezler

Değer Ölçütü	Hipotez
Teknolojinin Yaygınlığı	Hipotez 2a: Üniversite bakış açısı ile teknolojinin yaygınlığı, üniversite patentlerinin değerlenmesinde önemli bir değer ölçütüdür.
	Hipotez 2b: Sanayi bakış açısı ile teknolojinin yaygınlığı üniversite patentlerinin değerlenmesinde

	önemli bir değer ölçütüdür.
Patentin koruma kapsamı	Hipotez 3a: Üniversite bakış açısı ile patentin koruma kapsamı, üniversite patentlerinin değerlenmesinde önemli bir değer ölçütüdür.
	Hipotez 3b: Sanayi bakış açısı ile patentin koruma kapsamı, üniversite patentlerinin değerlenmesinde önemli bir değer ölçütüdür.
Coğrafi koruma	Hipotez 4a: Üniversite bakış açısı ile patentin coğrafi kapsamı, üniversite patentlerinin değerlenmesinde önemli bir değer ölçütüdür.
	Hipotez 4b: Üniversite bakış açısı ile patentin coğrafi kapsamı, üniversite patentlerinin değerlenmesinde önemli bir değer ölçütüdür.
Patentin toplam geliştirme maliyeti	Hipotez 5a: Üniversite bakış açısı ile patentin toplam geliştirme maliyeti, üniversite patentlerinin değerlenmesinde önemli bir değer ölçütüdür.
	Hipotez 5b: Sanayi bakış açısı ile patentin toplam geliştirme maliyeti, üniversite patentlerinin değerlenmesinde önemli bir değer ölçütü değildir.
Patentin firma tarafından kullanılması için gerekli ilave yatırım miktar	Hipotez 6a: Üniversite bakış açısı ile patentin firma tarafından kullanılması için gerekli ilave yatırım miktarı, üniversite patentlerinin değerlenmesinde önemli bir değer ölçüt değildir.
	Hipotez 6b: Sanayi bakış açısı ile patentin firma tarafından kullanılması için gerekli ilave yatırım miktarı, üniversite patentlerinin değerlenmesinde önemli bir değer ölçüdür.
Firmanın teknoloji özümseme kapasitesi	Hipotez 7a: Üniversite bakış açısı ile firmanın özümseme kapasitesi, üniversite patentlerinin değerlenmesinde önemli bir değer ölçüt değildir.

	Hipotez 7b: Sanayi bakış açısı ile firmanın özümseme kapasitesi, üniversite patentlerinin değerlenmesinde önemli bir değer ölçütüdür.

Bu hipotezlerin test edilmesi için yukarıda da belirtildiği gibi conjoint analiz yöntemi kullanılmıştır. Conjoint analiz yönetimi kapsamında ilk olarak her bir değer ölçütü bir faktör olarak tanımlanmıştır. Bu çerçevede her faktöre yönelik olası aşamalar belirlenmiş ve her bir patente bir fiyat aralığı atanmıştır.

Faktör 1- Teknolojinin yaygınlığı

Aşama 1- Patent gelişmekte olan bir teknoloji alanında yapılan bir buluştur.

Aşama 2- Patent yaygın bir teknoloji alanında yapılan bir buluştur.

Faktör 2- Patentin koruma kapsamı

Aşama 1- Patentin koruma kapsamı geniştir.

Aşama 2- Patentin koruma kapsamı dardır.

Faktör 3- Patentin coğrafi koruması

Aşama 1- Patentin coğrafi koruma kapsamında Türkiye'nin yanı sıra başka ülkelerde vardır.

Aşama 2- Patentin coğrafi koruma kapsamında sadece Türkiye vardır.

Faktör 4- Patentin toplam geliştirme maliyeti

Aşama 1- Patentin toplam geliştirme maliyeti düşüktür. Sadece üniversite araştırma fonu kullanılmıştır.

Aşama 2- Patentin toplam geliştirme maliyeti orta seviyedir. Sadece bir adet ulusal veya uluslararası fon sağlayıcı tarafından desteklenen bir araştırma sonucunda patent ortaya çıkmıştır.

Aşama 3- Patentin toplam geliştirme maliyeti yüksektir. Birden fazla ulusal veya uluslararası fon kullanılarak geliştirilmiştir.

Faktör 5- Firma tarafında yapılması gereken ilave yatırım miktarı

Aşama 1- İlave yatırıma ihtiyaç yoktur.

Aşama 2- İlave yatırım miktarı düşüktür.

Aşama 3- İlave yatırım miktarı yüksektir.

Faktör 6- Firmanın teknoloji özümseme kapasitesi

Aşama 1- Yeterlidir

Aşama 2- Yetersizdir.

Faktör 7- Fiyat

Aşama 1- 500.000 TL

Aşama 2- 850.000 TL

Aşama 3- 1.200.000 TL

Yukarıda bahsedilen her bir faktörden bir aşama özelliğe sahip toplam 432 (2x2x2x3x3x2x3) patent bulunmaktadır. Anketi cevaplayacak kişilerin 432 patenti sağlıklı değerlemesi mümkün görünmemektedir. Bu nedenle 432 patentin bir ortogonal alt kümesi seçilmiştir. Alt küme seçiminde R yazılımı kullanılmış olup 432 patentten oluşan tüm patentlerin özelliklerini en iyi yansıtan ortogonal bir alt küme seçilmiştir. Bu alt küme oluşturulurken yine R yazılımı kullanılmıştır. Yazılım sonuçlarına göre 18 patent hipotezlerin test edilmesi için seçilmiştir. Bu 18 patentin özellikleri yukarıda belirtilen 7 faktörün her birisinden bir aşamadan oluşmaktadır. Bu patentler satıcı taraf olan üniversite ve alıcı taraf olan sanayi tarafından değerlendirilmesi istenilmiştir. Üniversite tarafına patentin satma kolaylığını değerlendirmesi sanayi tarafına ise patenti alma isteğini 1-7 arasında değerlendirmesi talep edilmiştir. Üniversite adına patentleri TTO yöneticileri ve TTO'ların fikri haklar birimi yöneticilerinin değerlemesi talep edilmiştir. Değerlendirme sırasında cevaplayıcıları aşağıdaki ölçütlere göre değerlemeleri istenilmiştir.

1 Puan: Kesinlikle kolay satamam

2 Puan: Kolay satamam

3 Puan Nispeten kolay satamam

4 Puan: Kararsızım

5 Puan: Nispeten kolay satarım

6 Puan: Kolay satarım

7 Puan: Kesinlikle kolay satarım

Sanayi tarafında ise TTO'ların ilişkili oldukları firmalardan ve TÜBİTAK'a patent destek başvurusu yapmış firmalardan değerlemesi talep edilmiştir. Sanayi tarafında ise kullanıcılara satın alma isteği sorulmuş olup yine patentleri 1-7 arasında değerlemeleri istenilmiştir.

1 Puan: Kesinlikle satın almak istemem

2 Puan: Satın almak istemem

3 Puan Nispeten satın almak istemem

4 Puan: Kararsızım

5 Puan: Nispeten satın almak isterim

6 Puan: Satın almak isterim

7 Puan: Kesinlikle satın almak isterim

60 TTO kullanıcısı ve 42 sanayi kullanıcısı patentlere yönelik değerlendirme yapmıştır. Anketi cevaplayanlarının yaş, eğitim bilgileri, cinsiyet, iş tecrübeleri hakkında bilgileri de toplanılmıştır.

Değerlendirmeler sonucunda üniversite tarafı için faktörlerin önem sırası ve önem değeri aşağıdadır.

1) Firmanın teknoloji özümseme kapasitesi - 20,09
2) Firma tarafından yapılması gereken ilave yatırım - 19,06
3) Patent koruma kapsamı - 15,17
4) Patentin coğrafi koruması - 13,06
5) Fiyat – 13,19
6) Patentin toplam geliştirme maliyeti - 12,75
7) Teknoloji yaygınlığı – 5,88

Firma özümseme kapasitesi, firma tarafından yapılması gereken yatırımlar, patentin özümseme kapasitesi ve patentin coğrafi koruma kapsamı üniversite bakış açısıyla istatistiksel olarak patent değerleme önemli görünmektedir.

Sanayi tarafı için faktörlerin önem sırası ve önem değerleri ise:

1) Patent koruma kapsamı – 18,65
2) Firmanın yapması gereken ilave yatırım miktarı – 17,77
3) Coğrafi koruma – 16,03
4) Firma özümseme kapasitesi – 15,93
5) Toplam geliştirme maliyeti - 11
6) Teknolojinin yaygınlığı – 7,43

Firma özümseme kapasitesi, firma tarafından yapılması gereken yatırımlar, patentin özümseme kapasitesi ve patentin coğrafi koruma kapsamı sanayi bakış açısıyla istatistiksel olarak patent değerleme önemli görünmektedir.

Her iki grup için de patent koruma kapsamı ve teknolojinin yaygınlığı değere olan etkisi istatistiksel olarak önemli görünmemektedir. Teknoloji yaygınlığını belirten ileri atıf ve geri atıf sayıları literatürde en sık rastlanan patent değerleme kriterlerinden biri olmasına bu çalışmada teknoloji yaygınlığı patent değerine istatistiksel olarak önemli bir etkiye sahip değil görünmektedir. Bunun nedeni özellikle ülkemizde atıf sayıları ile ilgili verinin olmaması ve patentle korunan teknolojinin durumundan ziyade hem üniversite hem de sanayi tarafının patentli teknolojinin uzun vade de getireceği faydaları göz ardı etmeleri olabilir.

Değerlendirilen 18 patent için üniversite ve sanayi değerlemelerine yönelik %90 güven aralığında t-Testi yapılmıştır. t-Testi sonuçlarına göre üniversite ve sanayi 4 patent için istatistiksel olarak anlamlı olacak şekilde farklı değerlendirme yapmıştır. Diğer 14 patent için ise her iki grubun yaptığı değerlemenin %90 güven aralığında farklı değerlendirme yaptığına dair yeterli delil bulunmamaktadır. Bu kapsamda tezde savunulan ilk hipotez olan üniversite ve sanayinin üniversite patentlerinin değerlenmesine farklı bakışa sahip olduğunu sadece 4 patentin değerlemesi için geçerli olduğu belirtilebilir. Diğer 14 patent için hipotezin doğruluğu söz konusu değildir.

Anket sonuçlarına göre üniversite bakış açısıyla:

1) Hipotez 2a: (Üniversite patentlerinin değerlemesinde teknolojinin yaygınlığı üniversite için önemli etkiye sahiptir.) ret edilmiştir.
2) Hipotez 3a: (Üniversite patentlerinin değerlemesinde patentin koruma kapsamı üniversite için önemli etkiye sahiptir.) ret edilmemiştir.
3) Hipotez 4a: (Üniversite patentlerinin değerlemesinde patentin coğrafi koruma kapsamı üniversite için önemli etkiye sahiptir.) ret edilmemiştir.
4) Hipotez 5a: (Üniversite patentlerinin değerlemesinde patentin toplam geliştirme maliyeti üniversite için önemli etkiye sahiptir.) ret edilmiştir.
5) Hipotez 6a: (Üniversite patentlerinin değerlemesinde firmanın yapması gereken ilave yatırım üniversite için önemli etkiye sahip değildir.) ret edilmiştir.
6) Hipotez 7a: (Üniversite patentlerinin değerlemesinde firmanın özümseme kapasitesi üniversite için önemli etkiye sahip değildir.) ret edilmiştir.

Üniversite bakış açısına göre patentin niteliğinden ziyade patentin lisanslanacağı veya satılacağı firmanın özelliklerine patentin özelliklerinden daha fazla önem verildiği görülmektedir. Literatürde sıklıkla rastlanan patentin teknoloji yaygınlığı ise üniversite bakış açısıyla önem arz etmemektedir. Toplam geliştirme maliyeti yüksek ve kuvvetli bir araştırma sonucu ortaya çıkabilecek gelişmekte olan bir teknolojik alanda yapılacak buluşlar üniversite tarafından önemli görülmemektedir. Bu durumda yeni üniversite yeni pazarlar oluşturmak ve yüksek gelir elde edebilecekleri patentlere odaklanmamaktadır. Üniversite bakış açısıyla patentin hızlı bir şekilde ticarileşmesi patentin özelliklerinden daha önemli görünmektedir. Bu çerçevede gelişmekte olan bir teknoloji alanında yapılan buluş için yurt dışına yapılacak lisanslama fırsatı göz ardı edilmektedir.

Hipotezlerin kabul veya ret durumu sanayi bakış açısıyla değerlendirilecek olursa

1) Hipotez 2a: (Üniversite patentlerinin değerlemesinde teknolojinin yaygınlğı sanayi için önemli etkiye sahiptir.) ret edilmiştir.
2) Hipotez 3a: (Üniversite patentlerinin değerlemesinde patentin koruma kapsamı sanayi için önemli etkiye sahiptir.) ret edilmemiştir.

3) Hipotez 4a: (Üniversite patentlerinin değerlemesinde patentin coğrafi koruma kapsamı sanayi için önemli etkiye sahiptir.) ret edilmemiştir.
4) Hipotez 5a: (Üniversite patentlerinin değerlemesinde patentin toplam geliştirme maliyeti üniversite için önemli etkiye sahip değildir.) ret edilmemiştir.
5) Hipotez 6a: (Üniversite patentlerinin değerlemesinde firmanın yapması gereken ilave yatırım firma için önemli etkiye sahiptir.) ret edilmemiştir.
6) Hipotez 7a: (Üniversite patentlerinin değerlemesinde firmanın özümseme kapasitesi üniversite için önemli etkiye sahiptir) ret edilmemiştir.

Sanayi bakış açısıyla değerlendirme yapıldığında koruma kapsamının geniş olması, ilave yatırımın az olması ve özümseme kapasitesinin yeterli olması tercih edildiği görülmektedir. Bu durumda sanayinin patentin getirdiği risk ve belirsizliklerden kaçındığını göstermektedir. Sanayi üniversite patentlerinin en önemli beklentisi riski asgari düzeyde tutarak patente sahip olmak istemektedir.

Araştırma sonuçları gerek üniversitenin gerekse sanayinin sağlam bilimsel temellere sahip olan ve gelişmekte olan bir teknoloji alanında yapılan buluşların getireceği fırsatların göz ardı edildiğin göstermektedir. Bu durumda ise artımsal yeniliklerin radikal yeniliklerden daha fazla önemsendiğini göstermektedir. Bu da radikal inovasyonların gelişmesine ve getireceği finansal ve sosyal fırsatların kaçırılmasına neden olabilir. Bu kapsamda radikal inovasyonların gelişmesi amacıyla kamunun yeni politikalar geliştirmesi gerekli olabilir. Bu politika amacını gerçekleştirmek için üniversiteye yönelik TÜBİTAK tarafından sadece gelişmekte olan teknolojilerin yurtdışına lisanslanmasına yönelik bir destek programı araç olabilir. Program kapsamında destek süresi toplamda 3 yıldan uzun ve toplam geliştirme maliyetini aşmayacak şekilde üniversitelere lisanslanan patentin değerinin belirli bir oranı kadar yine o teknoloji alanında yapılacak çalışmalar için üniversite araştırma bütçesine destek olunabilir. Bu durumda gerek üniversitenin yurt dışına teknoloji lisanslama gerekse geliştirilen patentle ilişkili başka buluşlarının yapılmasına yardımcı olunacaktır.

Tezin bulgularına göre sanayinin riskini azaltmak amacıyla yine TÜBİTAK tarafından bir program tasarlanabilir. Bu kapsamda sanayinin gelişmekte olan bir teknoloji alanında olan bir patente yapacağı lisanslama veya satış işlemi sonrası oluşabilecek maliyetlerin belirli bir kısmı TÜBİTAK tarafından desteklenebilir. Program çerçevesinde bir patent için verilecek destek süresi 3 yılı aşmamalıdır. Programın toplam süresi ise 10 yılı geçmelidir.

Her iki program ile uzun vade Türkiye'de üniversite gelişmekte olan teknolojilere yapılan yatırımları artırarak radikal inovasyonları destekleyen bir ekosistem oluşturulacaktır.

Son olarak bu tez kapsamında ortaya çıkan sonuçların Türkiye'de lisanslanan patent sayısının artmasıyla gerçek patentler ile tekrar gözden geçirilmedir.

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