GENDER DESEGREGATED ANALYSIS OF MEXICAN INVENTORS IN PATENT APPLICATIONS UNDER THE PATENT COOPERATION TREATY (PCT)

BERENICE CEPEDA ZETTER, CLAUDIA GONZÁLEZ BRAMBILA and MIGUEL ÁNGEL PÉREZ ANGÓN

SUMMARY

Following the Organization of Economic and Cooperation and Development recommendations, we have used patent data comprised in the PATENTSCOPE database as an indicator of technological innovation and in order to analyze Mexican inventors' involvement on patent filing over a 20 year period (1995-2015). The analysis was gender desegregated to observe patterns and trends of participation of both male and female inventors. Some indicators such as participation, contribution and presence are shown. Findings reveal that Mexican female inventors more often apply for patent titles within a small to medium sized team, while male inventors prefer single-authored applications. It has also been found that the stronger technological area in which both male and female Mexican inventors apply for patent titles is that relative to Chemistry and Metallurgy, inclusive of all its subareas. The results reveal gender disparities that should be addressed in Mexican public policy to accomplish United Nations Millenium Goals and UN Sustainable Development Goals, and to and promote gender equity in Science and Technology related activities.

There are bibliometric studies that address the determinants of scientific productivity in terms of the number of publications in indexed journals (Long, 1990; Mauleón and Bordons, 2006; González-Brambila, 2014; Marmolejo-Leyva, 2015). However, there are other research products that have not been taken into account often when measuring the scientific and technological progress. This is the case of the number of patent applications generated as a result of either academic or industrial research efforts.

The use of patent statistics as indicators of innovation has been used extensively (Archibugi, 1992; OECD, 1994; Patel and Pavitt, 1995). International organizations such as the Organization for Economic Cooperation and Development (OECD) have developed manuals in order to measure economic progress and innovation (OECD, 1994) that include the measurement of patent applications and granted patents. The importance of the study of patenting activity is based on the fact that patents are obtained for commercialization purposes of the inventions, serve as a legally based monopoly of the exploitation of those inventions and may be used as a knowledge repository for future developments. Patents are used as indicators of known knowledge of the enterprises or even countries (Schmoch and Hinze, 2004; Frietsch and Schmoch, 2006; Frietsch *et al*., 2009). There is a vast litera-

KEYWORDS / Gender / IPC / Mexico / Patents / TCP / Technological Fields /

Receive: 01/21/2016. Modified: 03/14/2017. Accepted: 03/20/2017.

Berenice Cepeda Zetter. Electronics and Communications Engineer, IPN, Mexico. M.Sc. in Data Communications, University of Sheffield, UK. Ph.D. in Technological and Scientific Development, Centro de Investigación de Estudios Avanzados (Cinvestav), Instituto Politécnico Nacional (IPN), Mexico. Address: Cinvestav-IPN. Apdo. postal 14-740 07000 México, D.F., México. e-mail: bcepeda@cinvestav.mx

Claudia González Brambila. Industrial Engineer, Universidad Autónoma Metropolitana, Mexico. Master in Engineering, Universidad Nacional Autónoma de México. Ph.D. in Engineering and Public Policy, Carnegie Mellon University, USA. e-mail: cgonzalez@itam.mx

Miguel Ángel Pérez Angón. Doctor in Physics, Cinvestav-IPN, Mexico. Researcher, CinvestavIPN, Zacatenco, Mexico. e-mail: mperez@fis.cinvestav.mx

ture in which patents are thought to promote new scientific and technological applications and serve as catalysts for economy growth (Kieff, 2001; Loise and Stevens, 2010).

We used the PATENTSCOPE reference database (WIPO, 2015a) to analyze patent applications, as it offers a global view of patent applications under the Patent Cooperation Treaty (PCT) and a comprehensive search engine allowing filters of nationality of the authors of each application. Other studies concerning patent applications use the United States Patent Office (USPTO) database (Guzmán, 2012; Sugimoto *et al.*, 2015), the Worldwide Patent Statistical Database (PATSTAT; Frietsch *et al.*, 2009; Toivanen and Suominen, 2015), or country specific patent databases (Mauleón and Bordons, 2010; Meza-Rodriguez *et al.*, 2015; Millán-Quintero and Meza-Rodríguez, 2015), according to the scope of the research.

The aim of this study is to use patent analysis to characterize the involvement of Mexican inventors in patenting activities involving PCT applications. The period chosen for the analysis is from 1995 to 2015 because of the addition of México to the Treaty in 1995. In this article, the participation of Mexican inventors is analyzed by gender and the relationship between the inventors' team size, the patent categories and the patent holders are studied. This analysis will help determine the strongest technological areas in which Mexican inventors work, to achieve knowledge of strengths and opportunities of the nation's human capital as well as the capability of knowledge absorption. It is based on patent applications published in the World Intellectual Property Organization (WIPO) database instead of doing it on granted patents, given that the publication of a patent application is the first formal and public knowledge of the invention it describes (Balconi *et al.*, 2004; Breschi *et al.*, 2007; Frietsch *et al.*, 2009) and that the time to grant a patent in the regional or national offices is often very long. The WIPO database was used because it concentrates all patents filed under the PCT, whichever the regional or national patent office has been chosen by the inventor(s).

Participation of female inventors in patent applications could give an indication of the degree the UN Millenium Goals (United Nations, 2015) have been covered, as this implies access to science, technology and business. It has also direct implications on the role of gender-based innovations for the United Nations Sustainable Development Goals (WISET, 2016) as the inventions where they participate could contribute to have clean water and sanitation, affordable and clean energy, improvements for industry, sustainable cities, etc. and by promoting their inclusion on inventors' teams gender equality and decent works would be a step forward. Many of the elements needed to achieve gender equality differ significantly by country and there is little research undergone on Latin American (and other developing) countries (Barroso *et al.*, 2009; Guzmán, 2012; Guzmán *et al.*, 2012). Thus, the interest of our study focusing on Mexican female inventors is relevant.

The document is organized as follows: first we have established the demographic panoramas related to inventive and patenting activities in the world; next, the methodology applied to the analysis is explained, as well as the limitations concerning the data set used; results obtained follow and, finally conclusions are pictured.

Gender disparities, the global view

The use of human capital in conjunction with new technologies and specialized workforce mobility is essential to generate richness, growth and competitiveness within countries. Education, specialization, research and development have become crucial factors to achieve goals set by countries' governments and international organizations.

The United Nations have set specific goals concerning women and girls' access to education, training, science and technology, as well as equal access to full employment and decent work (United Nations, 2015). We believe women participation in patent applications gives an indication of the degree these goals have been covered, as this implies access to science, technology and business, and that the analysis made might provide elements to accomplish the goals set by the UN.

The OECD has interpreted the low presence of female scientists and inventors as a barrier for economic growth of their member countries (OECD, 1994). Women constitute 49.65% of the global population (US Census Bureau, 2015), thus they represent a potential human capital that has barely being exploited, especially in Latin-American and other developing countries. This might be explained as result of the traditional role women play in society as mothers and housekeepers (Whittington, 2011), the opportunities they have to access graduate and postgraduate education, and the choice of professional activities.

In Mexico, women constitute 51.6% of the total population (World Bank, 2015). However, the labor force represented by Mexican women older than 15 years of age that are able to work is only 16.4% of the total (INEGI, 2015). Various studies (Atlas, 2014; Contreras-Gomez *et al.*, 2015) have found that in Mexico women participation in Ph.D. degrees varies between disciplines, with the highest percentage of participation in Humanities (45%) and the least in Physics (15%). This proportion is consistent to OECD (2011) figures for member countries, where the large majority of degrees in humanities and health are awarded to women (71%) while the majority of degrees in mathematics and engineering degrees are awarded to men (75%).

Female situation is different from one country to another and depends on various factors, such as participation in scientific and technological activities, the area of study related to each invention (Frietsch *et al.*, 2009) and even the policies implemented to accomplish gender equality. The 'leaky pipeline' phenomenon in which the proportion of women decreases in every higher educational step is present worldwide (OECD Employment, 2006; OECD iLibrary, 2011; US GAO, 2015). It is therefore important to account for the collection of data at a country level, as well as country specific studies in order to appreciate more clearly the reason for the shortage of females in some areas or jobs (especially those that are technology related), and determine if there is the need of public policy implementation to improve gender equality. These studies would also serve to compare gender situation throughout time, and evaluate measures taken by firms or governments to reduce gender gap in Science and Technology (S&T) related activities. Gender segregated technology indicators are being encouraged (OECD, 2011) in both national and international levels. The 2010 America Invent Act stressed the need to understand diversity in patenting, taking special interest in patent applicants that are women, minorities or veterans (AIA, 2010).

Mexican women that represent the nation's labor force are on average 38.5 years old and have 10 years of formal studies, while male labor force are on average 39 years old with a formal education of 9.3 years (INEGI, 2015). However, only 11.86% of Mexican labor force was occupied in S&T related activities (INEGI, 2015). This percentage is important in order to demonstrate capabilities of adoption, im-

plementation and use of new technologies, as well as participation in international technology trade (Toivanen and Suominen, 2015) and can be compared with that of other countries.

In the last years, several studies have been made in order to analyze women participation in patenting activities in different countries, regions or patent categories, especially within the European Union (Naldi *et al*., 2004; Wittington and Smith-Doerr, 2005, 2008; Frietsch *et al*., 2009; Mauleón and Bordons, 2010; Jung and Ejermo, 2014). However, there are only a few studies concerning patenting activity in Latin America (Barroso *et al*., 2009; Guzmán, 2012; Guzmán *et al*., 2012; Meza-Rodriguez *et al*., 2015; Millán-Quintero and Meza-Rodríguez, 2015). The studies claim that the gender gap is declining, but still male scientists all around the world generate more patent applications than female inventors do (Whittington and Smith-Doerr, 2005, 2008; Ding *et al*., 2006; Stephan and El-Ganainy, 2007; Frietsch *et al*., 2009; McMillan, 2009; Jung and Ejermo, 2014; Sugimoto *et al*., 2015).

Methodology

The PATENTSCOPE database (WIPO, 2015a) has been used to obtain all patent applications where at least one of the inventors is Mexican from 1995 to 2015. The search results were then organized in Excel datasheets. Afterwards, the registries have been analyzed individually to determine the number, nationality and gender of inventors in each of them. An inventor with more than one patent in a given year is counted as many times as the patent applications in which he or she appears (full counts).

A two letter code indicating nationality and full name of inventors (one name and surname) are usually recorded in the database unlike the publications' databases such as Web of Science, in which many problems arise when trying to identify the author because of the many ways of signing publications (Ruíz-Pérez *et al*., 2002; Macías-Chapula *et al*., 2006; Costas, 2007). Gender aspects of inventors have been studied based on the fact that the first name works as a gender identifier in most cultures, although gender identification is a laborious and often difficult task. There have been studies conducted to determine the gender of the inventors (Sugimoto *et al*., 2015), in which the first name of authors are matched with country-specific name lists (Sugimoto *et al*., 2015). The patent data used by Jung and Ejermo (2014) was compared to a national demographic database provided by Statistics Sweden. In the present study, the knowledge of names used in Spanish language was used instead of an already defined list as in other studies involving Hispanic inventors (Mauleón and Bordons, 2010), given that there are few cases when a name can be used for both men and women and that there is a significant difference between names for men and women.

Other studies (Jung and Ejermo, 2014) have taken into account other variables (age and education of inventors) matching the inventors names with national demographic information of Swedish citizens. In other cases, inventors' surveys have been used to obtain demographic data in Japan, United States and the European Union (Giuri *et al*., 2007; Walsh and Nagaoka, 2009). The Mexican national statistics agency, INEGI, does not include a list of inventors, and there has not been any survey on this subject conducted in the country, so the only information available was the one in PATENTSCOPE.

The International Patent Classification (IPC) was used to identify the section that the patent applications relate to, in order to analyze the main areas in which Mexican inventors participate. The IPC consists in a hierarchical system of language independent symbols according to different areas of technology, and serves as an instrument for the orderly arrangement of patent documents in order to facilitate access to the technological and legal information contained therein. The IPC version used is the one that came into force on January 1st 2015 (WIPO, 2015c).

The indicators obtained, following Naldi *et al.* (2004) and Mauleón and Bordons (2010) are divided in i) Participation: number of patent applications with male only, women only or mixed inventors teams; ii) Presence: whole count of inventors both male and female; iii) Co-inventorship index: total number of inventors in each of the patent applications; and iv) Percentage of female and male patent applications that are single-authored.

Results

A total of 3350 patent applications with at least one Mexican inventor were found. Considering full counts, 1089 inventors of all those listed in the applications were Mexican female inventors. Uncertainty in the gender identification of inventors comprised 73 registries (2.18%) due to: a) names that can be used either by men or by women such as Ari, Magdiel or Merced; b) names not commonly used in Spanish, such as Tetsuya or Naoko; c) only initials of the inventor's name were used, as in Andrade F. or Hernandez, T.; and d) names were written in Cyrillic characters, such as in ТЕЙЛОР Брэдли.

Presence of Mexican inventors in patent applications

An increase in the number of Mexican inventors is shown for both males and females during the decade studied. The proportion of women is still low compared to men as can be seen in the Figure 1.

Female participation in patent applications

The percentage of participation of female inventors on the data analyzed showed a large fluctuation across

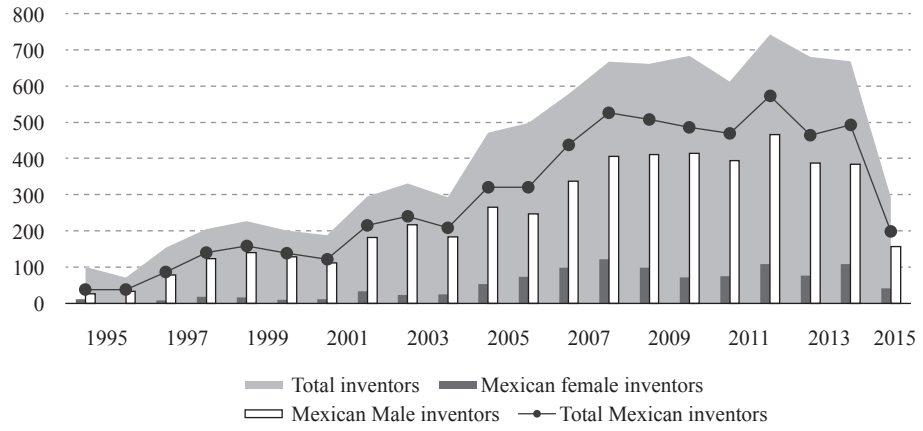

Figure 1. Evolution of patenting activities in PATENTSCOPE database in PCT applications with at least one Mexican inventor between years 1995 and 2015. Note: total inventors account for Mexican and foreign inventors listed in the patent application.

the period studied, with an average of 20% of the total PCT patent applications with at least one Mexican inventor (foreign and Mexican females considered). This is consistent with studies conducted in other countries (Mauleón and Bordons, 2010; Sugimoto *et al*., 2015). We can therefore conclude that Mexican inventors situation is the same as reflected in most countries around the globe, with the exception of few countries which are female dominated in relation to patenting activities (Sugimoto *et al*., 2015), and is slightly high when compared with other studies analyzing USPTO database (Sugimoto *et al*., 2015) and others that consider a large number of countries comparing several countries in terms of female participation, or the Spanish Patent Office database for a country specific analysis (Mauleón and Bordons, 2010). According to Frietsch *et al*. (2009), women contribution to patents filed by European countries ranges from 2.9% in Austria to 14.2% in Spain up to 2005. Therefore, the percentage found in patenting activities is high, not only given worldwide statistics, but also the proportion of Mexican labor force represented by females.

The size of inventors' teams and the co-inventorship index

Mexican female inventors have more co-inventors on average than Mexican male inventors, who are also prone to produce single-authored PCT patent applications. The mean size for mixed teams is 4.69, while males only inventors teams present a mean of 2.06. This is congruent also with the results expressed in Sugimoto *et al*. (2015) and Mauleón and Bordons (2010), who state that female inventors tend to work in mixed-gender teams more frequently than alone.

According to the number of single authored patent applications we established a collaboration indicator that transcends because gender issues condition the participation of female inventors as single authors. This can be seen on Table I.

TABLE I
SINGLE AUTHORING IN PATENT APPLICATIONS BY GENDER

	Mixed teams	Males only teams	Females only teams
Single authored applications (total count)	---	1367	111
Number of applications (total count)	496	2743	111
Percentage from the total applications	0.16	0.82	0.03

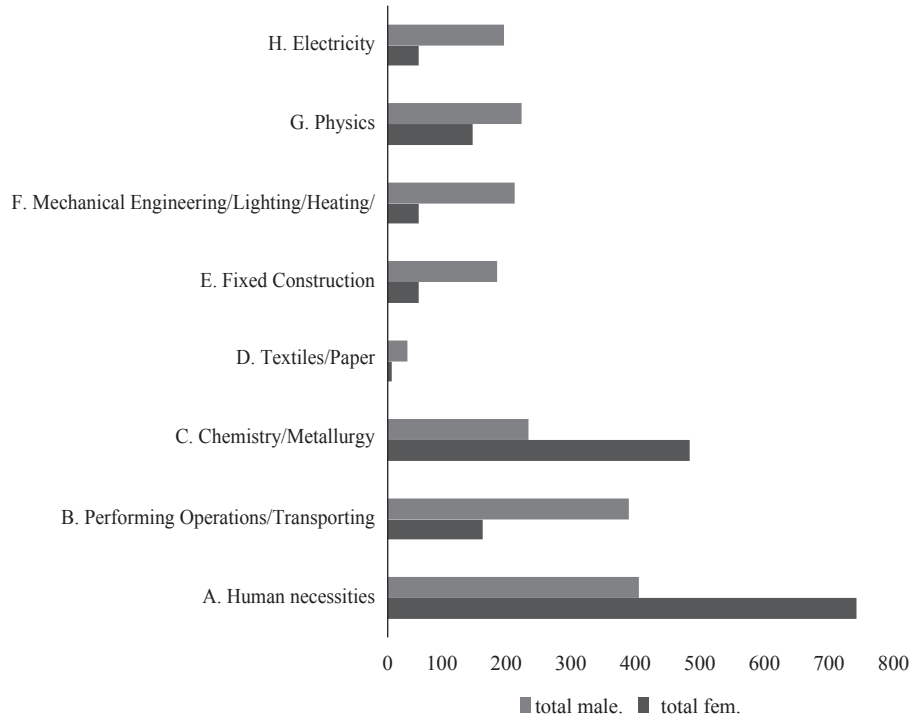

Figure 2. PCT patent applications with at least one Mexican inventor by gender and IPC section.

Propensity to patenting among Mexican inventors according to IPC

In the International Patent Classification (IPC) gender distribution varies across sections, as seen in Figure 2. Mauleón and Bordons (2010) analyzed 16 years of patents from the Spanish Patent Office, showing the female involvement in patent generation by sectors and technological fields; their findings apply also to the Mexican case in the period studied. Women involvement in patent applications varies depending on the technological sections. The percentage of applications with at least one Mexican female inventor goes from 8.33% in the Textile/Paper Section, to a 34.12% participation in the Chemistry and Metallurgy Section.

Given the variety of Classes and Subclasses in each of the Sections, the IPC- Technology concordance Table constructed by WIPO was used in order to determine the technological branch into which Mexican PCT patent applications can be organized (WIPO, 2015b). A concordance between predefined fields of technology and the IPC has been used for several years by WIPO and other intellectual property offices. Lately, these fields of technology have been reviewed and the concordance has been revised. There are 35 fields of technology in the Table in which we have mapped patent applications with Mexican inventors. This approach has been taken also in other studies (Sugimoto *et al*., 2015). The use of the Table allowed us to determine the national focus of patent applications in the period studied and gives a better understanding of Mexican inventors influence in each of the technological fields.

As shown in Figure 3, the largest share within the PCT patent applications analyzed corresponds. in both decades, to the Chemistry and Metallurgy Section, specifically to the Organic Fine Chemistry technological branch. Female inventor participation in this branch is relevant. This is consistent with the findings of other studies using the first name of the inventors to accomplish gender identification (Frietsch *et al*., 2009; Jung and Ejermo, 2014; Naldi *et al*., 2004), in which female participation or contribution is strongest in pharmaceutical technology, followed by chemicals, with least activity in mechanical engineering and machinery in European countries.

This finding relates to a strong Chemistry school in Mexico that

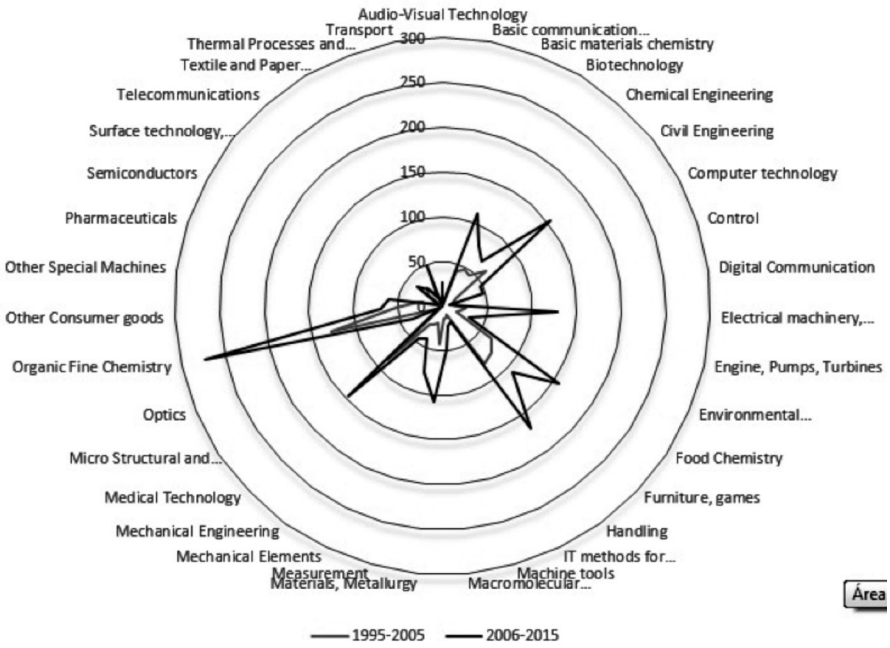

Figure 3. PCT patent applications with at least one Mexican inventor according to the IPC-Technology correspondence table.

has been historically productive in publications and patents in all the branches of the discipline (Atlas, 2014). An example of this affirmation is the case of steroids research that led to the contraceptive pill (Hernández-García *et al*., 2016) yielding a great number of publications in mainstream journals as well as registered patents. Even in those early stages of Mexican patenting activities (1952-1965) a Mexican female inventor was involved in that specific development.

Technology surveillance using the IPC-Technology concordance data

The number of categories in which Mexican inventors participate has increased consistently during the period studied, as can be seen in Table II. In most of the in the period the category of Organic Fine Chemistry is the one with more patent applications being filed, with the exception of 2002 and 2011. This information is useful to monitor for emerging and consolidated technologies in the country profile. For example, it is important to note the presence of patent applications in fields such as Biotechnology and Nanotechnology that have appeared in recent years and are considered priority fields in the current National Development Plan.

Discussion and Conclusions

Patent applications are a good source of information about the inventors in a given country, sector or technological field, although they do not comprise all active inventors, as some might prefer other intellectual property instruments, such as industrial secrecy, according to their invention.

This study, unlike the literature found on patenting activities, has focused on the whole universe of Mexican inventors instead of a segment such as academic inventors or those working on a particular technology. The time span of 20 years for the study begins in 1995 with the inclusion of Mexico to the TCP and ends in 2015. There has been an increase in both patent applications filed and number of inventors throughout the period. This is explained by modern innovation theory, in which firms tend to apply for more patents in order to monopolize a certain technology or have revenues due to its licensing. The way of doing this is by increasing the number of inventors. The gender segregation approach has shown that Mexican female inventors represent a small percentage of the people dedicated

TABLE II
PATENT APPLICATIONS BY TECHNOLOGICAL BRANCH

	1995-2005	2006-2015	Increase
Audio-Visual Technology	16	26	38.46%
Basic communication processes	0	2	100.00%
Basic materials chemistry	42	110	61.82%
Biotechnology	47	79	40.51%
Chemical Engineering	45	67	32.84%
Civil Engineering	62	154	59.74%
Computer technology	18	47	61.70%
Control	11	47	76.60%
Digital Communication	11	8	-37.50%
Electrical machinery, apparatus, Energy	27	129	79.07%
Engine, pumps, turbines	21	53	60.38%
Environmental technology	16	32	50.00%
Food Chemistry	66	156	57.69%
Furniture, games	76	108	29.63%
Handling	80	169	52.66%
IT methods for management	11	20	45.00%
Machine tools	14	23	39.13%
Macromolecular chemistry, polymers	15	49	69.39%
Materials, Metallurgy	43	108	60.19%
Measurement	20	77	74.03%
Mechanical Elements	23	40	42.50%
Mechanical Engineering	25	45	44.44%
Medical Technology	86	146	41.10%
Micro Structural and Nanotechnology	0	4	100.00%
Optics	7	37	81.08%
Organic Fine Chemistry	128	272	52.94%
Other consumer goods	52	70	25.71%
Other special machines	28	61	54.10%
Pharmaceuticals	4	6	33.33%
Semiconductors	2	10	80.00%
Surface technology, coating	20	36	44.44%
Telecommunications	27	25	-8.00%
Textile and paper machines	14	10	-40.00%
Thermal processes and apparatus	14	49	71.43%
Transport	0	0	0.00%

to patenting activities, yet productive and growing.

There have been some difficulties in identifying the inventors gender that could be surpassed, due to the knowledge of the proper names commonly used in Mexico. The certainty of the name identification was 97.82%. As it is clearly seen, this technique has an inherent cultural bias. Some researchers have developed name matching techniques to determine the gender of the inventors, but these cannot be applied to other cultures or in the cases where there are not gender distinctive naming conventions.

We have not been able to cross-match inventors names retrieved from the patent applications with other databases, as the coincidences with publicly known inventors, such as the academic researchers found in Web of Science publications were not significant. There have not been any national surveys on inventors, although there have been some efforts to contact the inventors listed in patent titles granted by the Mexican patent office (IMPI; Meza-Rodríguez *et al*., 2015).

Participation of Mexican female inventors is high, accounting for 12.63% of the total inventors in the universe of patent applications, in relation to historical studies which account for female participation between 2 to 14% of total patenting in many countries (Mauleón and Bordons, 2010; Sugimoto *et al*., 2015). The participation of female inventors in patenting activities is outstanding, given the proportion of labor force represented by women in Mexico.

There is a strong relationship between the patenting activity of Mexican inventors, and the IPC section of Human Necessities. This is also proven by the use of the IPC-Technology Concordance Table, which shows the largest amount of patent applications in the technological field of Organic Fine Chemistry for both female and male Mexican inventors, a finding relating to the strongest technological areas in which Mexican inventors participate. Further study could show consistency with the academic subjects and industries developed in the country, technological fields that are likely to be the most productive in future periods. It is also important to note the presence of patent applications in novel areas of technology, such as biotechnology and medical technology, that could represent fields of future growth in number of patents.

The gender gap between technological fields has also been explored in other studies, and the results obtained herein are similar to those using national (USPTO, OEPM) or regional (EPO) databases (Naldi *et al*., 2004; Giuri *et al*., 2007; Frietsch *et al*., 2009; Mauleón and Bordons, 2010; Sugimoto *et al*. 2015).

The differences between male and female Mexican inventors are accentuated by the fact that male inventors often use single-authored patent application, while mixed inventor teams are medium sized. This results in the fact that patent applications with male only inventor teams are presented to the offices by individuals, the inventor himself or his representative being the patent holders. This has been used to establish a co-inventorship index related to the number of inventors collaborating in each patent application which could lead to further studies about the way inventors collaborate in each country. The higher co-inventorship index for mixed inventor teams show a collaboration pattern that might be studied to analyze their conformation. It is worth noting that there is also a high percentage of single authored patent applications within the female only inventor teams, but given the proportion of this subset of the analyzed data we cannot say female inventors prefer to apply alone for patents. They are present more often in mixed inventors teams.

We consider of importance to promote and develop gender desegregated research on a national basis in order to promote or support public policies that attain gender equality in S&T activities and to monitor them throughout the years. The analysis in other time spans and comparison with the results obtained in this study might help forecasting participation of Mexican inventors in patenting activities according to the evolution of the technological fields.

Further Work

The creation of a country specific commonly used names list would be desirable, although it might be a thorough and complicated task that would have to be addressed in an intercultural collaboration group. Given this, the best solution to this problem would be to include an indicator of the gender of inventors in the patent application. As the proposal of adding extra information such as age, level of education or gender to patent information might not seem compatible with the principles of equality and universality of science, it is desirable to complement data obtained by this instrument with other information sources, such as national databases that concentrate this information. No such data has been found in our case.

REFERENCES

AIA (2010) Leahy-Smith American Invents Act. *Public Law 112-29*. September 16, 2011.

Archibugi D (1992) Patenting as an indicator of technological innovation: A review. *Sci. Publ. Policy 6*(19): 357-367.

Atlas (2014) *Atlas de la Ciencia Mexicana*. Academia Mexicana de Ciencias. www.atlasdelacienciamexicana.org.mx.

Balconi M, Breschi S, Lissoni F (2004) Networks of inventors and the role of academia: An exploration. Italian patent data. *Res. Policy 33*: 127-145.

Barroso W, Quoniam L, Pacheco E (2009) Patents as technological information in Latin America. *World Pat. Inf. 31*: 207-215.

Breschi S, Lissoni F, Montobbio F (2007) The scientific productivity of academic inventors: New evidence from Italian data. *Econ. Innov. New Technol. 2*(16): 101-108.

Contreras-Gomez LE, Baquero-Parra R, Robles-Belmont E, Pérez-Angón MA (2015) Patrones de movilidad de los físicos mexicanos en el Sistema Nacional de Investigadores, *Interciencia 40*: 525-532.

Costas R, Bordons M (2007) Algoritmos para solventar la falta de normalización de nombres de autor en los estudios bibliométricos. *Inv. Bibliotecol. Arch. Bibliotecol. Inf 21*(42): 13-32.

Ding W, Murray F, Stuart TE (2006) Gender differences in patenting in the academic life sciences. *Sciencw 313*: 665-667.

Frietsch R, Schmoch U (2006) Technological structures and performance reflected by patent indicators. In Schmoch U, Rammer C, Legler H (Eds.) *National Systems of Innovation in Comparison. Structure and Performance Indicators for Knowledge Societies*. Springer. Dordrecht, Netherland. pp. 89-105.

Frietsch R, Haller I, Funken-Vrohlings M, Grupp H (2009) Gender-specific patterns in patenting and publishing. *Res. Policy 38* (4): 590-599.

Giuri P, Mariani M, Brusoni S, Crespi G, Francoz D, Gambardella A, Garcia-Fontes W, Geuna A, Gonzales R, Harhof D, Hoisl K, LeBas C, Luzzi A, Magazzini L, Nesta L, Nomaler O, Palomeras N, Patel P, Romanelli B, Verspagen B (2007) Inventors and invention processes in Europe. Results from the PatVal-EU survey. *Res. Policy 36*: 1107-1127.

González-Brambila C (2014) Social capital in academia. *Scientometrics 101* (3): 1609-1625.

Guzmán Chávez A, López-Herrera F, Venegas-Martínez F (2012) Un análisis de co-integración entre patentes y crecimiento económico en México, 1980-2008. *Inv. Econ. 71*: 83-115.

Guzmán A (2012) Women inventors: the challenges of incorporating women to innovation activities in emerging countries. The case of Mexico. *Int. J. Sci. Adv. Technol. 2*(11): 54-60.

Hernández-García Y, Chamizo JA, Kleiche-Dray M, Russel JM (2016) The scientific impact of Mexican steroid research 1935-1965: A bibliometric and historiographic analysis. *J. Assoc. Inf. Sci. Technol. 67*: 1245-1256.

INEGI (2015) *Temas Estadísticos*. Instituto Nacional de Estadística y Geografía. Mexico. www3.inegi.org.mx/sistemas/temas (Cons. 12/ 2015)

Jung T, Ejermo O (2014) Demographic patterns and trends in patenting: Gender, age, and education of inventors. *Technol. Forecast. Soc. Change 86*: 110-124.

Kieff F (2001) Facilitating scientific research: Intellectual property rights and the norms of science- A response to Rai and EisenbergLong, J. S. (1990) The origins of sex differences in science. *Soc. Forces 68*: 1297-1315.

Loise V, Stevens A J (2010) The Bayh-Dole act turns 30. *Sci. Translat. Med. 2*: 27-52.

Long J S (1990) The origins of sex differences in science. *Soc. Forces 68*: 1297-1315.

Macías-Chapula C, Mendoza-Guerrero J, Rodea-Castro I, Gutiérrez-Carrasco A (2006) Construcción de una metodología para identificar investigadores mexicanos en bases de datos del ISI. *Rev. Esp. Docum. Cient. 29*: 220-238.

Marmolejo-Leyva R, Perez-Angon MA, Russell JM (2015) Mobility and international collaboration: Case of the Mexican scientific diaspora. PLoS ONE *10(6)*: e0126720.

Mauleón E, Bordons M (2006) Productivity, impact and publication habits by gender in the area of Materials Science. *Scientometrics 66*: 199-218.

Mauleón E, Bordons M (2010) Male and female involvement in patenting activity in Spain. *Scientometrics 83*: 605-621.

McMillan GS (2009) Gender differences in patenting activity: An examination of the US biotechnology industry. *Scientometrics 80*: 683-691.

Meza-Rodriguez N, Millan-Quintero G, Perez-Angon MA (2015) Patentes mexicanas del Distrito Federal: caracterización y áreas tecnológicas (2009-2012). Investigacion Bibliotecologica.

Millan-Quintero G, Meza-Rodriguez N (2015) Los miembros del Sistema Nacional de Investigadores (SNI) mexicano: un acercamiento desde la producción de patentes 2003-2012. *Interciencia 40*: 840-846.

Naldi F, Luzi D, Valente A, Vannini P (2004) Scientific and technological performance by gender. In Moed HF, Glänzel W, Schmoch U (Eds.) *Handbook of Quantitative Science and Technology Research*. *The Use of Publication and Patent Statistics in Studies of S&T Systems*. Kluwer. Dordrecht, Netherland. pp. 299-314.

OECD (1994) *The Measurement of Scientific and Technological Activities. Using Patent Data as Science and Technology Indicators. Patent Manual 1994*. OECD/GD(94)114. Paris, France.

OECD Employment (2006) *Women in Scientific Careers: Unleashing the Potential*. Vol. 2006, Nº 9, pp. i-209. www.aic.ca/gender/pdf/OECD_Careers.pdf. (Cons 04/2015).

OECD (2011) *Report on the Gender Initiative: Gender Equality in Education, Employment and Entrepreneurship*.

OECD iLibrary (2011) *Women in Science*. www.oecd-ilibrary.org/education/women-in-science_hemp-v22-art3-en?crawler=true. (Cons 04/2015).

Patel P, Pavitt K (1995) Patterns of technological activity: their measurement and interpretation. In Stoneman P (Ed.) *Handbook of the Economics of Innovation and Technological Change*. Wiley. Chichester, RU. pp. 14-51.

Ruíz-Pérez R, López-Cózar ED, Jiménez-Contreras E (2002) Spanish personal name variations in national and international biomedical databases: implications for information retrieval and bibliometric studies. *J. Med. Libr. Assoc. 90*: 411-430.

Schmoch U, Hinze S (2004) Opening the Black Box. In Moed HF, Glänzel W, Schmoch U (Eds.) *Handbook of Quantitative Science and Technology Research*. *The Use of Publication and Patent Statistics in Studies of S&T Systems*. Kluwer. Dordrecht, Netherland. pp. 215-235.

Stephan PE, El-Ganainy A (2007) The entrepreneurial puzzle: Explaining the gender gap. *J. Technol. Transf. 32*: 475-487.

Sugimoto CR, Ni C, West JD, Larivière V (2015) The academic advantage: Gender disparities in patenting. PLoS ONE 10(5): e0128000.

Toivanen H, Suominen A (2015) The global inventor gap: Distribution and equality of world-wide inventive effort, 1990-2010. PLoS ONE 10(4): e0122098.

UN Millennium Project (2005) *Investing in Development: A Practical Plan to Achieve the Millenium Development Goals*. United Nations. New York, NY, USA. www.unmillenniumproject.org/reports/fullreport.htm (Cons. 05/2015).

United Nations (2015) *Millennium Development Goals and Beyond*. www.un.org/millenniumgoals/gender.shtml (Cons. 04/2015).

UNU (2006) Using science and technology indicators to support knowledge based economies. Policy Brief. Nº II. United Nations University. Tokyo, Japan.

US Census Bureau (2015) www.census.gov/topics/population.html (Cons. 04/2015).

US GAO (2015) *Science, Technology, Engineering, and Mathematics Education: Assessing the Relationship between Education and the Workforce.* GAO14-374. US Government Accountability Office. Washington DC, USA. 80 pp. www.gao.gov (Cons. 04/2015).

Walsh JP, Nagaoka S (2009) Who invents?: evidence from the Japan-US inventor survey, RIETI Discussion papers.

Whittington K (2011) Mothers of invention?: gender, motherhood, and new dimensions of productivity in the science profession. *Work Occup. 38*: 417-456.

Whittington K, Smith-Doerr L (2005) Gender and commercial science: Women's patenting in the life sciences. *J. Technol. Transf. 30*: 355-370.

Whittington KB, Smith-Doerr L (2008) Women inventors in context. Disparities in patenting across academia and industry. *Gender Soc. 22*: 194-218.

WIPO (2015a) PATENTSCOPE. World Intellectual Property Organization. Geneva, Switzerland. www.wipo.int/patentscope/en/ (Cons. 04/2015).

WIPO (2015b) www.wipo.int/ipstats/en/statistics/technology_concordance.html World Intellectual Property Organization. Geneva, Switzerland. (Cons. 05/2015).

WISET (2016) www.wiset.or.kr/eng/

World Bank (2015) World Bank Open Data. http://data.worldbank.org/ (Cons. 12/2015).

ANÁLISIS DE LOS INVENTORES MEXICANOS DESAGREGADOS POR GÉNERO EN SOLICITUDES DE PATENTES BAJO EL TRATADO DE COOPERACIÓN EN MATERIA DE PATENTES (PTC)

Berenice Cepeda Zetter, Claudia González Brambila y Miguel Ángel Pérez Angón

RESUMEN

Siguiendo las recomendaciones de la Organización para la Cooperación y Desarrollo Económico, hemos utilizado la información de patentes contenida en la base de datos de consulta PATENTSCOPE como un indicador de innovación tecnológica con el fin de analizar la participación de los inventores Mexicanos en las solicitudes de patentes en un periodo de veinte años (1995-2015). Se realizó el análisis tomando en cuenta el género de los inventores para contrastar la participación de hombres y mujeres. Se muestran algunos indicadores tales como participación, contribución y presencia. Los resultados del estudio establecen que las inventoras Mexicanas participan en los títulos de patentes con un equipo de inventores pequeño a mediano (de acuerdo al número de inventores enlistados), mientras los inventores Mexicanos tienden a hacerlo en solitario. Se establece también que el área tecnológica en la que los inventores Mexicanos hombres y mujeres tienen mayor participación es la de Química y Metalurgia. Los resultados revelan disparidades de género que deberían atenderse mediante políticas públicas para alcanzar las Metas del Milenio y las Metas de Sustentabilidad y Desarrollo establecidas por la ONU, así como promover la equidad de género en las actividades relacionadas con Ciencia y Tecnología.

ANÁLISE DOS INVENTORES MEXICANOS DESAGREGADOS POR GÉNERO EM SOLICITAÇÕES DE PATENTES SOB O TRATADO DE COOPERAÇÃO EM MATÉRIA DE PATENTES (PCT)

Berenice Cepeda Zetter, Claudia González Brambila e Miguel Ángel Pérez Angón

RESUMO

Seguindo as recomendações da Organização para a Cooperação e Desenvolvimento Econômico, temos utilizado a informação de patentes contida na base de dados de consulta PATENTSCOPE como um indicador de inovação tecnológica com a finalidade de analisar a participação dos inventores Mexicanos nas solicitações de patentes em um período de vinte anos (1995-2015). Foi realizada a análise levando em consideração o género dos inventores para contrastar a participação de homens e mulheres. São mostrados alguns indicadores tais como participação, contribuição e presença. Os resultados do estudo estabelecem que as inventoras Mexicanas participam nos títulos de patentes com uma equipe de inventores entre pequena a média (de acordo com o número de inventores listados), por sua vez, os inventores Mexicanos tendem a fazê-lo à sós. Foi estabelecido também que as áreas tecnológicas nas quais os inventores Mexicanos, homens e mulheres, têm maior participação são as de Química e Metalurgia. Os resultados revelam disparidades de género que deveriam ser atendidas mediante políticas públicas para alcançar as Metas do Milênio e as Metas de Sustentabilidade e Desenvolvimento estabelecidas pela ONU, assim como promover a equidade de género nas atividades relacionadas com Ciência e Tecnologia.