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# ***IP5 Summary Report on Studies on IP's Impact on Economy***



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European Patent Office,

Japan Patent Office,

Korean Intellectual Property Office,

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## Preface

The IP5 Summary Report on Studies on IP's Impact on Economy is jointly produced by the "IP5 Offices," namely the China National Intellectual Property Administration (CNIPA), the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), and the United States Patent and Trademark Office (USPTO).

This report consists of five main parts:

- A brief introduction to China's patent activity, and the links between patent activities and economic performance of enterprises in China.
- The importance of intellectual property rights (IPRs) activities for the EU economy and high-growth firms, and patent commercialization of European SMEs.
- The effect that IPRs have on consumers' "willingness to pay" in Japan.
- The economic contribution of IP-intensive industries in Korea.
- Information on women's participation in the U.S. patent system and the use of examiner's amendments at the USPTO.

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It is the first time that the IP5 Offices have collaborated to publish a research report on the impact of intellectual property on the economy, depicting the outcome of the latest economic studies from the five largest intellectual property offices in the world. The IP5 Offices hope that this report could help the readers to outline the latest researches conducted by five offices and contribute to providing useful information and deepening the understanding of the public and the researchers on the relationship between intellectual property and economy.

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## **Chapter 1**

# **CHINA NATIONAL INTELLECTUAL PROPERTY ADMINISTRATION**

### **Report on the China's Patent Survey in 2020**

The CNIPA had consecutively conducted sampling surveys on Chinese patents ever since 2008. The patent survey in 2020 focused on the valid patents and their patentees by the end of 2019 in China. A total of 15,005 patentee questionnaires and 41,905 patent information questionnaires were distributed. The survey questionnaires covered the whole process of patents including their creation, protection, management and service. The questionnaire recovery rate exceeded 80%. The main findings of the survey were as follows:

- The industrialization rate of Chinese valid patents reached 34.7% in 2020, wherein the rates relating to the patentees of enterprises, scientific research institutes and universities were 44.9%, 11.3% and 3.8% respectively. The industrialization rate of Chinese valid patents remained stably above 30% during 2016-2020, with the rate relating to the enterprise patentees exceeded 40%.

- The percentage of the patentees who had experienced patent infringement was 10.8% in 2020, while the percentage was 14.5% in 2015, which reflected the improvement on the environment of intellectual property protection and the effective curbing of patent infringement activities in China.

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- 73.9% of Chinese enterprise patentees adopted measures to protect their intellectual property rights when encountered with patent infringement in 2020, while the ratio was 61.8% in 2015. The ratio arose gradually in recent years, demonstrating that the Chinese patentees, with the increased awareness of protecting IPs, could proactively take actions to protect their legitimate rights.

- The amount of adjudicated damages in patent infringement litigation increased step by step. In 2020, 7.3% of the amount of damages in judicial decision, reconciliation on trial or mediation of the patent infringement cases in China exceeded 1 million yuan (RMB), whereas the ratio was 2.9% in 2015. The gradual increase of such percentage showed the constantly uplifted cost of patent infringement due to establishment and amelioration of the intellectual property punitive damages system in China.

- 78.3% of enterprise patentees had conducted cooperative innovation, wherein 52.1% of enterprise patentees cooperated with upstream and downstream enterprises and customers, 34.9% had cooperation with peer enterprises, and 27.5% had collaboration with universities or scientific research institutes.

- There were 38.2% of enterprise patentees expecting the increase of income through patent utilization in the next year, 35.1% anticipating similar income as before, 3.8% forecasting the decrease in their income, and 22.9% choosing the option of 'unclear'. The Chinese enterprise patentees generally held a positive attitude to the income increase through patent utilization in the future.

- The patent transfer and transformation index was 54.7 in 2020, with an increase of 3.6 compared to the previous year, which indicated continuous ascension of the liveness of valid patent transfer and transformation in China

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Resource:

The full study report (available only in Chinese) can be found at:

[http://www.cnipa.gov.cn/module/download/down.jsp?i\\_ID=158969&collID=88](http://www.cnipa.gov.cn/module/download/down.jsp?i_ID=158969&collID=88)

## **Report on the Patent Activities and Economic Performance of Industrial Enterprises above Designated Size in 2017**

The CNIPA and the Renmin University of China carried out jointly a report on the relationship between patent activities and economic performance of industrial enterprises above designated size (hereinafter referred to as "enterprises") in China. Statistics showed that in 2017 the enterprise's patent activity was more active, and the economic benefit for the enterprises was, in accordance, effectively uplifted.

### **1) The patent activities of industrial enterprises above designated size continued to be improved**

In 2017, the number of Chinese enterprises with patent applications, patent grants, patents in force or PCT applications reached 114,000, accounting for 30.6% of the total number of enterprises. In terms of different patent activities, the number of patents in force increased by 23.4%, significantly higher than the growth rates of patents applications and patents granted in 2017.

### **2) Patents activities had significant synergistic effect with R&D in promoting economic income for the enterprises**



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In 2017, the new products sales rate was 27.7% in the enterprises with patent activities, which was 5.3% higher than that of those without patent activities. Patent activities effectively supported the innovation development of enterprises. In terms of the relationship between patents and R&D activities, among the enterprises with patent activities in 2017, 70,000 enterprises also had R&D activities, accounting for 61.4%, which increased by 4.6% than the previous year. The patent activities and R&D activities showed more and more interaction with each other. In 2017, the new products sales rate of enterprises with patent activities was 32.6 percent, significantly exceeding those rates of other types of enterprises. Patents activities proved to have significant synergistic effect with R&D in promoting economic income for the enterprises.

### **3) The degree of patent activities varied in accordance with the industry, the size and the ownership structure**

First of all, from the aspect of industries to which the enterprises belonged, high-tech manufacturing enterprises accounted for merely 8.6 percent of all enterprises in 2017, but their contribution to patent applications, grants and patents in force all transcended 20 percent of total, among which the numbers of invention patent applications, grants and patents-in-force of the high-tech manufacturing enterprises accounted for over 30 percent respectively, while the percentage of the PCT patent applications from the high-tech manufacturing enterprises out of all the enterprises reached 70.5%. High-tech manufacturing enterprises stood out in all enterprises with regard to all kinds of patent activities. Secondly, from the aspect of the enterprises' sizes, 64.3 percent of large enterprises had patent activities in 2017, but as for medium, small and micro enterprises, the percentages shrank to only 44.8 %, 28.4 % and 10.8 %.

Lastly, from the aspect of ownership structure, taking the granted invention patents as an example, the state-owned enterprises, though only accounting for 0.5% of the total number of enterprises, contributed 4.8% of the invention

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patents granted to all the enterprises. Meanwhile, the private enterprises, representing 57.7% of the total number of enterprises, only accounted for 25.4% of total invention patents granted to all the enterprises, while the foreign-funded enterprises, and Hong Kong, Macao and Taiwan-funded enterprises, accounting respectively for 6.1% and 6.6% of total enterprises number, both enjoyed 1.0 to 8.1 percent more than those of other types of enterprises with regard to the percentage of patent activities conducted by different enterprises.

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## Chapter 2

# EUROPEAN PATENT OFFICE

The European Patent Office published three economic studies in 2019.

### **Study on intellectual property rights intensive industries and economic performance in the European Union**

The third edition of this joint study by the EPO and the European Union Intellectual Property Office (EUIPO) analyses the contribution of IPR-intensive sectors to the EU economy. Instead of making policy recommendations, the study provides facts and figures that can be used by policymakers to raise awareness of intellectual property as an economic driver.

The study covers all major IP rights (patents, trade marks, designs, copyright, geographical indications and plant varieties). The methodology is designed to identify which industries make above-average use of them. The study quantifies the contribution of these IPR-intensive industries to major macro-economic variables (employment, wages, GDP, and trade) from across the EU.

As compared with the previous editions, a number of improvements have been made as regards the underlying data and the methodology. The matching exercise used to identify IPR-intensive industries has been updated to ensure that the selection reflects recent developments. In addition, to complement the data for the EU member states, Iceland, Norway and Switzerland have been included in this study. Specific chapters are dedicated to climate change mitigation technologies (CCMTs) and the Fourth Industrial Revolution (4IR) in IPR-intensive industries.

The main findings of the study are the following:

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- There are now 353 IPR-intensive industries in the EU economy, compared with the 342 identified in the previous (2016) study. Approximately two thirds of these industries are intensive in respect of more than one IP right.
  - IPR-intensive industries generated 29.2% of all jobs in the EU during the period 2014-2016. On average over this period, they employed almost 63 million people in the EU. In addition, another 21 million jobs were generated in industries that supply goods and services to IPR-intensive industries. Taking indirect jobs into account, the total number of IPR-dependent jobs rises to 83.8 million (38.9%).
  - Over the same period, IPR-intensive industries generated almost 45% of total economic activity (GDP) in the EU, worth €6.6 trillion. They also accounted for most of the EU's trade with the rest of the world and generated a trade surplus, thus helping to keep the EU's external trade broadly balanced.
  - IPR-intensive industries pay significantly higher wages than other industries, with a wage premium of 47% over other industries. This is consistent with the fact that the value added per worker is higher in IPR-intensive industries than elsewhere in the economy.
  - A comparison of the results of this study with those of the 2016 edition reveals that the relative contribution of IPR-intensive industries to the EU economy has increased between the two periods 2011-2013 (2016 study) and 2014-2016 (the present study), even after taking into account the change in the number of IPR-intensive industries.
  - Among IPR-intensive industries, the economic weight of industries engaged in the development of climate change mitigation technologies (CCMTs) and those related to the Fourth Industrial Revolution (4IR) has

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increased in recent years. CCMT industries accounted for 2.5% of employment and 4.7% of GDP in the EU in 2014-2016, while the 4IR sectors made up 1.9% of employment and 3.9% of GDP during the same period.

## **Study on high-growth firms and intellectual property rights**

Produced jointly by the EPO and the European Union Intellectual Property Office (EUIPO), this study aims to determine the importance of IPR activities for high-growth firms (HGFs) – i.e. companies that experience a growth rate in turnover of 20% or more for a three-year period – in Europe. To this end, the study assesses the correlation between the use of IPRs by SMEs and their likelihood of becoming HGFs in the subsequent years. It also examines the particular ways in which HGFs shape their IPR strategies prior to experiencing high growth.

This study draws on a rich dataset linking demographic information on European SMEs in manufacturing industries from 2005 to 2010 with data stored in the national and European registers for patents, trade marks and industrial design rights. HGFs represent only 6% of the sample of European SMEs analysed in the study, but contribute 28% of net job creation. Investigation into the links between IPR activity and high turnover growth is pursued by means of descriptive statistics and econometric analysis of data.

The main findings that emerge from the analysis are as follows:

- SMEs with prior IPR activities are more likely to grow than other SMEs. SMEs that have filed at least one IPR are 21% more likely to experience a subsequent growth period, and 10% more likely to become an HGF. The likelihood of experiencing a high growth period is 9% higher for

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SMEs that have filed at least one patent, and 13% higher for those that have filed at least one trade mark.

- The likelihood of becoming an HGF is even higher for SMEs that have filed a European IPR. The likelihood of experiencing a high growth period is 17% higher for SMEs that have filed at least one European IPR. Filing a European IPR therefore provides a positive indicator of an SME's readiness to scale up business to European level.
- Prior patent filings perform best as HGF predictors in high-tech and low-tech industries. In high-tech industries, the likelihood of high growth is 110% higher for SMEs that have filed one or more European patents. Interestingly, the predictive power of European patents is particularly high in low-tech industries (+172%), where a patent filing can be a relatively rare event.
- Prior trade mark filings perform best as HGF predictors in consumer-oriented industries. In consumer non-durable industries, SMEs are 62% more likely to experience high growth if they have filed a European trade mark. By contrast, the filing of a national trade mark is a better predictor (+49%) of the likelihood of high growth in consumer durable industries.
- SMEs that use bundles of trade marks, patents and designs instead of a single category of IPR are even more likely to achieve high growth. IP bundles involving trade marks systematically outperform other bundles and single IPR categories, thus suggesting that trade marks are the basic building block of effective IP bundles. This is likely due to the fact that a trade mark registration is related to market entry and thus turnover growth.

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## **Patent commercialisation scoreboard: European SMEs**

Based on a survey of patent applicants based in Europe, this study shows how SMEs with diverse profiles leverage European patents to sustain growth in Europe and cites concrete case studies. It is the first of a new series of patent commercialisation scoreboards that use survey data to monitor the market success of European patents.

This study is based on a survey of 1500 European SMEs that have filed European patent applications between 2008 and 2018. It documents whether and how the related inventions are commercially exploited, with a focus on collaborative forms of exploitation like licensing or co-operation. By analysing the patent commercialisation practices of European SMEs, the study offers policymakers valuable insights into the challenges facing these key players in European innovation ecosystems.

The study shows that most of the SMEs consider the invention for which they have filed a European patent application as important in their industry or highly relevant to their core business. Up to two thirds of the European inventions covered by the survey are already commercially exploited. SMEs typically rely on European patents to prevent competitors from imitating their inventions, build up a reputation and secure freedom to operate. However, about half of them also intend to use their patents for transactional purposes like setting up licensing agreements and commercial contracts.

Another key finding of the study is that SMEs rely heavily on partnerships with domestic or foreign partners. Half of all commercialised inventions are exploited in collaboration with an external partner via a licence, technology spin-off, or co-operation. Resource-constrained SMEs use partnerships as a way of entering new markets or sharing the financial burden of innovation. The majority of SMEs reported targeting business partners located in other European countries and the broad geographical scope of European patents makes them

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a useful tool in this respect. SMEs however struggle to find partners outside their close circle of personal or business contacts.

## **Patent commercialisation scoreboard: European universities and public research organisations**

Based on a survey of universities and public research organisations based in Europe that have been filing patent applications with the EPO, this study shows how research institutions use European patents to bring results from scientific research activities to market. This study is the second in a series of EPO patent commercialisation scoreboards.

The study finds that research institutions already commercialise more than one third (36%) of the inventions for which they have filed a patent application with the EPO. Licensing is by far their preferred commercialisation and creating a spin-off company is reported as a motive for 41% of commercialised inventions. Commercialisation partners include SMEs and large companies in equal proportions (around 40% each). Most of the successful collaborations (74%) involve partners from the same country and only 27% partners across European borders.

Commercialisation is planned but not yet achieved for 42% of the inventions for which European research institutions have filed patent applications with the EPO. In most cases this is because these inventions have not reached proof of concept, either because they are still at the R&D stage (63%) or because commercial opportunities have not yet been identified (55%).

Failure to find interested partners is reported as the third most important reason for failed or planned commercialisation (38%). Currently, personal



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networks (92%) and prior business and research partners (71%) are the most frequently used sources for finding partners, followed by business fairs and conferences (49%). Patent databases (21%) and internet trading platforms (15%) are used less frequently and could be developed to improve chances of finding suitable partners.

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## Chapter 3

# JAPAN PATENT OFFICE

## Effect that IPRs Have on Consumers' "Willingness to Pay" (WTP)

### Purpose

The purposes of this research are twofold. One is to examine the signaling function of intellectual property rights (IPRs) by using an experimental economics approach and the other is to investigate the effects that IPRs have on consumers' willingness to pay (WTP).

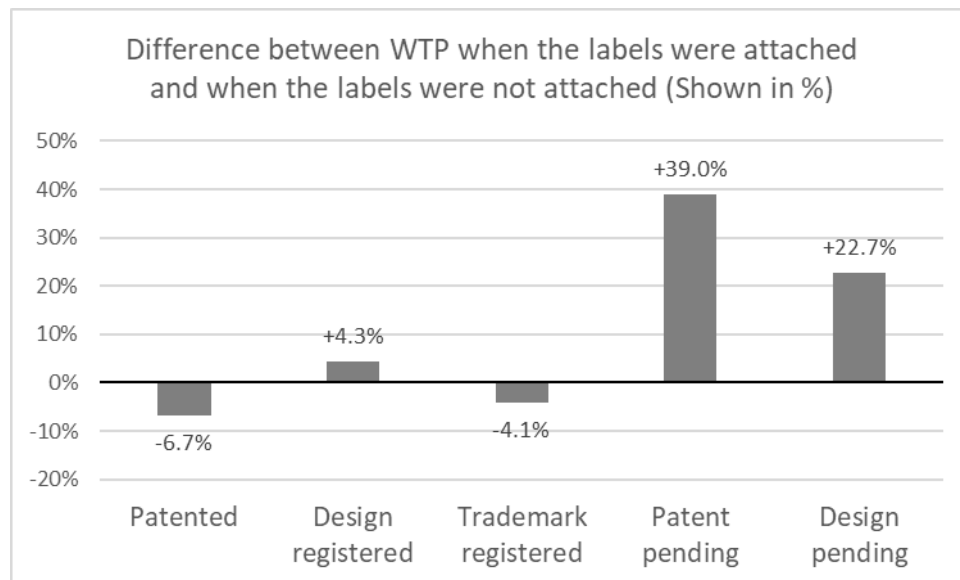
### Method

Descriptions and images of 26 different kinds of products were given to one group of participating subjects. In the test, all 26 of the products had some type of label such as "patented," "design registered," "trademark registered," "patent pending," and "design pending." Then, the same products without any labels were shown to the other group of participating subjects. The subjects gave prices ranging between 0 yen to 3000 yen as indications of how much they would pay for each of the products, with higher prices indicating greater degrees of interest/willingness to purchase them.

### Results and discussions

The graph below shows the difference (in %) between WTP when the labels were attached and when the labels were not attached. Only the label "patent

pending” was statistically significant at the 10% level and had a positive effect (39% increase in WTP). One reason for this would be because “patent pending” implies that the product is the latest invention. On the other hand, WTPs of “patented” and “trademark registered” decreased by 6.7% and 4.1% respectively comparing to those without labels. Possible reasons for this seemingly negative result would be because these labels may have an effect to decrease the variance of WTP (and to decrease the average level of WTP for products with higher uncertainty, such as products with the label “patented,” which are thought to be more high-tech and complex), and the effects of labels on WTP would vary depending on the characteristics of products, such as the stages of the product life cycle, the complexity of its structure and how and where the labels were placed.



Resource:

The full version of the study is available from the following (available only in Japanese):

[https://www.jpo.go.jp/resources/report/sonota/document/keizai\\_yakuwari/report\\_h30.pdf](https://www.jpo.go.jp/resources/report/sonota/document/keizai_yakuwari/report_h30.pdf)

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## **Chapter 4**

# **KOREAN INTELLECTUAL PROPERTY OFFICE**

## **Analysis of the Economic Effects of Patent Ownership by Industry**

In its strategic goal to deliver a Patent Ownership by Industry, the Korean government emphasizes a Patent Ownership driven by developments in science and technology and innovations in the corporate sector. In addition, intellectual property, which in its entirety, represents the national industrial competitiveness, continues to emerge as a core driver for realizing sustainable economic growth.

Along the path to delivering intellectual property-driven economic growth, it is vital to understand and interpret how much added value is created and how it is calculated from the patents generated through research & development at both the corporate and national levels. It is also necessary to explain how patents function to influence industrial competitiveness, by analyzing the importance of securing patent rights and the consequent creation effects of jobs and added value for each industrial sector.

This study measures the economic benefits of owning patent rights, to understand how these patent rights influence the growth and profitability of each industry, and provides insights into their implications to support the

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efficient implementation of policies on industrial property rights by the government. To this end, the study carried out an ‘inter-industry analysis,’ which measures the effects of revenue growth and job creation from owning patent rights for each industry, and an ‘intra-industry analysis,’ which compares the differences in economic benefits of the entities with or without patents. The overall analysis covered the manufacturing sector, where it was analyzed for each of the 24 medium-class and 82 small-class categories, according to the Korean Standard Industrial Classification (KSIC). The values and contribution effects of the patent rights within the manufacturing sector were quantified, by cross-referencing the annual patent registration and financial data of corporate entities, applying analytic modeling to calculate their respective patent elasticity in terms of revenue and the job creation coefficient.

As for the results, it was shown that the maximum patent elasticity of revenue in manufacturing was 0.232, which denotes that each patent in ownership increases revenue by KRW 970 million (appx. USD 826,000) and creates 6.4 new jobs. However, the patent elasticity of the added value had negative values, which signifies little competitive advantage for the patent-holders when compared with the non-holders. Thus, this study derives policy recommendations to increase the added value of the patent-holders, and thereby presents implications on how to activate patent-based industries.

Resource:

[https://www.kipo.go.kr/kpo/BoardApp/UlplnfOthApp?a=&board\\_id=others&cp=1&pg=1&npp=10&catmenu=m04\\_02\\_05&sdate=&edate=&searchKey=1&searchVal=%B0%E6%C1%A6&bunryu=all&st=&c=1003&seq=16453&gubun=](https://www.kipo.go.kr/kpo/BoardApp/UlplnfOthApp?a=&board_id=others&cp=1&pg=1&npp=10&catmenu=m04_02_05&sdate=&edate=&searchKey=1&searchVal=%B0%E6%C1%A6&bunryu=all&st=&c=1003&seq=16453&gubun=)

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## Chapter 5

# The United States Patent and Trademark Office

The USPTO published five major reports and five peer-reviewed research articles regarding the relationship between IP and the economy in 2019 and 2020.

### Reports

*Progress and Potential: A profile of women inventors on U.S. patents.* Office of the Chief Economist IP Data Highlights, Number 2, February 2019. Can be found at

<https://www.uspto.gov/sites/default/files/documents/Progress-and-Potential.pdf>.

Currently, women comprise a small percentage of patent inventors, suggesting that their innovative potential is underutilized. To better understand the progress of women in patenting, this report considers U.S. women inventors named on U.S. patents granted from 1976 through 2016. Using new data from PatentsView ([www.patentsview.org](http://www.patentsview.org)), the report examines the trends and characteristics of the patents of these women inventors. The key findings of the report include the following:

- The number of patents with at least one woman inventor has increased steadily since the 1980s, from about 7 percent to 21 percent. Despite

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this increase, the women inventor rate (the percentage of all inventors who are women) reached only 21 percent in 2016.

- Women inventor rates are higher in technology-intensive states and in states with more women actively participating in the overall workforce.
- Women inventors are increasingly concentrated in specific technologies and types of patenting organizations, suggesting that women are specializing where female predecessors have patented rather than entering into male-dominated fields or firms.
- Women are increasingly likely to patent on large, gender-mixed inventor teams, highlighting the growing importance of understanding the relationship between gender and innovative collaboration.

*Report to Congress pursuant to P.L. 115-273, the SUCCESS Act, October 2019.* Can be found at

<https://www.uspto.gov/sites/default/files/documents/USPTOSuccessAct.pdf>.

The Study of Underrepresented Classes Chasing Engineering and Science Success (SUCCESS Act) requires the Director of the USPTO, in consultation with the Small Business Administration (SBA), to identify publicly available data on the number of patents annually applied for and obtained by women, minorities, and veterans of the U.S armed services. In response, the USPTO reviewed available literature, sought public comments through a Federal Register Notice and held three public hearings. The literature review drew principally on peer-reviewed academic studies, as well as government reports and other academic literature analyzing the participation of women, minorities, and veterans in the U.S. patent system. The main findings are summarized as follows:

- There is a limited amount of publicly available data regarding the participation rates of women, minorities, and veterans in the U.S. patent

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system. However, the limited information that does exist, including the comments that the USPTO received, indicates that women and minorities are underrepresented as inventors named on U.S. granted patents.

- The bulk of the existing literature focuses on women, with a very small number of studies focused on minorities, and only some qualitative historical information on U.S. veteran inventor-patentees. Overall, there is a need for additional information to determine the participation rates of women, minorities, and veterans in the U.S. patent system.
- Empirical studies document some of the benefits of patenting, but few characterize these benefits specifically for women, minorities, or veterans, or for the companies that women, minorities, or veterans own.

In addition to the results above, the report summarizes the literature regarding external factors faced by potential inventor-patentees in three broad areas: (1) social norms and education, (2) institutional norms and practices, and (3) resource availability and access.

The report also provides legislative recommendations, which include enhancing the USPTO's authority to gather demographic information on inventors, enhancing authority for federal interagency data sharing and cooperation, and expanding the purposes/scopes of relevant federal grant programs, among others.

*Adjusting to Alice*. Office of the Chief Economist IP Data Highlights, Number 3, April 2020. Can be found at

[https://www.uspto.gov/sites/default/files/documents/OCE-DH\\_AdjustingtoAlice.pdf](https://www.uspto.gov/sites/default/files/documents/OCE-DH_AdjustingtoAlice.pdf).



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In 2014, the U.S. patent system experienced a major change. The U.S. Supreme Court reached a unanimous decision in *Alice Corp. v. CLS Bank International* that held generic computer implementation does not transform a patent-ineligible abstract idea into a patent-eligible invention, effectively broadening the scope of ineligible subject matter. Consequently, the decision created uncertainty in the business and legal communities.

This report focuses on two USPTO patent examination outcomes – rejections over subject matter eligibility and the degree of uncertainty in the examination process - and evaluates how these outcomes changed in response to the *Alice* decision and in response to USPTO adjustments made in the form of guidance for examiners. The main results include the following:

- For patent applications filed in *Alice*-relevant technologies, the likelihood of receiving a rejection for patent-ineligible subject matter rose by 31 percent in the 18 months following the *Alice* decision.
- For these technologies, uncertainty in patent examination increased by 26 percent during the same time period.
- In the 12 months following the USPTO's 2019 Revised Patent Subject Matter Eligibility Guidance (2019 PEG), the likelihood of receiving a rejection for patent-ineligible subject matter fell by 25 percent.
- Uncertainty in patent examination for *Alice*-affected technologies decreased by 44 percent in the 12 months following the issuance of the 2019 PEG.

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*Progress and Potential: 2020 Update on U.S. Women Inventor-Patentees.* Office of the Chief Economist IP Data Highlights, Number 4, July 2020. Can be found at

<https://www.uspto.gov/sites/default/files/documents/OCE-DH-Progress-Potential-2020.pdf>.

This report updates the results of the original Progress and Potential report that was issued in February of 2019. The study found that there has been continued improvement in the participation of women inventor-patentees. First, the share of patents with at least one woman inventor rose from 20.7 percent in 2016 to 21.9 percent in 2019. Second, the women inventor rate – the share of women among all U.S. inventor-patentees – grew from 12.1 percent to 12.8 percent over the same time period. Finally, the percentage of new women inventor-patentees rose from 16.6 percent to 17.3 percent. The report also found that the women inventor rate varied by geographic region and among the top patenting organizations.

*Inventing AI: Tracing the Diffusion of Artificial Intelligence with U.S. Patents.* Office of the Chief Economist IP Data Highlights, Number 5, October 2020. Can be found at

<https://www.uspto.gov/sites/default/files/documents/OCE-DH-AI.pdf>.

The broad scope of new products and services that build on AI technologies suggests that AI has the potential to fundamentally change how people perceive the world around them and live their daily lives. The question is how to gauge the potential impact of AI. One indicator is the nature and diffusion of

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AI technologies through patents. As the primary form of legal protection for inventions, patents can reveal whether AI technologies are growing in volume and, importantly, whether they are diffusing across a broad spectrum of technical areas, inventors, companies, and geographies.

In this report, we use a machine learning AI algorithm to determine the volume, nature, and evolution of AI and its component technologies as contained in U.S. patents granted from 1976 through 2018. The report builds on recent AI landscaping efforts by the European Patent Office (EPO), the World Intellectual Property Organization (WIPO), and others. Our primary advancement over those landscapes involves the use of an AI method that flexibly learns from the text of patent documents without being constrained by specific classifications and keywords. This approach improves the accuracy of identifying AI patents.

We find that AI is increasingly important for invention, diffusing broadly across technologies, inventor-patentees, organizations, and geography. For instance, in the 16 years from 2002 to 2018, annual AI patent applications increased by more than 100 percent, rising from 30,000 to more than 60,000. Over the same period, the share of all patent applications that contain AI grew from 9 percent to nearly 16 percent. In addition, patents containing AI appeared in about 9 percent of all technology subclasses used by the USPTO in 1976 and spread to more than 42 percent by 2018. Finally, the percentage of inventor-patentees who are active in AI started at 1 percent in 1976 and increased to 25 percent by 2018. Growth in the percentage of organizations patenting in AI has been similar.

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## Published Peer-Reviewed Journal Articles

Alan C. Marco and Richard D. Miller, "Patent Examination Quality and Litigation: Is There a Link?" *International Journal of the Economics of Business* 26(1): 65-92. Can be found at

<https://www.tandfonline.com/doi/abs/10.1080/13571516.2018.1553286?journalCode=cijb20>.

In this study, the authors build on previous academic research by using matched samples of litigated and non-litigated patents to investigate patent characteristics that predict patent litigation in the U.S. district courts. The main contribution of the paper is the inclusion of detailed patent examination characteristics and characteristics of the patent claims. The results on patent claims shed light on the relationship between patent scope and subsequent litigation. Interestingly, the analysis finds that variables defined prior to any examination at the USPTO are the strongest predictors of litigation. However, some patent characteristics such as scope (measured as the number of words in a patent's shortest independent claim) are also associated with litigation.

Dirk Crass, Dirk Czarnitzki, and Andrew A. Toole, "The Dynamic Relationship Between Investments in Brand Equity and Firm Profitability: Evidence Using Trademark Registrations." *International Journal of the Economics of Business* 26(1):157-176. Can be found at

<https://www.tandfonline.com/doi/abs/10.1080/13571516.2019.1553292?journalCode=cijb20>.

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This paper investigates how past investments in brand equity contribute to current profitability. The authors use 30 years of firm-level registered trademarks to proxy for investments into brand equity – the consumer-level construct that creates brand value. Based on a panel of public and private firms in Germany over the period from 2001 through 2010, the authors find the payoff profile from trademark investments in brand equity follows an inverted-U shape. On average, investments into brand equity do not contribute to profits in the first four years, reach peak returns from 11 to 15 years, and go back to zero after 19 years. For the median trademarking firm, brand equity contributes 265,000 Euros to annual profits.

Charles A. W. deGrazia, Jesse P. Frumkin, and Nicholas A. Pairolero, “Embracing Invention Similarity for the Measurement of Vertically Overlapping Claims.” *Economics of Innovation and New Technology* 29(2) 113-146. Can be found at

<https://www.tandfonline.com/doi/abs/10.1080/10438599.2019.1593035?journalCode=gein20>.

Clear and well-defined patent rights can incentivize innovation by granting monopoly rights to the inventor for a limited period of time in exchange for public disclosure of the invention. However, with cumulative innovation, when a product draws from intellectual property held across multiple firms (including fragmented intellectual property or patent thickets), contracting failures may lead to suboptimal economic outcomes. However, an alternative theory, developed by a variety of scholars, contends that patent thickets have a more ambiguous effect. Researchers have developed several measures to gauge the extent and impact of cumulative innovation and the various channels of patent thickets. This paper contends that mismeasurement may contribute to the

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incoherence and overall lack of consensus within the patent thickets literature. Specifically, the literature is missing a precise measure of vertically overlapping claims. The authors here propose a new measure of vertically overlapping claims that incorporates invention similarity to more precisely identify inventive overlap. The measure defined in this paper will enable more accurate measurement, and allow for novel economic research on cumulative innovation, fragmentation in intellectual property, and patent thickets within and across all patent jurisdictions.

Charles A. W. deGrazia, Nicholas A. Pairolero, and Mike H. M. Teodorescu, "Shorter Patent Pendency without Sacrificing Quality: The Use of Examiner's Amendments at the USPTO." *Academy of Management Proceedings* 2019(1). Can be found at

<https://journals.aom.org/doi/pdf/10.5465/AMBPP.2019.58>.

Prior research on USPTO examiner incentives suggests that increasing first action allowance rates with seniority and experience results in lower patent quality. However, the authors identify an examiner learning mechanism that accounts for this empirical fact. Their analysis suggests that the policy prescriptions in the literature regarding modifying time allocations should be reconsidered. In particular, rather than re-configuring time allocations for every examination promotion level, researchers and stakeholders should focus on the variation in outcomes between junior and senior examiners. Further, the examiner learning mechanism studied in this paper also reduces patent grant delay, and therefore likely benefits innovators and firms.

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Charles A. W. deGrazia, Amanda Myers, and Andrew A. Toole, "Innovation activities and business cycles: are trademarks a leading indicator?" *Industry and Innovation* 27(1-2), 2020. Can be found at

<https://www.tandfonline.com/doi/abs/10.1080/13662716.2019.1650252?journalCode=ciai20>.

Despite the widespread use of economic information to anticipate changes in business conditions, innovation metrics are not considered to be leading indicators. The authors argue that aggregate trademark data reflect firm-level choices that can help predict business cycles. In addition to establishing the conceptual basis for considering trademarks, the statistical evaluations, using turning point analysis and a novel machine learning method, find that trademark filings for product and service offerings in commercial use outperform many of the conventional leading indicators. Our work suggests that including trademark metrics in composite indexes could improve recession forecasting performance. The results also indicate that the use of examiner's amendments has no adverse effect on patent examination quality.