The Global Gender Gap in Innovation and Creativity

An International Comparison of the Gender Gap in Global Patenting over Two Decades

WIPO Development Studies

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Abstract: This report analyzes women's participation in international patent applications between 1999 and 2020 and finds that women are involved in only 23% of all applications, representing 13% of all inventors listed. Women's participation in patenting varies across regions, sectors, and industries, with higher representation in biotechnology, food chemistry, and pharmaceuticals, and lower in mechanical engineering. Women inventors are more prevalent in academia than in the private sector, and typically work in mostly-male teams or alone. Achieving gender parity will require significant effort, with an estimated target year of 2061 based on current trends.

Acknowledgments: This report was developed under the general direction of Marco Alemán (Assistant Director General) and Carsten Fink (Chief Economist). Elodie Carpentier's work on this report was also supported by a fellowship with Invent Together (https://inventtogether.org/). We are grateful to Megan Aanstoos, Jennifer Brant, Khari Cyrus, Holly Fechner, Intan Hamdan-Livramento, Joni Laura, Federico Moscatelli, Kristine Schlegelmilch, and Morgan Schreurs for their valuable comments throughout the preparation of this report. Our gratitude extends to Michael Falk (IP Australia), Alvaro Gonzalez (INAPI), Christopher Harrison (UKIPO), Connor Morgan (UKIPO), Annita Nugent (IP Australia), Michelle Saksena (USPTO), Andy Toole (USPTO), and Fabiana Visentin (UNU-MERIT), who kindly agreed to review this report prior to publication and provided valuable insights and suggestions.

Executive summary

Innovation is a major driver of economic growth, but the underrepresentation of women among inventors hinders their contribution to innovation.

This report examines women's participation in PCT international patent applications from 1999 to 2020 and reveals that women were involved in the inventions behind only 23 percent of all applications, while men were involved in 96 percent. As a result, women represent just 13 percent of all listed inventors in these filings, with an estimated contribution equivalent to only 10 percent of all PCT applications.

The global trends show an increasing participation of women in patenting. In the last available year, women participated in 31 percent of PCT applications and represent 16 percent of listed inventors. Their estimated contribution is equivalent to 14 percent of PCT applications.

Although women's participation in patenting has increased over time, achieving gender parity will take a while. Based on current trends, if the inclusion conditions of the past five years are maintained, we may observe that women inventors will reach the 50 percent target around the year 2061.

Women's participation in patenting varies substantially across world regions, sectors, and industries. When analyzed by region, women inventors account for 21 percent of all listed inventors in the Latin American and Caribbean region, 17 percent in Asia, 15 percent in Northern America, 14 percent in Europe, and 13 percent in Africa and Oceania.

Women inventors tend to be concentrated in specific industries, with little change over time. The fields of biotechnology, food chemistry, and pharmaceuticals have the highest rates of women inclusion, whereas fields related to mechanical engineering have far fewer women inventors.

The technological specialization of countries and regions can indicate their rankings of gender inclusion to a great extent. Although the national specialization significantly alters the ranking for a few countries, for most countries their technological specialization is not the main factor in the gender gap in patents. While differences between technological industries are relatively stable over time, there is more heterogeneity and fluctuation across countries.

Women inventors are more prevalent in academia (21 percent) than in the private sector (14 percent). Nevertheless, patent applications coming from academia represent only a minor share of the total.

While women's participation in patenting is on the rise, an examination of the gender composition of inventor teams shows that all-women teams are very rare, and women are seldom the numerical majority in mixed teams. Women work more frequently alone than in all-women teams or teams where they are the majority.

Furthermore, the decrease in the share of individual patenting explains much of the positive trend in global inclusion over the last two decades. We observe that the share of patents with only one man inventor decreases in all regions, while the share of one woman inventor only increases substantially in Asia. In virtually all regions, teams composed mostly of men increased more than gender-balanced teams or women-majority teams.

1 Introduction

Innovation relies on the ideas and discoveries of men and women from all over the world, of all ages and all origins. Yet statistics show that women have been and remain underrepresented inventors in comparison to their proportion of the population around the world (UKIPO, 2016; UKIPO, 2019; Martinez, Raffo, Saito, et al., 2016; OECD, 2018).

There are several reasons why women hold fewer patents on innovations than men. One hypothesis is that women may be less attracted to math-intensive fields, which produce most inventions. However, statistics show that women earn more bachelor and master degrees in Science, Technology, Engineering and Mathematics (STEM) than men (Huyer, 2015). Moreover, Delgado and Murray (2022) show that in the United States, this rationale only explains part of the gender gap in innovation.

Others factors behind women's lower participation in patenting include the socio-economic context of the family in which they grew up as girls, but also that in which they pursue their women's life (Bell et al., 2019; Hoisl, Kongsted, and Mariani, 2022), including their care-giving responsibilities (Delgado, Mariani, and Murray, 2019; Kim and Moser, 2021; Whittington, 2011), work environment, in particular their specialization and sector of employment (Eaton, 1999; Sugimoto et al., 2015; Whittington and Smith-Doerr, 2008), and the culture and institutions of their country (Jensen, Kovács, and Sorenson, 2018; Khan, 1996; Zosa, 2019).

Based on this research, this report exhaustively explores and contrasts gender differences in international patenting across regions, countries, sectors and industries, and their evolution over time. It also raises new questions for future research on the determinants of the patenting gender gap.

This report builds upon previous reports measuring the gender gap in patenting, at both the national (e.g. Miguelez et al., 2019; A. A. Toole et al., 2020; Huang, Finch, and Patrick, 2022) and international level (Martinez, Raffo, Saito, et al., 2016; UKIPO, 2016; UKIPO, 2019; OECD, 2018). It contributes to this line of research in three ways. First, it makes a technical contribution by including novel data on Chinese and Korean inventors in their original characters. Most prior gender studies had either ignored these inventors or had to rely on Romanized versions of their names, reducing the precision of the gender attribution (Martinez, Juano-i-Ribes, et al., 2021). In this report, we make

use of the most recent gender dictionary and international patenting databases, all containing names in their original characters, to update and increase the global coverage of statistics on women's participation in patenting.

Second, it contributes to the discussion on the various metrics used to characterize women's participation in patenting. This report builds on the recent literature on gender gap in patenting to review the existing metrics, and describe their respective strengths and weaknesses (Delgado and Murray, 2022; A. A. Toole et al., 2020; Cutura, 2019).

Third, it deepens the analysis of the inventors' teams by extending Martinez, Raffo, Saito, et al. (2016)'s first exploration of the role of gender. The report looks at the composition of inventors' teams in terms of size and gender, providing a finer-grained perspective on the dynamics of women's integration over time.

The report is organized as follows. In section 2 we introduce our data and discuss the strengths and weaknesses of different indicators to measure women's participation to patenting. We then report our empirical findings in section 3 and conclude in section 4.

2 Data and Methodology

In this section, we describe the source of our data and the matching procedure to identify the gender of inventors. We then discuss the different indicators that we use to measure women's participation to patenting.

2.1 Data

The analysis in this report relies mostly on three data sources: the PCT Patent Database, the World Gender-Names Dictionary, and partly PatentScope.

The PCT dataset includes 3,687,219 international patents applications from inventors in 198 different countries and territories and from 1999 to 2020. On average over the period, most PCT applications were filed by applicants in Europe (35 percent), Northern America and Asia (31 percent each), Oceania (1.4 percent), LAC (0.7 percent), Africa (0.3 percent). The gender of inventors is not reported on applications, therefore we split the full names of all 10,381,461 inventors listed

on the applications into first names and surnames and match the first names and locations to the latest World Gender-Names Dictionary (Martinez, Juano-i-Ribes, et al., 2021; Raffo, 2021).[1] For Chinese and Korean inventors, we use the first names in original characters from the PCT application when available (19 percent of applications), or retrieve their names in original characters on the subsequent national phase application when available in PatentScope (54 percent of applications). For Chinese and Korean inventors on the remaining 27 percent applications, we assigned gender based on their Romanized first names. Please refer to Figure A1 in Appendix for more details on the selection of data source for gender assignment.

Doing so, we were able to match 96 percent of inventors with a gender by assigning a gender to each inventor-territory pair when the dictionary reports a likelihood of at least 60 percent. [2] Below this threshold, the gender is considered unknown. With this rule, 13 percent of inventors in the PCT dataset are most likely women, 82 percent are most likely men and the remaining 5 percent are too ambiguous (e.g. unisex names) and therefore unassigned. As in previous studies, the name matching approach is less conclusive when considering PCT inventors from Asia, resulting in 10 percent unattributed names. This result is expected considering the higher gender ambiguity of names in Asia (Jiang-de Yu, Zheng, and Yu, 2014; Park and Yoon, 2007). All other regions have 3 percent or lower unattributed rates: North America has a 3 percent unattributed rate, Africa and Oceania 2 percent, Europe and Latin America and the Caribbean 1 percent.

For the analysis, we remove all patents for which we could not predict the gender of at least one inventor. This leaves us with a final dataset of 2,987,388 patents (81 percent of the initial dataset) in which the gender of all inventors is identified. Of the 7,635,406 unique inventors, 12 percent are most likely women and 88 percent most likely men. Note that for the 19 percent of patents for which we could not determine the gender of at least one inventor, the inventor teams are on average larger than for the patents we use in this report. This means that our analyses of teams may be biased in favour of the relatively smaller teams.

[1] We perform only one iteration of the first name with country of residence, then the first name and language expansion, and finally the first name without taking location into account. The latter approach differs from Martinez, Raffo, Saito, et al. (2016) who perform several iterations on the different first names listed. The risk of this approach is that the second or third name is not equally informative about gender, or even misleading in some cases, depending on the country of origin. Given the uncertainty, we prefer to reduce the risk of false positives, even though it reduces the coverage of Asian countries, in particular China and the Republic of Korea.

[2] There is no obvious reason to prefer a threshold to another. Yet, the key findings are found robust when using the gender probabilities as fractions of inventors by gender. The results are available upon request.

2.2 Selected metrics

Prior studies have used various metrics to measure women's contribution to patenting: the share of patents with at least one woman as inventor (ATL), the share of patents that can be attributed to women inventors (women's share of total patenting - WSP) and the proportion of inventors who are women (women inventor rate - WIR). These three simple metrics, or inclusivity scores, offer distinct and complementary views on women's participation in patenting. Building on them, Delgado and Murray (2022) introduced the inclusivity index that uniquely accounts for technological specializations at groups level.

2.2.1 Inclusivity scores

The share of patents with at least one woman inventor (ATL) is the most commonly used metric (Martinez, Raffo, Saito, et al., 2016; UKIPO, 2016; UKIPO, 2019; OECD, 2018). This metric is a convenient indicator for two reasons: First, it measures at the patent level, which allows for comparison with all other patent-level indicators; Second, it is directly computable from any patent database, without requiring any additional step (such as disambiguation of inventors) beyond identifying the gender of inventors. However, if women are a minority among men on inventor teams, this indicator will have the disadvantage of tending to overestimate women's contribution to patenting. A relevant consequence of such limitation is that this indicator does not offer a clear target for policy-makers. Women may contribute to more than half of the inventions and still represent a minority in most teams of inventors. Indeed, as we will see in section 3.3, women presence in teams has improved but it is far from the fifty percent target.

The second, much less common metric, is women's share of total patenting (WSP). It consists of assigning an equal fraction of the patent to each of its inventors and summing up the shares by inventors' gender. As for ATL, the WSP's underlying unit is a patent. Contrary to ATL, WSP does a better job at weighting women's contributions to patenting and has the advantage of still not requiring the disambiguation of inventors. A fifty percent target is appropriate when using WSP, as it is measuring the contribution of women and men with the same weight.

The women inventor rate (WIR) is the third indicator. It is the percentage of unique women inventors across all patents granted in a given year. When inventors are fully individualized, this indicator overcomes the limitations of the two prior indicators, as it can describe women's

contribution to patenting both in terms of labor force participation and per capita productivity. A proper calculation requires using individual inventors, as opposed to listed inventors, since listed inventors are duplicated each time they are reported on a new patent application. If a gender is more prolific than the other, then the indicator will be biased to the advantage of this gender. Nevertheless, in the absence of individual inventors, listed inventors constitutes a second best option to compute this indicator.

Studies of the gender gap in patenting at a global scale have historically only used the first metric, i.e. the share of patent with at least one woman as inventor (Martinez, Raffo, Saito, et al., 2016; UKIPO, 2016; UKIPO, 2019; OECD, 2018). A U.S. study, the Progress and Potential Report (Miguelez et al., 2019; A. A. Toole et al., 2020), shows that this metric tends to overestimate the presence of women in IP, as opposed to the WIR.

2.2.2 Inclusivity index applied to technologies

Based on the robust findings that women's participation rates vary greatly across technology classes, the inclusivity index is conceived to allow the comparison of groups with different technological specializations, such as countries or organizations, by neutralizing the influence of such specializations (Delgado and Murray, 2022).

Let's take the example of countries as groups and the women inventor rate as a score. In each technology class, a country's WIR is normalized to the world average and then weighted by the country's share of patents in that class. The inclusivity index is simply computed as the sum of all classes' normalized and weighted WIR, as follows:

$$Inclusivity\ Index_{country} = \sum_{tech=1}^{tech=35} Share\ Patents_{country}^{tech} \times \left(WIR_{country}^{tech} - WIR_{world}^{tech}\right) \quad (1)$$

In the next section, we first compare the three inclusivity scores, and then use the women inventor rate in the main analysis (including, where relevant, the inclusivity index derived from it). To check the robustness of our results, we reproduce in the appendix all the indicators using alternatively the share of patents with at least one woman as inventor and women's share of patenting. Notably, the metric chosen affects the magnitude of the gender gap that is measured, but usually not the typical trends and patterns observed.

3 Findings

In this section, we first describe the three metrics at a global scale, and their evolution over time. Then, we explore women inventor rates across regions, countries, academic and private sectors, and industries in four different time periods. We close with a characterization of the gender composition of inventor teams.

3.1 A global perspective on the gender gap

3.1.1 Description of the selected metrics

From the most comprehensive point of view, i.e. including data from the two decades and all the countries of the world, we find that 23 percent of patents include at least one woman as a listed inventor, while 96 percent of patents include at least one man as an inventor.

Only 4 percent of international patents are invented exclusively by women (either as a single inventor or as a team of women inventors). Similarly, UKIPO (2016) previously calculated that women were exclusive inventors on 2.2 percent of national and international phase patents.

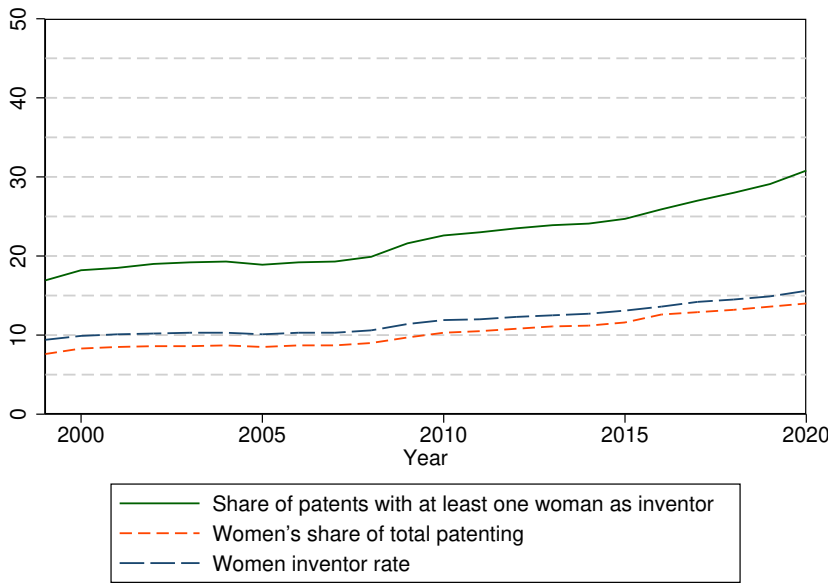
In terms of contribution to innovation, women generated one in ten patents while men produced the other nine. Finally, thirteen percent, or one in eight listed inventors in the world is a woman.

3.1.2 Time trends

Despite these numbers, from the global perspective, women's participation and contribution to innovation has evolved positively over time. Figure 1 presents the levels of the three metrics and their evolution over the past two decades. On the one hand, the share of patents with at least one woman as inventor has increased from less than 20 percent in 2000 to 30 percent in year 2020. On the other hand, the fraction of patents that can be attributed to women and the share of listed inventors that are women show lower levels and a slower progression, from 8-10 percent at the beginning of the period to 13-15 percent by the end.

The gap between the rate of women inventors and women's share of patents may reflects women's lower propensity to work alone as compared to men, among other factors such as business

Figure 1: Three indicators of women contribution to patenting



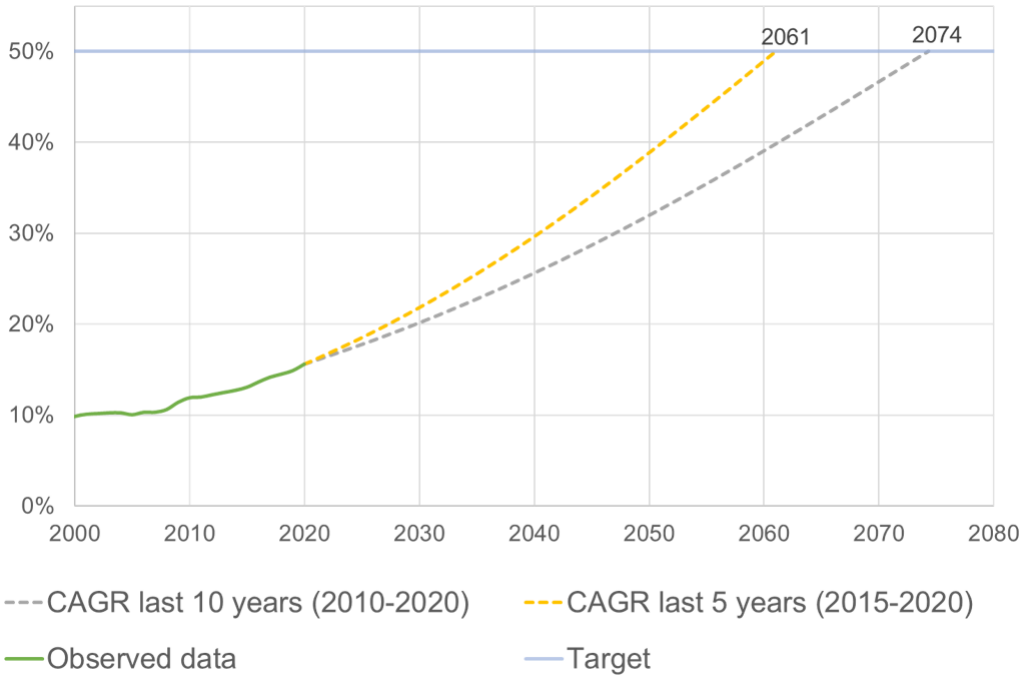
support and access to legal representation. This also suggests that the progression of women participation in patenting is not the same when considering groups of inventors rather than individuals. We will explore this further in section 3.3.

3.1.3 Expected year of gender parity

An interesting finding in Figure 1 is that women's participation in patenting has slightly accelerated over the last five years, particularly when considering the share of patents with at least one woman as inventor. Moreover, in a side calculation, we find that the number of listed women inventors has increased by 174 percent worldwide between the periods 2001-2005 and 2016-2020. The growth rate is positive in all regions: 808 percent in Asia, 240 percent LAC, 87 percent in Europe, 67 percent Northern America, 39 percent in Africa and 13 percent in Oceania.

What does this mean for the prospects of achieving gender parity? Figure 2 forecasts the evolution of the women inventor rate in the world if the inclusion conditions of the past five and ten years are maintained, respectively. Given that the inclusion conditions have improved over the past five years, we observe that gender parity – i.e., 50-50 – will likely happen in about 38 years, that is, around the year 2061. This forecast is 13 years earlier than if we consider the trends of the last

Figure 2: Forecast of the year of gender parity in patenting worldwide



Notes: data reflects observed and estimated women inventor rates; CAGR = Cumulative Average Growth Rate.

decade. Similarly, seven years ago, Martinez, Raffo, Saito, et al. (2016) foresaw that gender parity would likely be achieved by 2079.[3] This trend is encouraging, as with each forecasting exercise we seem to observe that gender parity predictions are getting closer over time.

However, this optimistic prediction is based on the naïve assumption that women will remain in similar conditions to those of the past half-decade. The occurrence of major force events can significantly delay the expected year of gender parity in patenting. For example, research shows that women's scientific output has been negatively affected by the recent COVID-19 pandemic (Gao et al., 2021) and the increase in domestic workloads has likely affected women in all sectors.

Moreover, even if recent trends continue, parity might not be achieved everywhere at the same time. Current trends in different regions of the world yield very different parity forecasts. As shown in the left panel of Figure 3, we can expect Northern America to be the first region to reach parity, around 2055, if we consider only the last five years. Under the same assumption, Asia will

[3]Martinez et al. used similar forecast methods, but not exactly the same.

achieve parity at almost the same time (2056), while Latin America and the Caribbean will take over a decade longer (2068). Europe and Oceania – both of which are expected to reach parity by 2088 – will take more than three decades longer than Northern America and Asia.

Comparing the five- and ten-year forecasts – i.e., the left and right panels of Figure 3 – provides insight into recent trend changes. The Asias and European regions observe no change in their forecasts when moving from five to ten years. This suggests that these countries have remained fairly stable over the past decade. Conversely, the other three regions have experienced a significant progression over the past five years.

These regional differences can be the consequence to some inclusion dynamics that are related to geographical or cultural aspects, as well as the result of successful inclusion policies and programs. In any case, it is worth exploring in further detail what could be behind these gender gap differences across the world. The next section will attempt to explore different dimensions of the gender gap in invention.

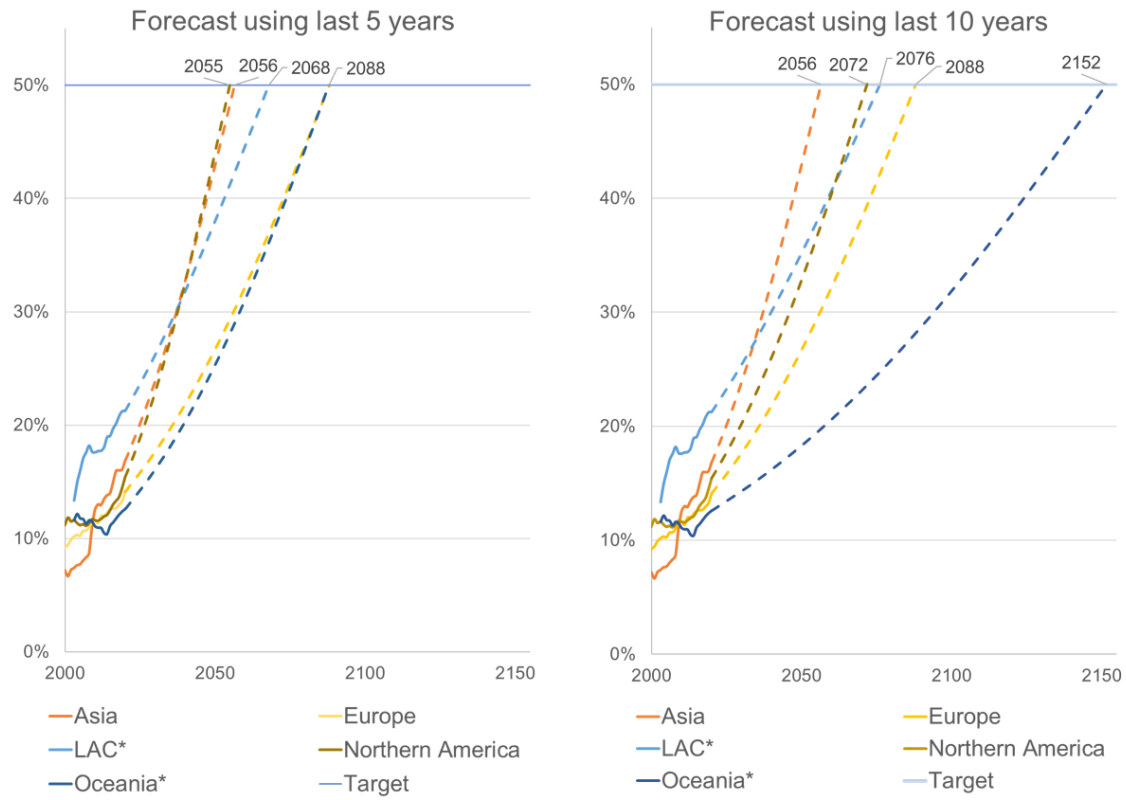
3.2 Gender gaps across regions, sectors and industries

3.2.1 Regions and countries

The participation of women in patenting varies across countries and regions. Splitting the past two decades (1999-2020) into four five-year periods, we plot in Figure 4 the women inventor rate (WIR) in the different world regions.[4] Latin America and the Caribbean (LAC) shows leadership in women's participation in patenting over time, with 16 percent of inventors being women in 2001-2005 and this proportion increasing to 21 percent in the most recent period, 2016-2020. As we will see in subsection 3.2.3, in patenting, the academic sector is more gender inclusive than the private sector. In Latin America and the Caribbean, the academic sector contributes relatively more to the region's patenting than in other regions. This could explain, in part, this exceptional performance of the region, but further research is needed to fully understand the different reasons and their explanatory power. Asia shows the fastest growth, from the world's lowest rate of women inventors in 2001-2005 (7.5 percent) to the world's second highest rate, behind LAC, in 2016-2020 (16 percent). It would be interesting to investigate the policy changes that might have occurred in Asia to bring about this rapid growth. While Africa and Europe steadily improve over time, the rate of women inventors decreased

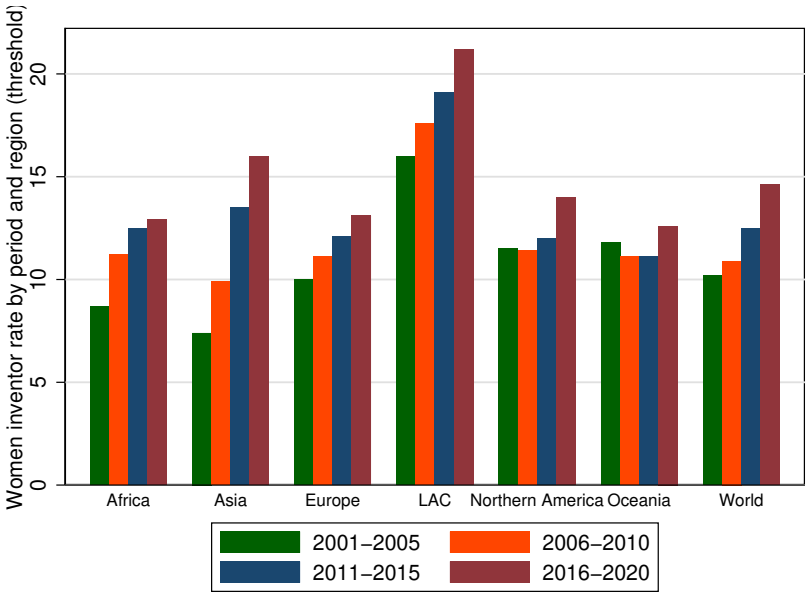
[4] Countries and territories are defined and grouped according to the classification of the United Nations Statistics Division.

Figure 3: Predicted year of gender parity in patenting for each region using the pace of the last 5 years



Notes: Data reflects observed (solid lines) and estimated (dashed lines) women inventor rates for the regions, as defined by the UN Statistics Division; LAC = Latin America and the Caribbean; (*) The series have been smoothed due to the low number of patents; Africa is omitted due to an insufficient number of observations.

Figure 4: Women inventor rate (WIR) by region and time periods



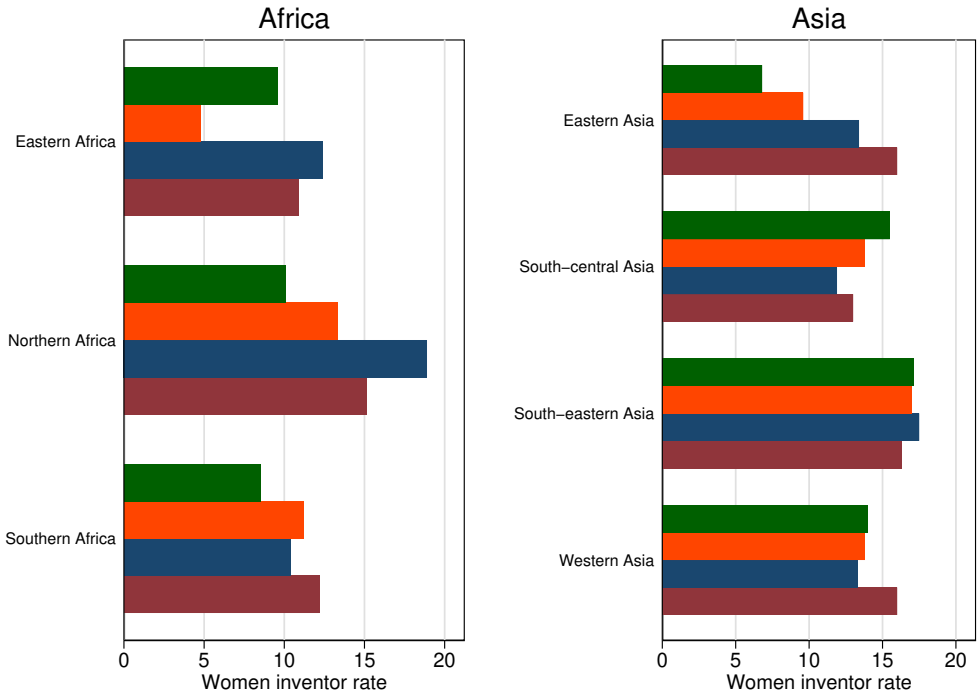
Notes: Regions as defined by the UN Statistics Division; LAC = Latin America and the Caribbean.

in North America and Oceania from 2001 to 2010, before increasing again in the following decade. This last period increase explains the significant improvement in the forecast observed earlier in Figure 3.

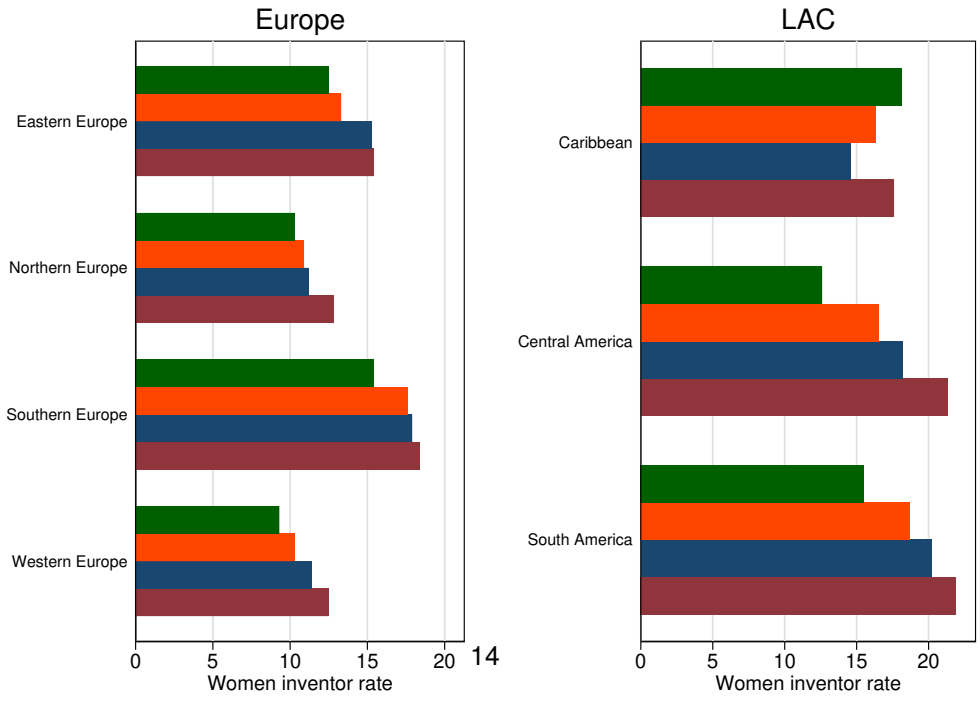
These patterns are consistent using the two alternative metrics (i.e., the share of patents with at least one woman and women's share of total patenting, see Figures A2 and A3 respectively in Appendix), with one exception. In the most recent period, Latin America and the Caribbean lost its world leadership position by 0.1 percentage points, with only 30.6 percent of patents including at least one woman inventor, compared to 30.7 percent in Asia.

Figure 5: Women inventor rate by sub-region and period

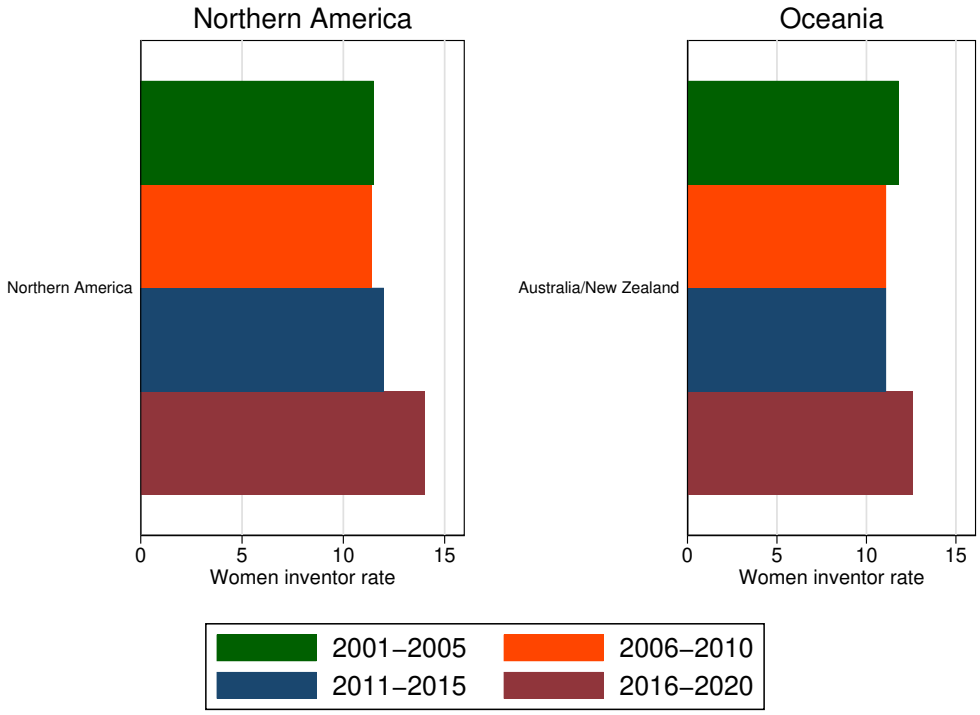
(a) Africa and Asia



(b) Europe and Latin America and the Caribbean



(c) Northern America and Oceania



Notes: The list of countries by sub-region is available in the notes of Appendix Figure A4. Note that countries and territories from Middle Africa and Western Africa, as well as Melanesia, Micronesia and Polynesia are omitted due to the low number of observations in these sub-regions.

An exploration at a more granular level, using the sub-regions, reveals relative homogeneity within the regions (Figure 5). In the African region, Northern Africa shows particularly high rates, but we caution in interpreting the indicators for this region given its low number of patents filed. The large variations between African sub-regions and over time may be due to the small number of observations. Similarly, the rapid evolution observed in Asia is entirely attributable to Eastern Asia, while the other parts of the region are more stationary over time. In Europe, Eastern and Southern countries have the highest rates of women inventors. These trends are confirmed using the two alternative metrics (see Figures A4 and A5 in Appendix).

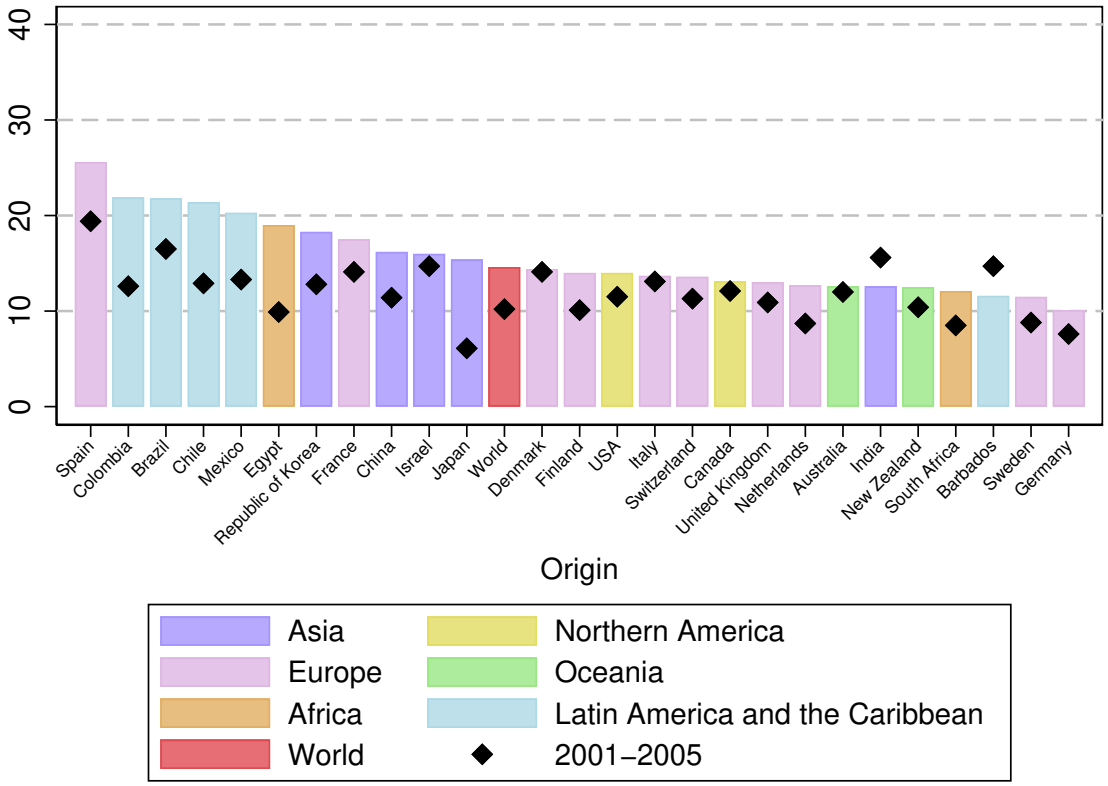
Finally, we look at the top 5 to 10 countries that file 90 percent or more of the patents in each region. Figure 6 reports the women inventor rate in this selection of countries. The bars indicate the values for the most recent period, 2016-2020, while the black diamond indicates the

values from 2001-2005 for comparison. In Spain, 26 percent of inventors are women, which ranks first in the world. Colombia and Brazil follow, with 22 percent of inventors being women in both countries. The Republic of Korea and China were ranked first and second in the previous calculations by Martinez, Raffo, Saito, et al. (2016). The improvement of the gender assignment due to the data on their names in original characters in PatentScope largely explains their fall to the seventh and ninth positions respectively. The only high filing countries that have regressed are India and Barbados, dropping from 16 and 15 percent respectively in the early 2000s to 13 and 12 percent respectively in the most recent period.

The ranking differs substantially for some countries using women's share of patenting (WSP) and the share of patents with at least one woman (ATL) (Figures A6 and A7 in Appendix). In particular, China and the Republic of Korea move up to the third and fifth positions using WSP, and fifth and fourth positions with ATL, respectively. Japan moves from 11th to eighth position with both metrics. In Europe, Sweden also moves up four places in the ranking, regardless of the metric used. Conversely, Italy loses six places in the ranking with both metrics. The most drastic movement occurs for Egypt, falling from a sixth position according to its women rate of inventors to the 25th position according to its share of patents with at least one woman. Finally, the USA pass above the world average with the share of patents with at least one woman among inventors.

When using the share of patents with at least one woman, the Republic of Korea falls to the fifth position and Japan climbs from the 12th to the sixth position. These movements in the ranking likely reflect different paths to include women in inventor teams across countries and cultures. In countries with higher WIR than ATL rankings, such as Egypt and Italy, gender segregation is likely to be more pronounced in teams, so that women work together on some patents, while men work separately on other patented technologies. Conversely, in countries ranked higher on the ATL than the WIR, such as China, the Republic of Korea, and Japan, women are likely to be dispersed across many inventor teams and, because they make up only a small share of the inventor workforce, are likely to be in a numerical minority on teams.

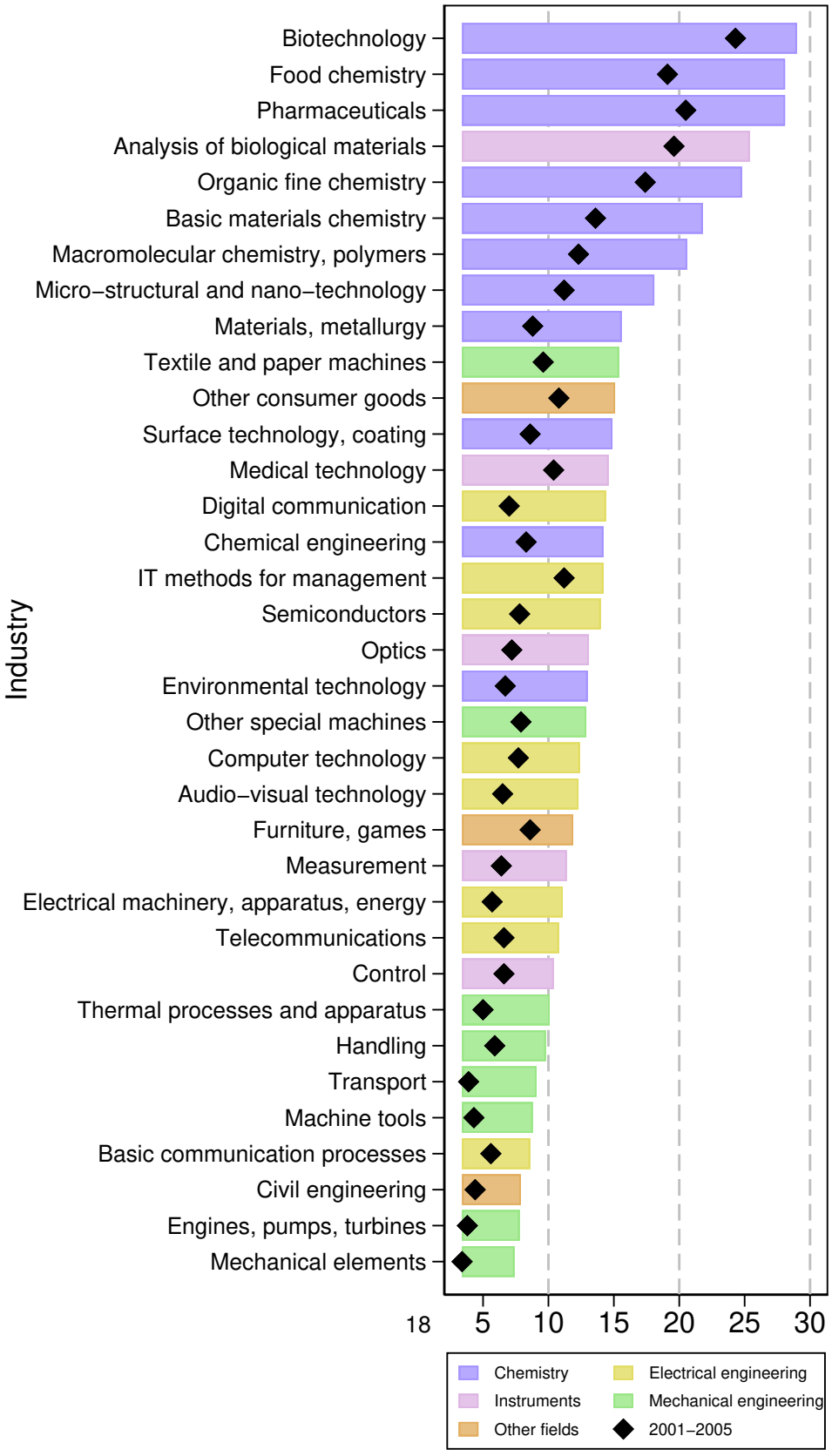
Figure 6: Women inventor rate (WIR) in the top patenting countries, by region (2016-2020)



3.2.2 Technology fields and industries

Countries specialize to varying degrees in the different technological fields (Archibugi and Pianta, 1992). For example, the PCT yearly review (World Intellectual Property Organization, 2022, Figure A21) shows that inventors in the United States are more specialized in biotechnologies than Japan, where inventors are more specialized in semiconductors. Thus, the ranking of countries can be explained in part by their different industrial composition.

Figure 7: Women inventor rate (WIR) in each industry (2016-2020)



Women inventors tend to be concentrated in specific industries, with little change over time. Figure 7 presents the rate of women inventors (WIR) in each technology class.[5] We find the highest rates in the fields of chemistry, with nearly 30 percent of women inventors in biotechnology, food chemistry, and pharmaceuticals. In contrast, we observe far fewer women inventors in the fields of electrical engineering and, even more so, mechanical engineering: Women represent only 10-15 percent of inventors and less than 10 percent respectively. While the levels vary according to the metric considered, the pattern strongly holds across metrics (Figures A8 and A9 in Appendix).

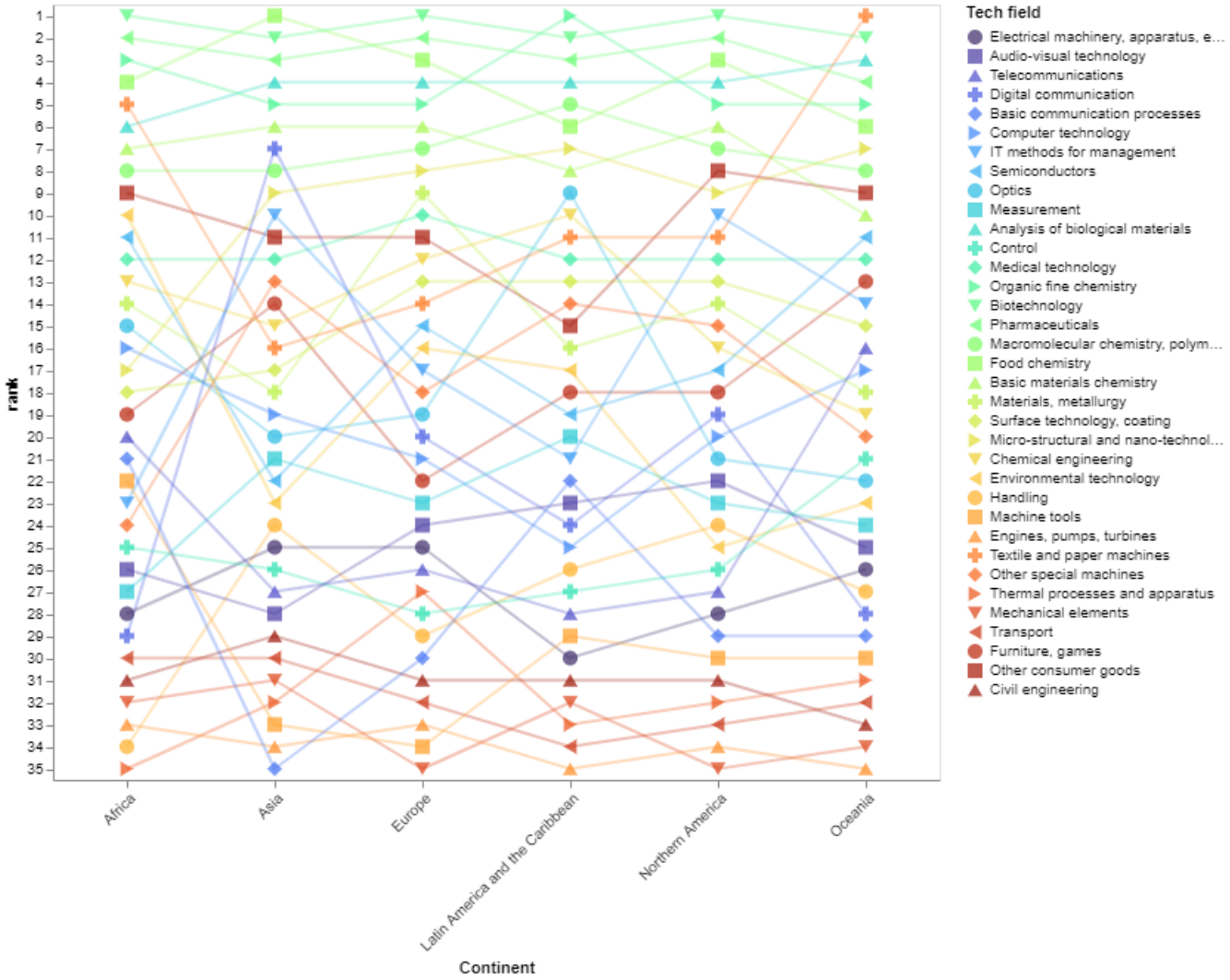
The fields in which women are concentrated vary across regions of the world. In Figure 8, we report the ranking of the technology classes based on the women inventor rate for each region. Regardless of the region, we always find the chemical fields at the top and the mechanical engineering fields at the bottom. The other classes make less consensus and vary more by region. For example, the digital communication field is the 7th most inclusive field in Asia, but ranks 19th and lower in all other regions. On the contrary, the basic communication processes ranks last in Asia against 21st in Africa and 22nd in LAC. The materials and metallurgy field ranks 10th in Europe, and 14th in Africa and Northern America, but is less inclusive in Asia and Oceania with a 18th position. More research is needed on each of these fields to understand why they are more or less inclusive in these regions.

In addition, Figure A20 through Figure A25 in Appendix show that the magnitude of the gender gap in these fields varies considerably across regions.[6] For example, compare mechanical elements and transports as examples of the mechanical engineering field, with biotechnology and pharmaceuticals as examples of the chemistry field. In Africa, Latin America and the Caribbean, Europe and Oceania, the women inventor rate is 7 to 10 times higher in chemistry than in mechanical engineering. It is about 5 times higher in North America, and only 2 times higher in Asia.

[5] We make use of WIPO's technological fields, which group international patent classification (IPC) symbols into 35 fields. Each patent application is classified into one or more technological fields.

[6] We are cautious to interpret the values of the WIR in regions that patent less intensively than others, such as Africa and Oceania. In these regions, the WIR is computed on a small number of observations in some technology classes so that the estimates' variance is higher and confidence is lower.

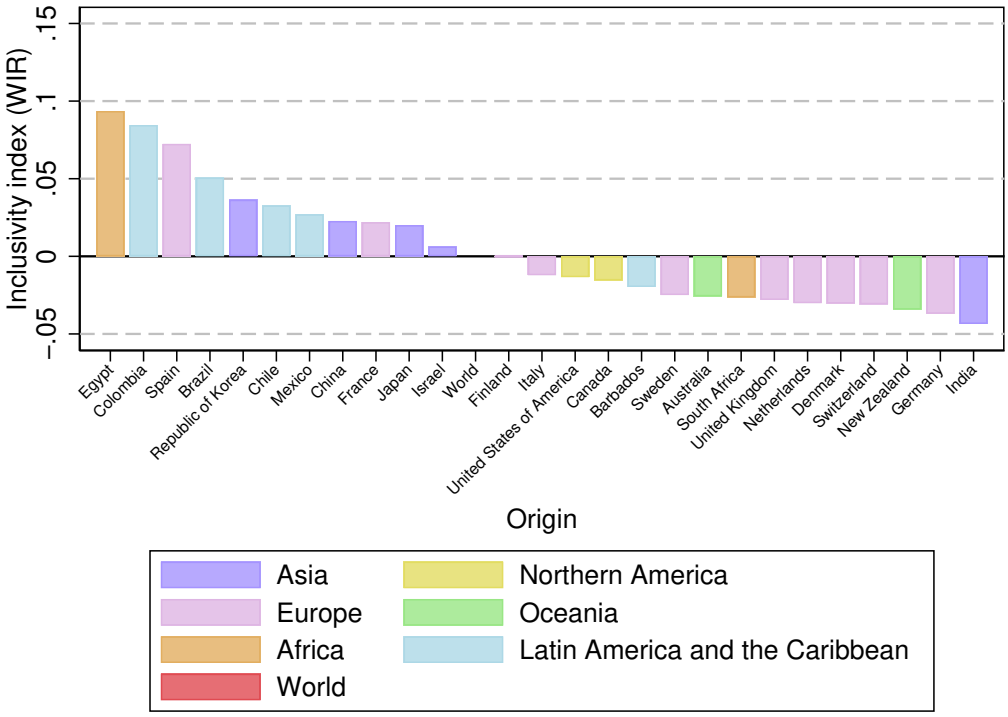
Figure 8: Ranking of technology classes according to WIR, by region (2016-2020)



At a more granular level, we can control for the potential effect of countries' technological specialization by computing the inclusivity index for each country, and again rank the top patent filers in Figure 9. Interestingly, compared to Figure 6, the normalization of industrial specialization has relatively little effect on most countries in the ranking. For countries above and below the world average, their position is slightly altered, but they remain on their side of the graph (left for those above, right for those below). Barbados, Sweden and Denmark make the biggest leap while

remaining in their category, moving 9 ranks up for the first two countries, and down for the third one. It means that Barbados, Sweden, but also Egypt and South Africa were ranked lower because of their national specialization in industries that are less gender inclusive, while Denmark, Switzerland and India were ranked higher for their specialization in more gender inclusive industries. This result suggests that the technological specialization of countries is a key factor in the gender gap in patents, and the ranking is quite sensitive to the metric selected, in particular between the WIR and ATL (see Figures A10 and A11 in Appendix for the replication using ATL and WSP).

Figure 9: Inclusivity index (based on WIR) in the top patenting countries by region (2016-2020)

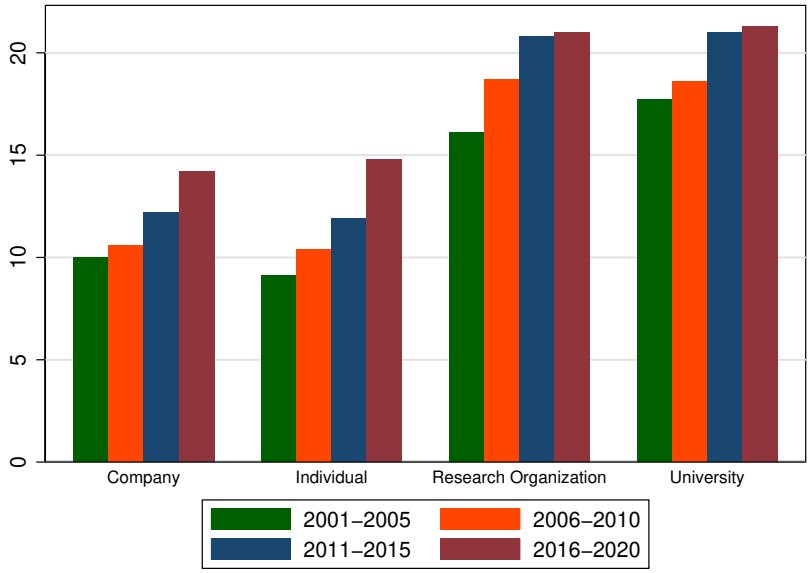


3.2.3 Academic and industrial sectors

The weight of the academic sector, in terms of contribution to patenting, varies to some extent from country to country.[7] The academic sector includes patent applicants that are universities or research organizations, while the industrial sector includes firms and individual applicants. Since

[7] See Carayol and Carpentier (2022) section 2.1 for a recent review of the literature reporting the percentage of academic patents among all national patents in different countries of the world, as well as section 3.4 for the most recent figures in France.

Figure 10: Women inventor rate (WIR) by sector over time



patents often have more than one applicant, but the database only provides a reliable category for the first applicant only, all the following calculations and comments are based on the first applicants only. Since women are more frequently inventors in the academic sector than in the private sector (Martinez, Raffo, Saito, et al., 2016), this partially explains why countries with a more important academic sector have a higher rate of women's participation.

Our data supports this explanation. We find that women inventors are more prevalent within academia (21.3 percent in universities and 21 percent in research organization in 2016-2020) than in the private sector (14.2 percent in companies and 14.8 percent for individuals). Figure 10 illustrates the gap that persists over time between academia and industry. However, in 2016-2020, international patent applications coming from academia represented only 3.8 percent of total applications, which is less than applications from individuals (7 percent) and companies (89.2 percent). These figures vary substantially by region: the share of patents stemming from academia and individuals is up to 14.6 percent and 35.7 percent in Latin America and the Caribbean, 13.7 percent and 51 percent in Africa, 6.1 percent and 14.8 percent in Oceania, and down to 3.4 percent and 6.3 percent in Northern America, 4 percent and 6.2 percent in Europe, and 3.6 percent and 7.1 percent in Asia, respectively.

This higher participation of women in the academic sector is robust across all regions except Asia, where the divide between sectors is very small. We report in Figures A26 through A31 in Appendix the statistics for each region separately. We find that the women inventor rate is 1.5 to 2 times higher in academia than in industry in all regions but Asia, where the WIR is just about 30 percent higher in academia.

3.2.4 Ranking of applicants

Each sector is constituted of many actors, sometimes very heterogeneous. For example, the private sector involves companies of different sizes and industries. Similarly, universities and research organizations vary in size and scientific specialization. To better understand which organizations are the most inclusive in terms of women's participation in patenting in each sector, we select the top 100 patent filers in academia and rank them according to their rate of women inventors in the years 2016-2020.

The Table 1 reports the top 20 universities and research organizations according to their rate of women inventors, the value of their women inventor rate as well as the other two metrics, and their rank based on each metric.[8] The Spanish CSIC is first, with 38.4 percent of women among inventors, 72.9 percent of patents including at least one woman and 37.3 percent of patents produced by women. Immediately after is the French medical research institute (INSERM) and the American Tufts University. The different metrics are quite unanimous for the first four institutions, while the rankings of many other organizations depend heavily on the metric chosen. For example, the University of Miami would rank 20th based on the share of patents with at least one woman inventor or 11th using women's share of total patenting, while it ranks fifth using the rate of women inventors. This reflects a greater propensity for women to work among themselves and in smaller teams in these organizations, rather than mixing up with men's bigger teams.

In contrast, the Hebrew University of Jerusalem and the University of North Carolina would rank higher using the share of patents with at least one woman inventor or the share of women in total patenting. This reflects a greater mix in inventor teams, where women are not necessarily in the numerical minority since they contribute substantially to patents. It differs from the dynamics of the University of Florida, for example, where the ranking is lower (therefore better) according to

[8] Alternatively, Table A2 in Appendix selects the top 5 institutions in terms of gender inclusion out of the 30 most patenting institutions in each region.

Table 1: Ranking of the top 20 academic applicants

Applicant name	Appl. country	WIR (%)	ATL (%)	WSP (%)	Rank WIR	Rank ATL	Rank WSP
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS (CSIC)	ES	38.4	72.9	37.3	1	1	1
INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE	FR	37.1	72.6	36	2	2	2
TUFTS UNIVERSITY	US	32	57.3	29.9	3	8	4
TEL AVIV UNIVERSITY	IL	29.4	53.2	24.6	4	12	14
UNIVERSITY OF MIAMI	US	28.9	45.6	24.9	5	20	11
COLUMBIA UNIVERSITY	US	28.9	55.4	29	6	11	5
UNIVERSITY OF MASSACHUSETTS	US	28.6	51.1	24.7	7	14	12
HEBREW UNIVERSITY OF JERUSALEM	IL	28.4	61.8	30.7	8	4	3
UNIVERSITY OF NORTH CAROLINA	US	28	59.2	28.4	9	6	6
MCGILL UNIVERSITY	CA	27.5	64.9	26.8	10	3	7
UNIVERSITY OF FLORIDA	US	26.2	50.7	26.4	11	15	8
CASE WESTERN RESERVE UNIVERSITY	US	26.1	58.4	25.8	12	7	9
JOHNS HOPKINS UNIVERSITY	US	26.1	56.6	25.1	13	9	10
NEW YORK UNIVERSITY	US	25.7	51.6	22.9	14	13	18
KYUSHU UNIVERSITY	JP	25.5	50	21.2	15	17	20
UNIVERSITY OF CHICAGO	US	25.5	60.2	24.7	16	5	13
TEXAS A & M UNIVERSITY SYSTEM	US	25.3	47.1	22.9	17	18	19
AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH	SG	25.3	50.6	24.4	18	16	16
KEIO UNIVERSITY	JP	25.2	46.3	23.1	19	19	17
SLOAN-KETTERING INSTITUTE FOR CANCER RESEARCH	US	25	56.1	24.5	20	10	15

the share of women in total patents. It implies instead that if the teams are mixed, women are more likely to be in the numerical minority. It is worth noting that this is a case-by-case analysis, deduced only from the relative ranking of institutions based on the three metrics. These findings calls for more research on the dynamics of women's participation in patenting, as individual inventors or as part of small or large teams, and the implications for their ability to contribute.

In a similar way, Table 2 reports the ranking of companies based on their rate of women inventors between 2016 and 2020.[9] In this sector, only the top organization, l'Oreal, holds its position unanimously across the three metrics. In the French company, 46.6 percent of inventors are women, 67.6 percent of patents include at least one woman and 44.9 percent of patents are produced by

[9]As we previously did for academic institutions, these companies are selected from an initial pool of the 100 most-patenting applicants at all times.

women, thus nearly achieving gender parity. The other top organizations in gender inclusion come primarily from Europe (Germany, Switzerland, Great Britain and the Netherlands), Asia (Japan, the Republic of Korea, and China), and the United States.

Alternatively, if we consider the top five gender-inclusive companies in terms of their WIR among the top 30 patenting companies on each region, as reported in the Table A3 in Appendix, we get a fairly distinct picture. The top of the ranking now includes companies located in Brazil, Barbados, and Australia. The Brazilian company Natura Cosmeticos moves ahead of France's L'Oreal to become the world's first most inclusive company, in which 84.1 percent of inventors are women, 97.9 of patents include at least one woman among inventors, and 84.1 percent of patents are produce by women. We exercise caution in interpreting the statistics for companies marked with one star, as they filed a total of less than 100 patents over the entire period, and even more so for those marked with two stars, which filed less than 30 patents.

Interestingly, we note that top companies produce personal care and health care products. This is consistent with a recent large-scale empirical investigation showing that all-women and women-led teams of inventors are 35 percent more likely to innovate in areas of women's health than all-men teams (Koning, Samila, and Ferguson, 2021).

3.3 Gender composition of inventors' teams

After exploring the distribution of women inventors from a macro perspective, we now examine their presence within inventor teams. The growing size of inventive teams increases the chances that one of its members is a woman. As mentioned in sub-section 2.2, we chose the WIR metric precisely because it takes into account the unequal value of having one woman in a mostly men team compared to an all-women team, for instance. In this sub-section, we explore the proportion of patents that stem from different kinds of teams, in terms of gender composition but also team size.

3.3.1 Team composition

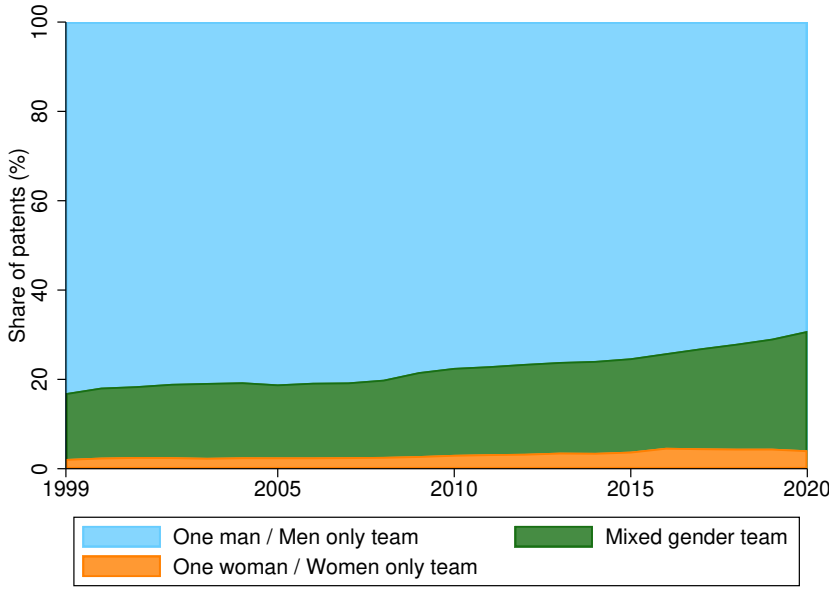
Women take part in inventive teams in different ways than men. In Figure 11, the combination of the orange and green areas indicates the proportion of patents protecting inventions either by women alone or by teams of inventors including at least one woman. Although small in volume (only 4.9 percent in 2020), the share of patents from all-women teams increased by a factor of 2.2, the largest

Table 2: Ranking of the top 20 company applicants

Applicant name	Appl. country	WIR (%)	ATL (%)	WSP (%)	Rank WIR	Rank ATL	Rank WSP
L'OREAL	FR	46.6	67.6	44.9	1	1	1
HENKEL KOMMANDITGESELLSCHAFT AUF AKTIEN	DE	33	60.5	29	2	4	3
UNILEVER PLC	GB	31.3	62.3	30.5	3	2	2
NESTEC S.A.	CH	28	52.8	25.1	4	11	7
MERCK PATENT GMBH	DE	25.7	60.7	23.3	5	3	8
DSM IP ASSETS B.V.	NL	25.6	55.2	26.5	6	9	6
EASTMAN KODAK COMPANY	US	25.1	48.6	26.9	7	14	4
PROCTER & GAMBLE COMPANY	US	23.4	57.9	23.2	8	6	9
NTN CORPORATION	JP	23.4	37.6	26.6	9	19	5
LG CHEM, LTD.	KR	23.2	57.7	22.4	10	7	10
F. HOFFMANN-LA ROCHE AG	CH	23	58.5	21.1	11	5	15
NOVARTIS AG	CH	22.8	50.4	21.4	12	13	14
ZTE CORPORATION	CN	21.9	37.3	21.6	13	20	13
KIMBERLY-CLARK WORLDWIDE, INC.	US	21.6	51.9	22	14	12	11
SANYO ELECTRIC CO., LTD.	JP	21.5	39	21.6	15	18	12
ASAHI GLASS COMPANY, LIMITED	JP	20.8	44.4	19.9	16	15	17
NITTO DENKO CORPORATION	JP	19.8	44.2	19.1	17	16	18
DOW GLOBAL TECHNOLOGIES INC.	US	19.6	56.6	20.3	18	8	16
BASF SE	DE	19.4	53.7	17.7	19	10	20
LG ELECTRONICS INC.	KR	18.5	39.8	18.2	20	17	19

increase over the period, compared to 1.7 for the share from mixed gender teams, which represents 26.1 percent of patents in 2020. Therefore the visible progression of the share of patents with at least one woman as inventor is achieved simultaneously through their increasing inclusion in mixed teams (green area) and through their increasing propensity to work either alone or among women inventors (orange area).

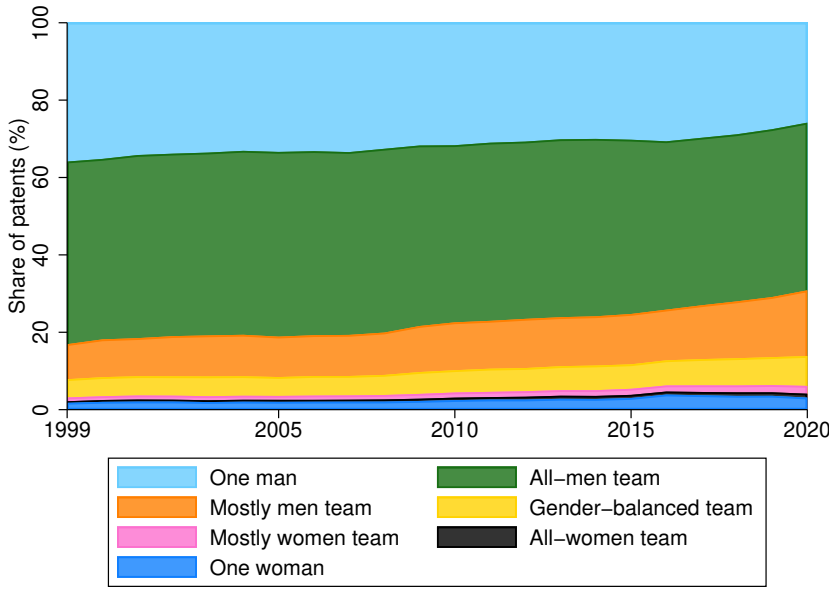
Figure 11: Share of patents by gender groups over time



Since part of the study is at the patent level, it hides some diversity in the gender composition of inventors teams, especially when the primary metric is a patent *with at least one woman inventor*. Combining all time periods and territories, we find that 30 percent of patents come from solo inventors, 28 percent of whom are men and only 2 percent are women. The remaining 70 percent originates from teams that are all-men (47 percent) or a majority of men (14 percent), while 6 percent are gendered-balanced, 2 percent are made of a majority of women and 1 percent are all-women teams.

This picture clearly emerges in Figure 12, where the years are on the x-axis and the percentage of patents by gender composition of inventors is on the y-axis. We observe that the share of patents from single women inventors (dark blue), all-women teams (black), mostly women teams (pink), and gender-balanced teams (yellow) is growing slowly over time, to reach a cumulative

Figure 12: Share of patents by inventor's gender composition over time



share that remains below 15 percent in 2020. The share of patents from mostly men teams is more substantial (17 percent), while the largest share of patents is produced by all-men teams (43 percent), followed by single men inventors (26 percent). This last category is shrinking to the benefit of both gender-balanced teams and teams including a minority of women (i.e. mostly men teams). One might infer that single men inventors are increasingly willing to collaborate with women, while teams of men are relatively more closed to the inclusion of women.

Second, we observe that the share of patents on which women are either in gender parity or in the majority is overwhelmed by the large overrepresentation of men on patents. It appears that women work more frequently alone than in mixed teams where they are in the majority, and even more than in all-women teams. Men show an opposite pattern: They work more often in all-men teams than in mixed teams where they are in the majority, and even more than alone.

3.3.2 Team composition by region

The overwhelmingly large proportion of patents stemming from one-man inventor or all-men inventor teams is observed quite consistently among regions of the world, with some interesting heterogeneity. We repeat the figure for each region separately in Figures A32 through A37 in Appendix. Africa

Table 3: Percentage points change of the share of patents by team composition and continent between 2001-2005 and 2016-2020

	One man	All-men team	Mostly men team	Gender-balanced team	Mostly women team	All-women team	One woman
Africa	-8.3	3	1	2.8	1	-0	0.5
Asia	-0.8	-14.3	5.9	3.8	1.2	0.7	3.6
Europe	-7.3	1.5	3.1	1.6	0.8	0.4	-0
Latin America and the Caribbean	-8.3	0.3	3.3	2.6	1.8	0.9	-0.7
Northern America	-8.1	0.7	5.4	1.3	0.5	0.2	-0
Oceania	-7.5	4.7	2.3	0.3	0.2	0.2	-0.2
World	-5.1	-4.1	4.4	2	0.8	0.4	1.5

and Oceania stand out with a lack of evolution over time, and a proportion of patents stemming from single men inventors that is two and three times higher than the world average, respectively (Figures A33 and A37). Furthermore, Latin America and the Caribbean exhibit a higher proportion of patents issued by single women inventors and by teams consisting mostly of women compared to the rest of the world (Figure A35).

To get a better sense of the evolution of these different patterns over time, we compute the variation in percentage points of each modality between 2001-2005 and 2016-2020 and report the results for each region separately, as well as the world in Table 3. The worldwide trend indicates a decrease in the share of patents from one man as inventor or all-men teams, in favor of all other possible team compositions. However, these trends hide important variations between regions.

First, we observe that the share of patents with only one man as inventor decreases in all regions, although the decline is much smaller in Asia (just 0.8 percentage points less). On the contrary, by losing 14.3 percentage points, Asia alone explains the worldwide drop in the share of all-men teams.

Second, these two very different patterns in the decline of the all-men share are contributing the most to the share increase in mixed-gender teams across all regions of the world. Indeed, the share of mixed teams has increased in all regions. However, in virtually all regions, teams with mostly men inventors increased by more percentage points than gender-balanced teams, which in turn always increased more than mostly women teams.

Third, and last, we observe a modest increase in percentage points of all-women teams

in almost all regions.[10]. The patent from one woman inventors displays a much less impressive pattern across regions. We observe an increase only in Asia (3.6 percentage points) and Africa (0.5 percentage points).

How to read these trends? Despite the enthusiasm for observing the increase in women's participation in patenting, it should be noted that, to a large extent, such an increase is explained by the growth in the size of inventor teams, regardless of gender. The worldwide participation of individual inventors declined by 3.6 percentage points in the period, a decline that would be much larger if Asia were excluded from the analysis. Indeed, as noted above, Asia was the only region to see an increase in individual patenting (2.8 percentage points in total), which was primarily due to the increase in women patenting. Asia also experienced the only substantial decrease in any team share, which was observed in the previously mentioned all-men teams. As a result, it is likely that the rise in the propensity to work in teams rather than alone affects the propensity for gender inclusion. It would be interesting to conduct more research to understand how these two phenomena interact in different regions.

3.3.3 Team composition in academia and industry

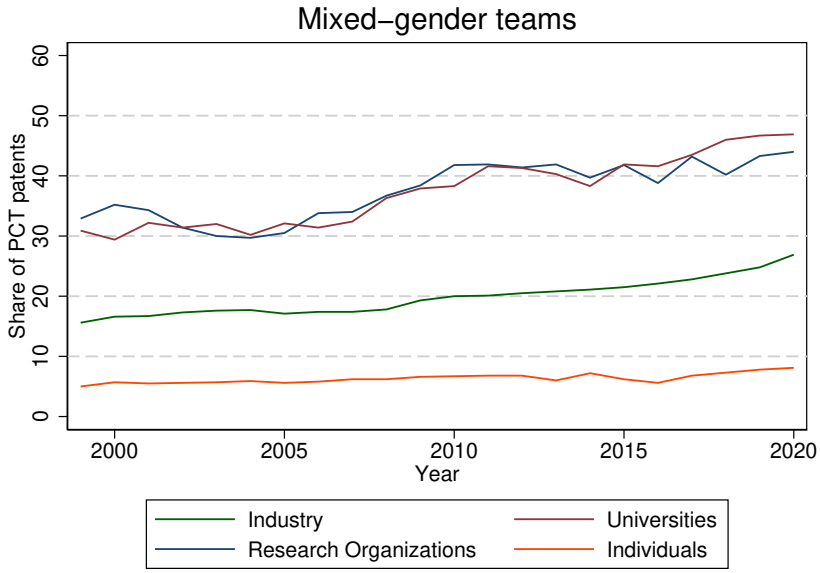
Collaboration and inclusion practices vary considerably between the academic and industrial sectors. Globally, Figure 13 shows the share of patents from mixed gender teams that belong to academia, i.e., universities or research organizations, and industry, i.e., companies or individuals. We can clearly see that a larger share of patents comes from mixed teams in academia than in companies and, even more so, than in individual ownership. However, if we focus on the share of patents coming from women inventors alone or from women-only teams in Figure 14, there is no longer an academic advantage. Instead, patents protecting inventions from single women inventors or teams of women only are significantly more likely to be in individual ownership.

3.3.4 Team size

As suggested previously, the changes in the gender balance of teams are partly connected to the shifts in the overall size of teams. Jones (2009) suggests that the rise in the burden of knowledge is driving the growth of inventor teams over time. Intuitively, given constant human resources, the greater the need to expand teams, the more likely it is that women will be included in those inventor

[10] In Africa, the share of patents from all-women teams actually decreases by 7.5 percent, but from a very low percentage.

Figure 13: Share of patents from mixed gender teams by applicant's sector over time



teams.

Table 4: Summary statistics on size of teams by gender composition over time

	2001-2005					2016-2020				
Team composition	Min	Mean	Median	Max	Nb Obs	Min	Mean	Median	Max	Nb Obs
Mostly men team	3	4.8	4	53	249,350	3	4.8	4	37	633,283
Mostly women team	3	3.7	3	19	18,988	3	3.7	3	20	58,493
All-men team	2	3.0	3	21	719,729	2	3.1	3	23	1,195,679
Gender-balanced team	2	2.8	2	37	70,464	2	3.0	2	31	187,273
All-women team	2	2.3	2	8	5,965	2	2.4	2	8	18,917
Total teams	2	3.3	3	53	1,064,496	2	3.4	3	37	2,093,645
One man	1	1.0	1	1	169,332	1	1.0	1	1	255,013
One woman	1	1.0	1	1	10,269	1	1.0	1	1	32,018
Total solo inventors	1	1.0	1	1	179,601	1	1.0	1	1	287,031

Figure 14: Share of patents from lone women inventors or women-only teams by applicant's sector over time

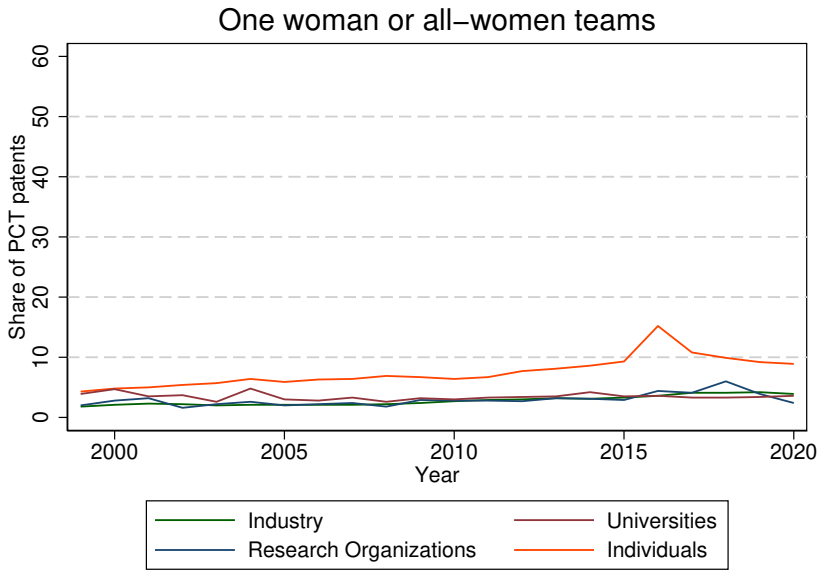


Table 4 reports summary statistics on the size of teams according to their composition by gender, for two periods: 2001-2005 and 2016-2020. In the most recent period, the largest teams are those that are mixed and unbalanced, in particular mostly men teams with an average of 4.8 members and up to 37 members, followed by mostly women teams which are 3.6 members on average and up to 20 members. Although these numbers are down from the first period, it is worth noting that the number of patents from solo inventors has increased by 59 percent, compared to a 96 percent increase in patents from teams. Invention is thus increasingly a team effort, but the size of these teams tends to decrease slightly over time. Further research could highlight variations across regions, and by gathering more information on team member roles, document a possible evolution of the role of women in inventor teams.

4 Conclusion

Innovation is a key driver of economic growth and development, and gender diversity is critical for promoting innovation. This report provides updated statistics and a more in-depth analysis of gender gaps in patenting, using the most recent version of the PCT patent application data for the period

1999-2020.

As of 2020, we find that women continue to be underrepresented in patenting, with only 31 percent of patents including at least one woman inventor and women producing only 14 percent of all patents. Women account for only 16 percent of all inventors in 2020. However, there is a positive trend of increasing participation of women in patenting over the recent period, with Latin America and the Caribbean leading the way, followed by Asia.

While there is a greater representation of women in chemistry fields as compared to mechanical engineering, controlling for the industrial specialization effect has little impact on most countries' ranking in gender inclusion. Moreover, despite more women graduating in STEM fields, the unbalanced distribution of women inventors by technological industries shows no particular change over the last twenty years.

We also observe that the share of patents obtained by teams of women only or consisting mainly of women is less than 5 percent overall and does not increase substantially over time. On the contrary, the majority of patents still come from single men inventors or from men-only teams, with an increasing share of patents from mixed teams with a minority of women or gender-balanced teams. Asia only explains most of the increase in single woman inventors share. These findings suggest that more effort is needed to promote gender diversity in teams and to encourage men and women to collaborate on inventive activities.

Despite modest encouraging trends in women's participation in patenting, there is still much work to be done to ensure equal opportunities for women in all countries. The relatively higher participation of women in Asia and Latin America and the Caribbean may provide insights into the factors that enable women to participate. Additionally, policies and actions to stimulate gender diversity in teams and to promote gender-balanced teams should be prioritized. Finally, further research is needed to understand the societal and technological factors contributing to the gender gap in patenting and to identify effective policies and actions for promoting gender diversity in innovation.

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Appendix

Figure A1: Decision tree for selecting the data source to assign gender

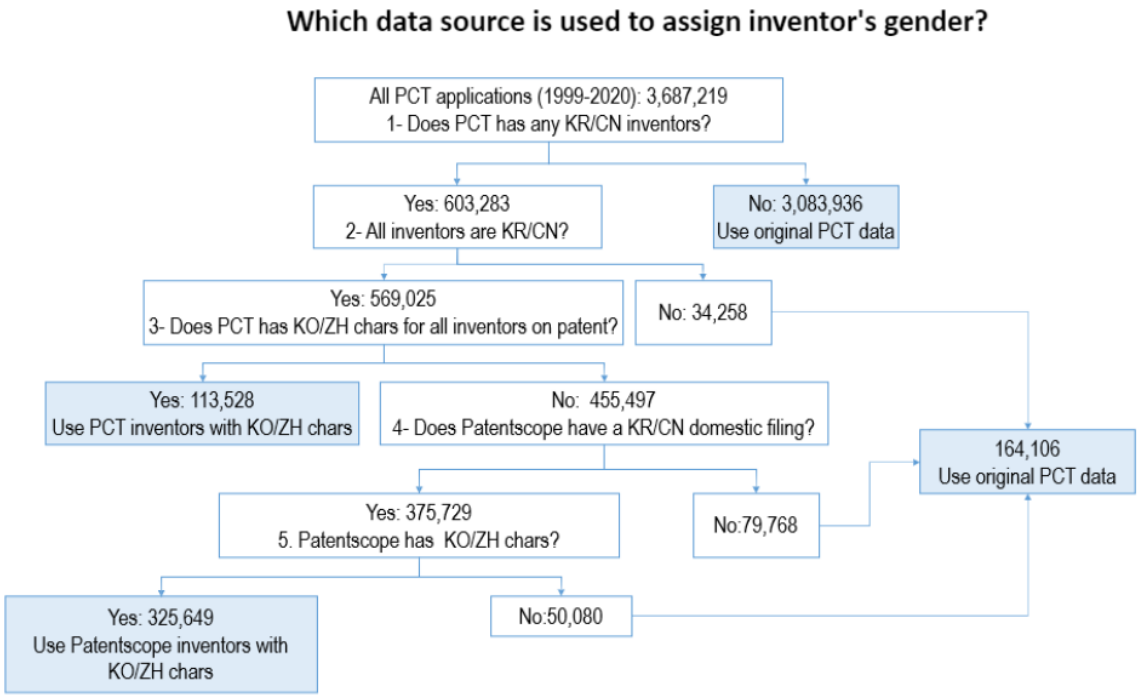


Figure A2: Share of patents with women (ATL) as inventors by region and time periods

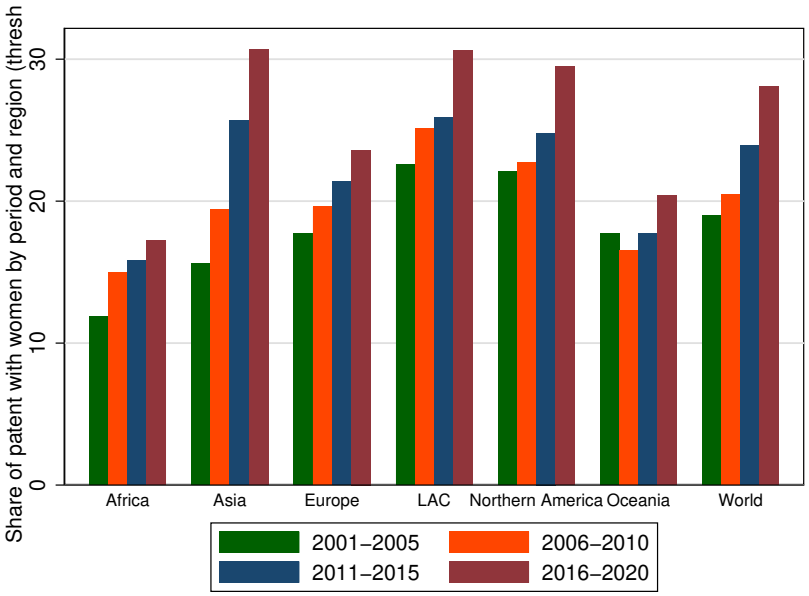


Figure A3: Women's share of patenting (WSP) by region and time periods

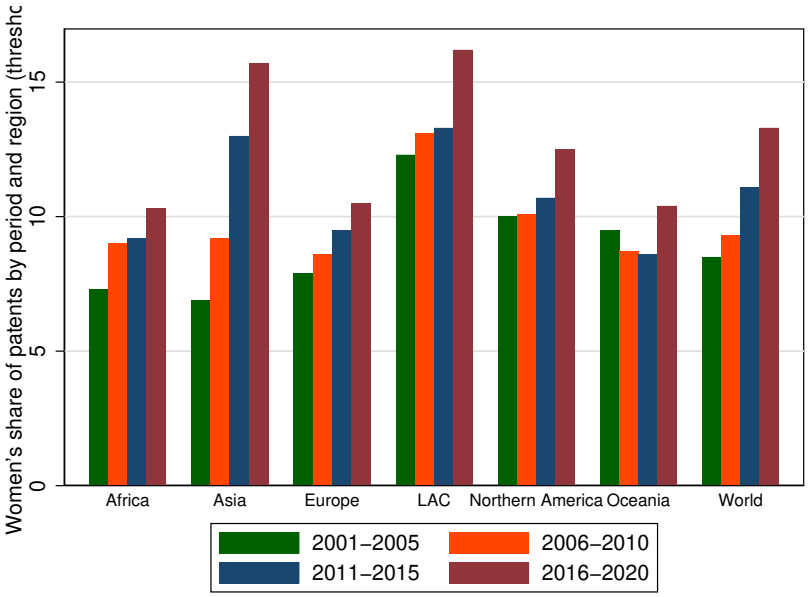
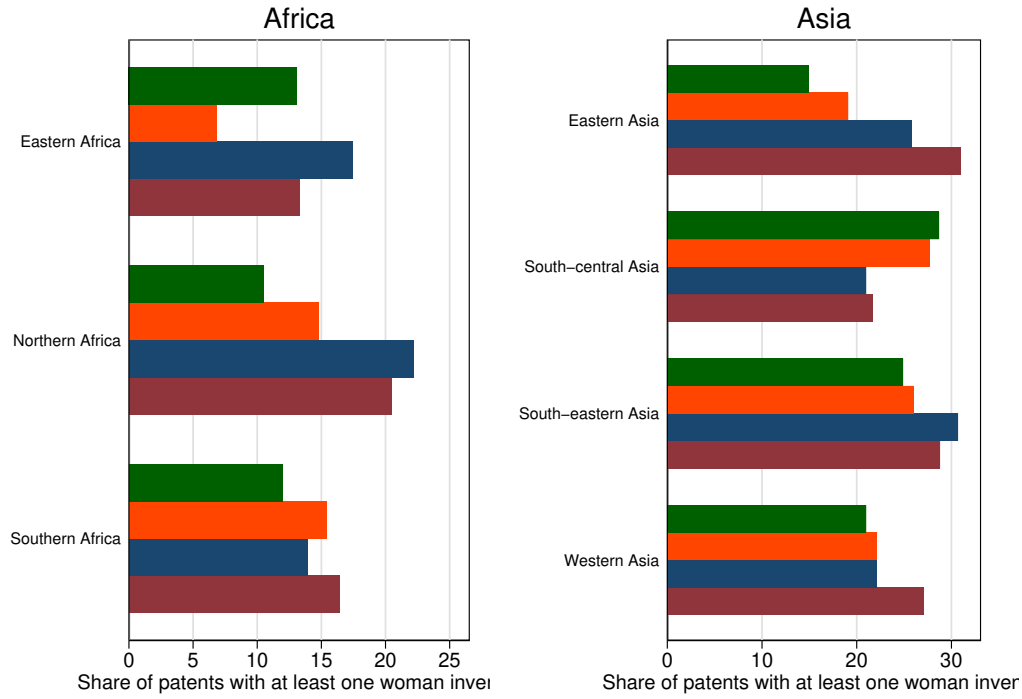


Table A1: Growth rate of the share of patents by team composition and continent between 2001-2005 and 2016-2020

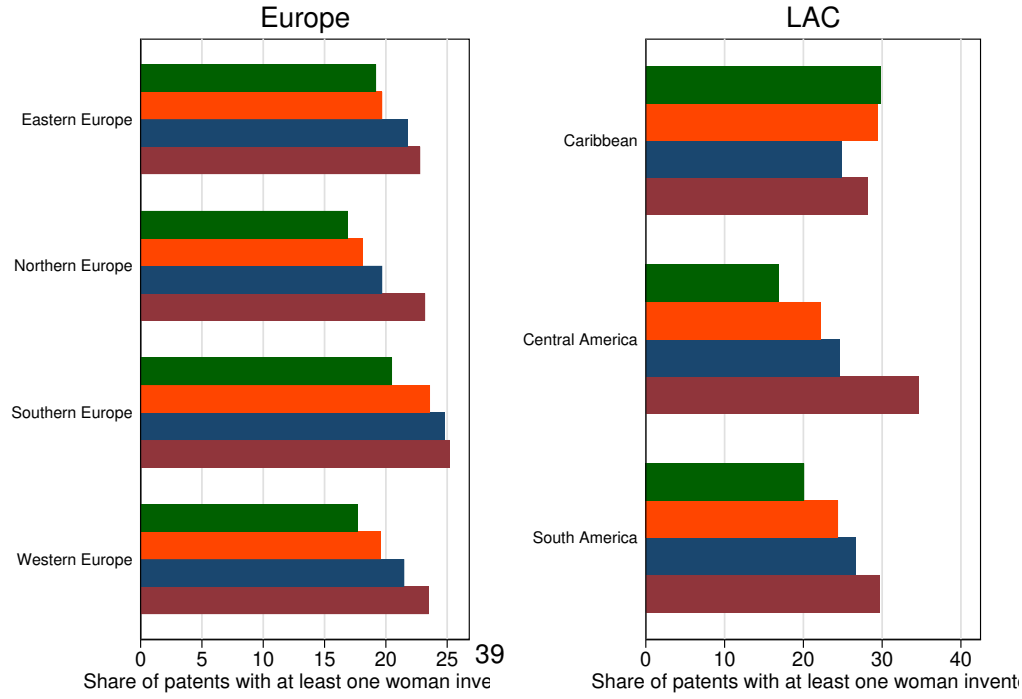
	One man	All-men team	Mostly men team	Gender-balanced team	Mostly women team	All-women team	One woman
Africa	-13.1	12.2	23.8	97.9	348.8	-8.2	13.6
Asia	-2.5	-27.6	65.6	101.4	234.7	260.8	170.7
Europe	-20.4	3.1	31.2	33.7	74.5	83.2	-.4
Latin America and the Caribbean	-17.6	1.1	36	42	105.1	112.4	-15
Northern America	-26.8	1.5	45.6	22.2	42	26.5	-1.2
Oceania	-15	14.5	32.1	5	18.8	60.1	-6.2
World	-15	-8.6	42.5	40.8	73.2	76.3	76.1

Figure A4: Share of patents with women as inventors (ATL) by sub-region and period

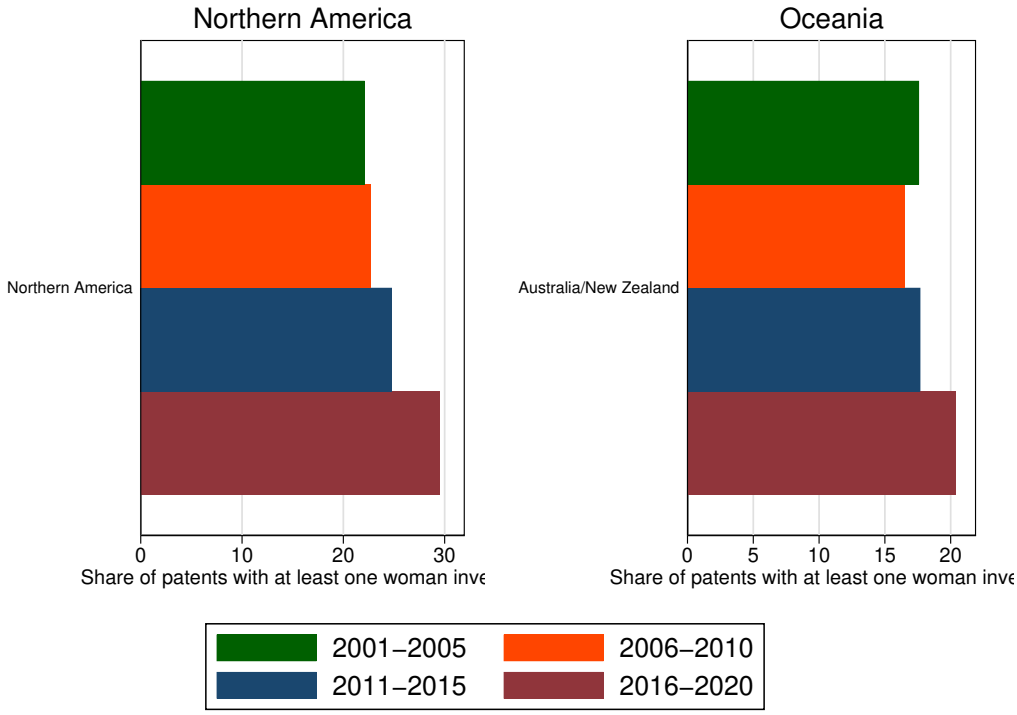
(a) Africa and Asia



(b) Europe and Latin America and the Caribbean



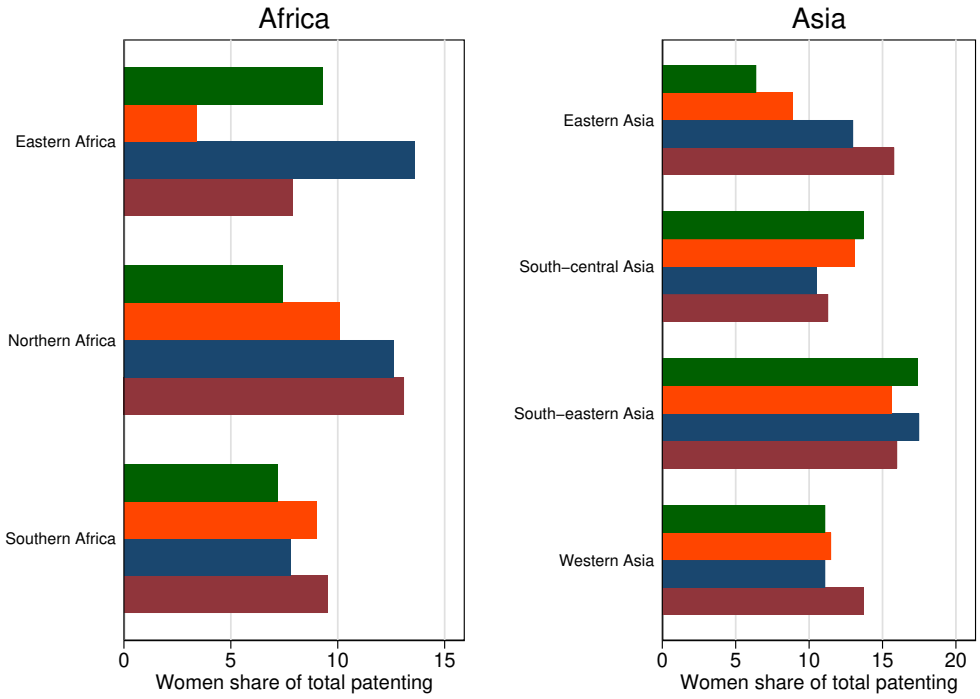
(c) Northern America and Oceania



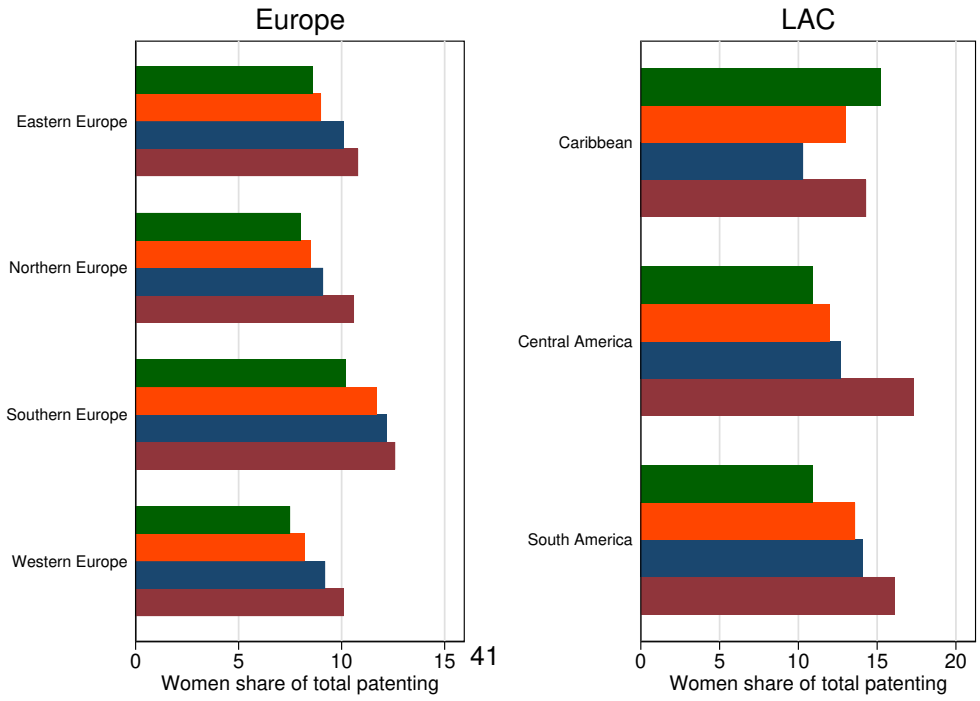
Notes: The list of countries included in each sub-region is defined by the UN Statistics Division and it is available here: UNSD - Methodology page. Note that countries and territories from Middle Africa and Western Africa, as well as Melanesia, Micronesia and Polynesia are omitted due to the low number of observations in these sub-regions.

Figure A5: Women's share of patenting (WSP) by sub-region and period

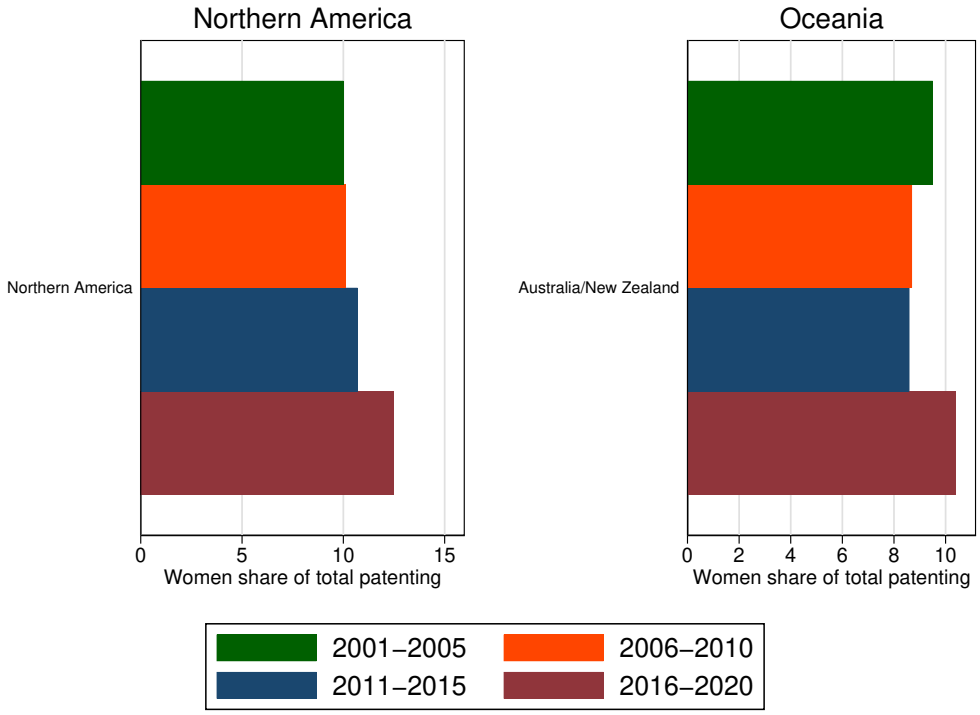
(a) Africa and Asia



(b) Europe and Latin America and the Caribbean



(c) Northern America and Oceania



Notes: The list of countries by sub-region is available in the notes of Appendix Figure A4. Note that countries and territories from Middle Africa and Western Africa, as well as Melanesia, Micronesia and Polynesia are omitted due to the low number of observations in these sub-regions.

Figure A6: Women's share of patents (WSP) in the top patenting countries by region (2016-2020)

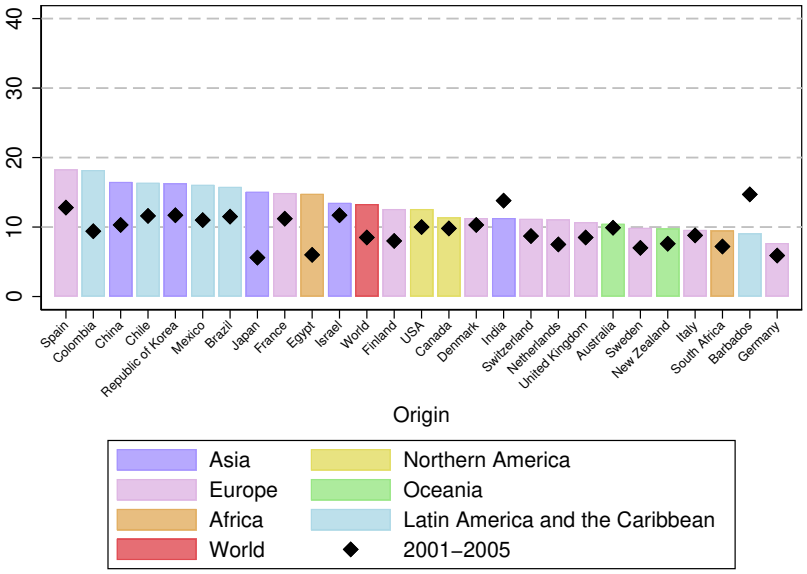


Figure A7: Share of patents with women as inventors (ATL) in the top patenting countries by region (2016-2020)

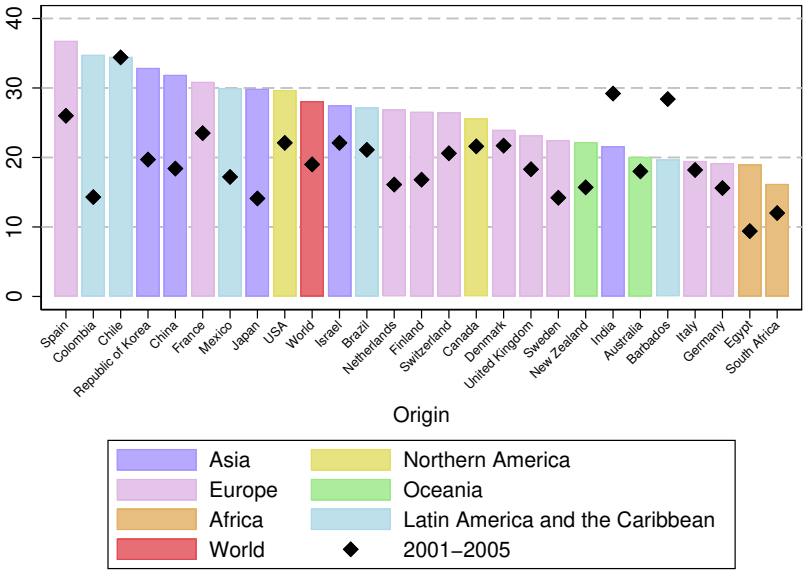


Figure A8: Share of patents with women inventors (ATL) in each industry (2016-2020)

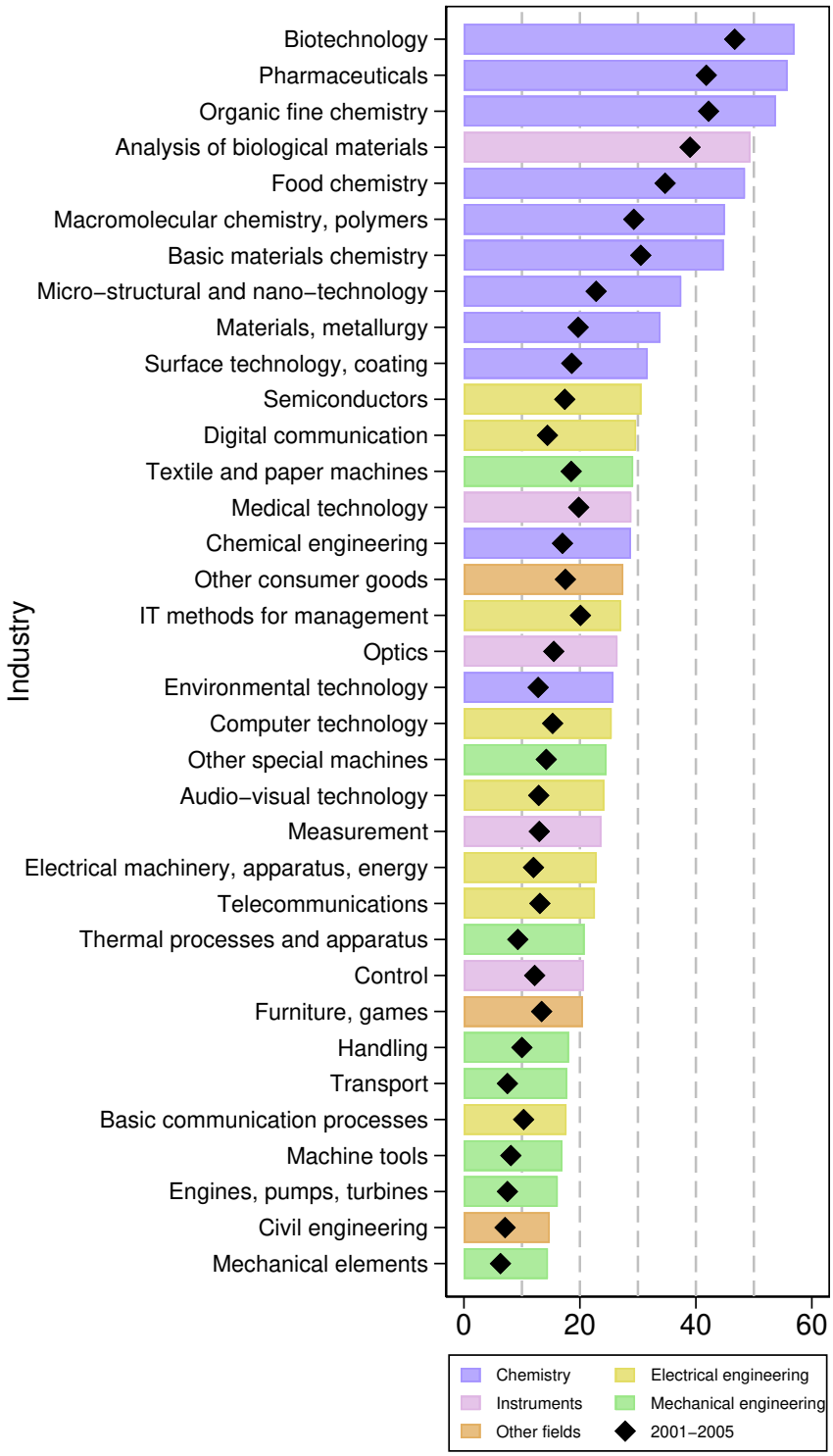


Figure A9: Women's share of patenting (WSP) in each industry (2016-2020)

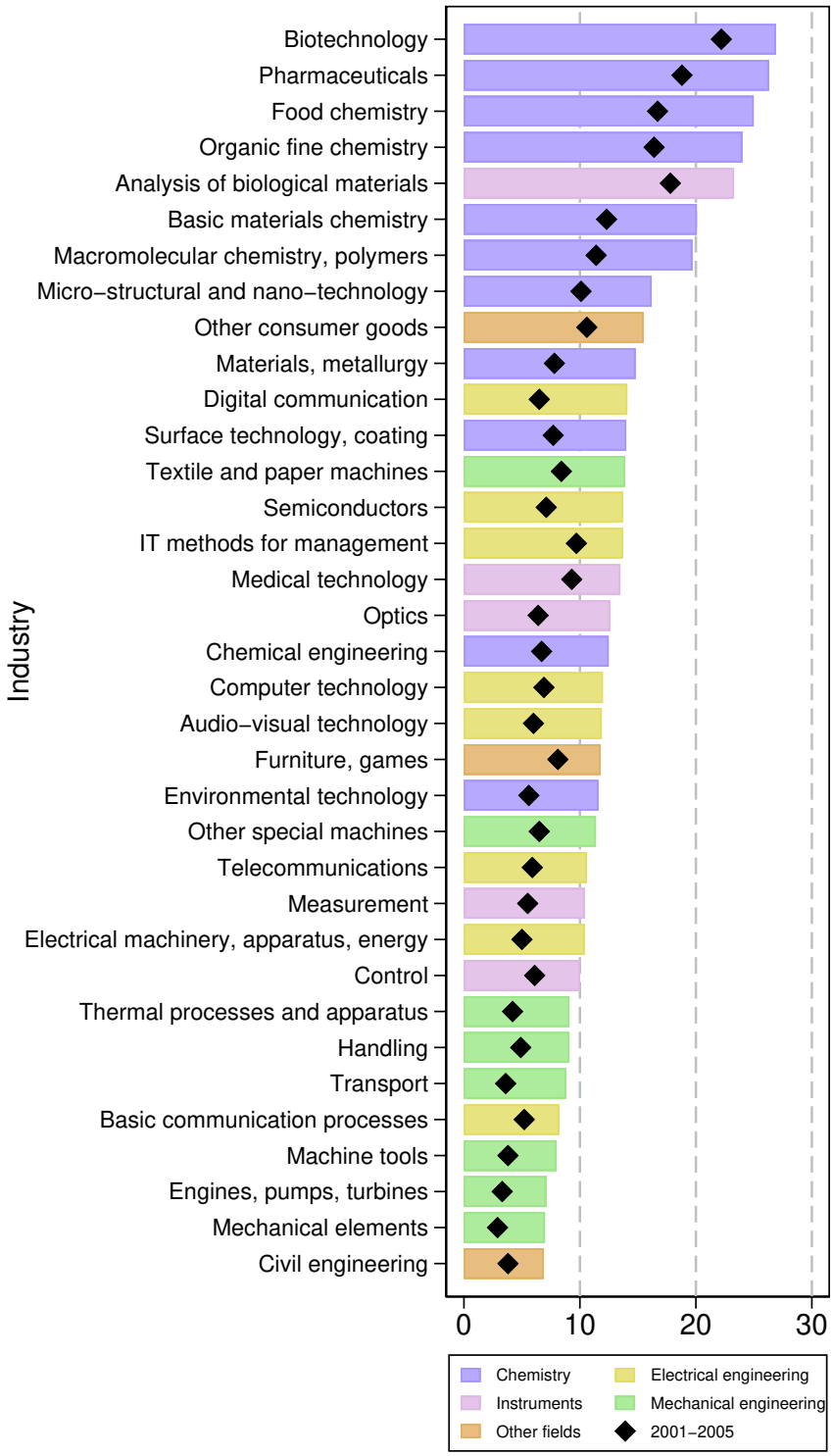


Figure A10: Inclusivity index (based on ATL) in the top patenting countries by region (2016-2020)

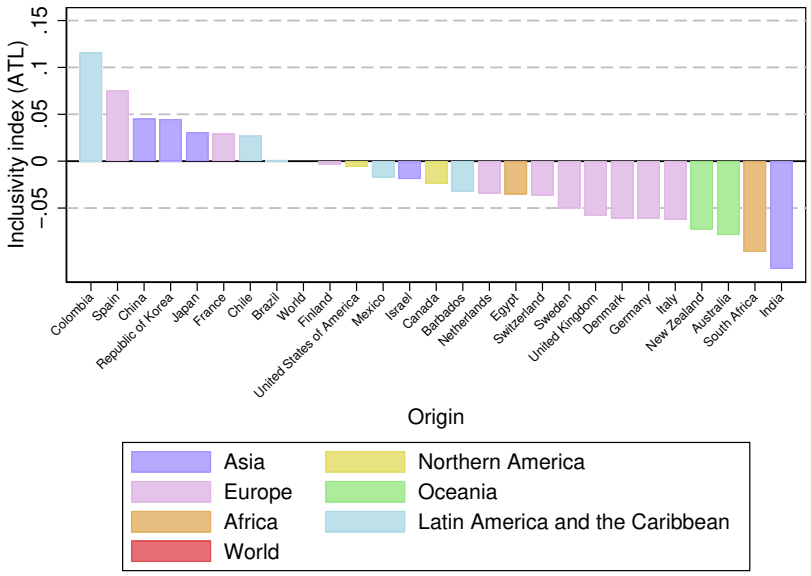


Figure A11: Inclusivity index (based on WSP) in the top patenting countries by region (2016-2020)

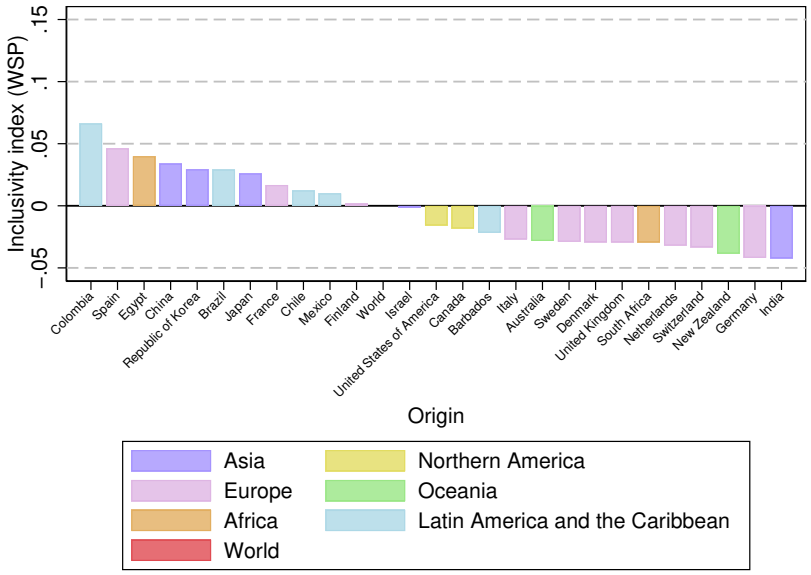


Figure A12: Share of patents with women as inventors (ATL) by sector over time

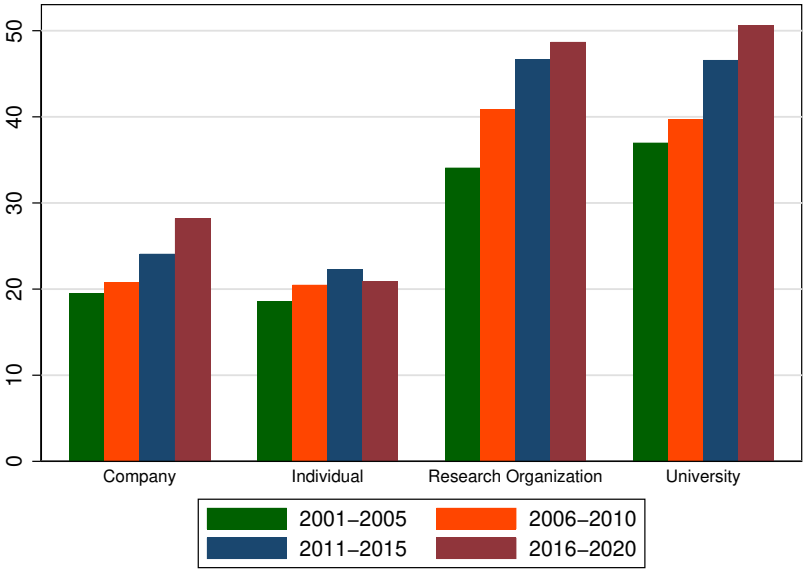


Figure A13: Women's share of patents (WSP) by sector over time

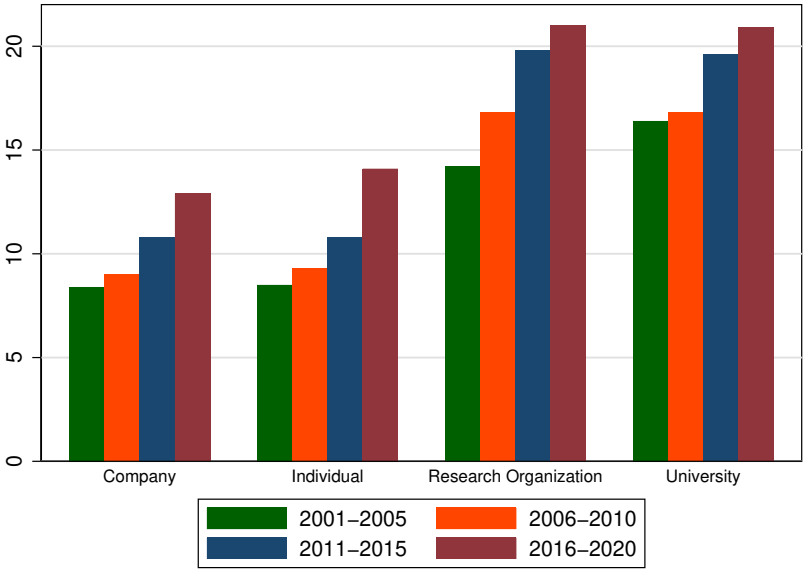


Table A2: Ranking of the top 5 academic applicants per continent

	Appl. country	WIR (%)	ATL (%)	WSP (%)	Rank WIR	Rank ATL	Rank WSP
ESTADUAL DE CAMPINAS - UNICAMP	BR	47.3	81.6	47.1	1	3	1
UNIVERSIDADE DE SANTIAGO DE COMPOSTELA	ES	44.1	88.9	43.6	2	2	2
UNIVERSIDAD NACIONAL DE COLOMBIA*	CO	42.9	70	39.1	3	9	5
LA TROBE UNIVERSITY*	AU	40	58.8	39.8	4	17	4
UNIVERSITY OF TECHNOLOGY, SYDNEY*	AU	40	70.6	42.6	5	8	3
UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO	MX	39.8	72.4	36.3	6	7	8
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS (CSIC)	ES	38.4	72.9	37.3	7	5	7
INSTITUT NATIONAL DE LA SANTE ET DE LA RECHERCHE MEDICALE	FR	37.1	72.6	36	8	6	9
UNIVERSIDAD DE LA FRONTERA**	CL	36.8	61.5	29.7	9	14	14
CENTRO DE INGENIERIA GENETICA Y. BIOTECNOLOGIA*	CU	36.1	90	37.3	10	1	6
UNIVERSITY OF THE WITWATERSRAND*	ZA	35.2	64.7	29.4	11	10	15
GARVAN INSTITUTE OF MEDICAL RESEARCH*	AU	34.7	58.8	32.9	12	18	12
GRIFFITH UNIVERSITY*	AU	33.3	76.9	35.3	13	4	10
DEAKIN UNIVERSITY*	AU	32.5	61.5	32.9	14	13	11
TEL AVIV UNIVERSITY	IL	29.4	53.2	24.6	15	22	24
COLUMBIA UNIVERSITY	US	28.9	55.4	29	16	21	16
UNIVERSITY OF MASSACHUSETTS	US	28.6	51.1	24.7	17	23	23
HEBREW UNIVERSITY OF JERUSALEM	IL	28.4	61.8	30.7	18	12	13
UNIVERSITY OF NORTH CAROLINA	US	28	59.2	28.4	19	16	17
NIHON UNIVERSITY	JP	27.1	61.1	27.3	20	15	19
UNIVERSIDAD POLITECNICA DE VALENCIA	ES	26.5	57.1	22.2	21	19	27
UNIVERSITY OF FLORIDA	US	26.2	50.7	26.4	22	24	20
JOHNS HOPKINS UNIVERSITY	US	26.1	56.6	25.1	23	20	22
KYUSHU UNIVERSITY	JP	25.5	50	21.2	24	26	28
POLITECNICO DI MILANO	IT	25.5	63.1	25.9	25	11	21
AGENCY FOR SCIENCE, TECHNOLOGY AND RESEARCH	SG	25.3	50.6	24.4	26	25	25
CSIR	ZA	25	30	20.5	27	30	29
UNIVERSITY OF PRETORIA*	ZA	25	33.3	27.8	28	29	18
UNIVERSITY OF CAPE TOWN	ZA	24.4	40.8	20.5	29	28	30
STELLENBOSCH UNIVERSITY	ZA	24.4	42.9	22.9	30	27	26

Notes: * applicants who filed less than 100 patents over the whole period,
** applicants who filed less than 30 patents.

Table A3: Ranking of the top 5 company applicants per continent

	Appl. country	WIR (%)	ATL (%)	WSP (%)	Rank WIR	Rank ATL	Rank WSP
NATURA COSMETICOS S.A.	BR	84.1	97.9	84.1	1	2	1
L'OREAL	FR	46.6	67.6	44.9	2	5	2
CSL LIMITED*	AU	41.2	76.9	41.5	3	3	4
COOPERVISION INTERNATIONAL HOLDING COMPANY, LP*	BB	40	50	36.1	4	17	6
BIONOMICS LIMITED*	AU	34.8	100	44.8	5	1	3
FUNDACAO OSWALDO CRUZ - FIOCRUZ*	BR	34.5	72.7	36.7	6	4	5
NATIONAL ICT AUSTRALIA LIMITED	AU	34.4	41.7	25.7	7	19	12
HENKEL KOMMANDITGESELLSCHAFT AUF AKTIEN	DE	33	60.5	29	8	10	8
BRASKEM S.A.	BR	31.5	61.9	27.4	9	8	10
UNILEVER PLC	GB	31.3	62.3	30.5	10	7	7
NESTEC S.A.	CH	28	52.8	25.1	11	14	13
ANSELL LIMITED*	AU	27	63.6	28.1	12	6	9
MEXICHEM FLUOR S.A. DE C.V.*	MX	26	34.9	16.7	13	23	25
MERCK PATENT GMBH	DE	25.7	60.7	23.3	14	9	14
EASTMAN KODAK COMPANY	US	25.1	48.6	26.9	15	18	11
PROCTER & GAMBLE COMPANY	US	23.4	57.9	23.2	16	11	15
LG CHEM, LTD.	KR	23.2	57.7	22.4	17	12	16
NEWSOUTH INNOVATIONS PTY LIMITED	AU	22	50.7	22.1	18	16	17
ZTE CORPORATION	CN	21.9	37.3	21.6	19	22	19
KIMBERLY-CLARK WORLDWIDE, INC.	US	21.6	51.9	22	20	15	18
DOW GLOBAL TECHNOLOGIES INC.	US	19.6	56.6	20.3	21	13	20
LG ELECTRONICS INC.	KR	18.5	39.8	18.2	22	20	23
BRIDGESTONE CORPORATION	JP	18.3	27.7	18.7	23	24	21
SHENZHEN CHINA STAR OPTOELECTRONICS SEMICONDUCTOR CO., LTD.	CN	18.2	23.5	18.5	24	25	22
E I DU PONT DE NEMOURS	US	18.1	39.7	17	25	21	24
NCM INNOVATIONS (PTY) LTD*	ZA	2.9	5.3	1.3	26	26	26
EPIROC HOLDINGS SOUTH AFRICA (PTY) LTD**	ZA	0	0	0	27	27	28
DETNET SOUTH AFRICA (PTY) LTD*	ZA	0	0	0	28	28	27

Notes: * applicants who filed less than 100 patents over the whole period,
** applicants who filed less than 30 patents.

Figure A14: Three indicators of women contribution to patenting in Africa

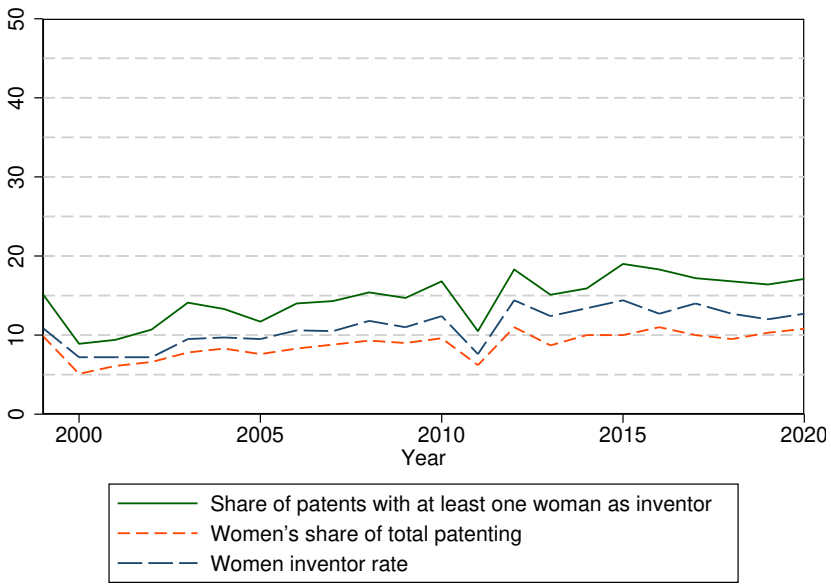


Figure A15: Three indicators of women contribution to patenting in Asia

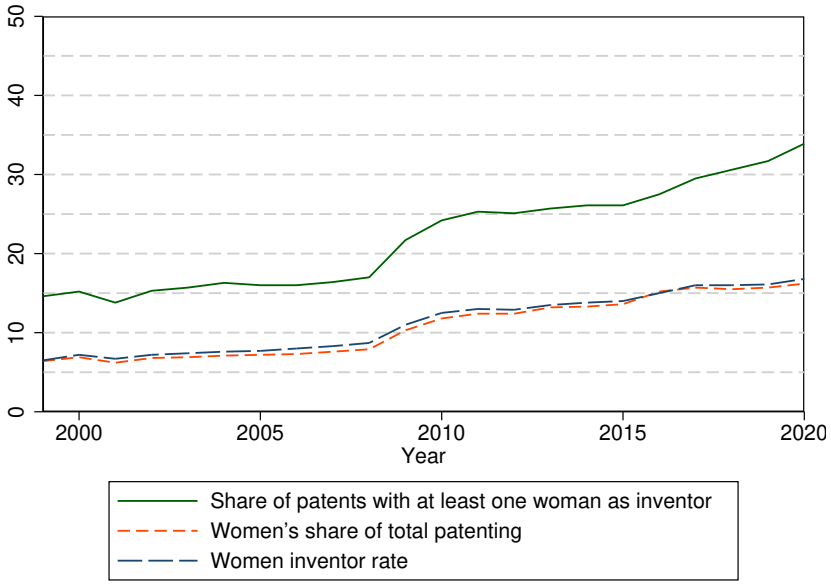


Figure A16: Three indicators of women contribution to patenting in Europe

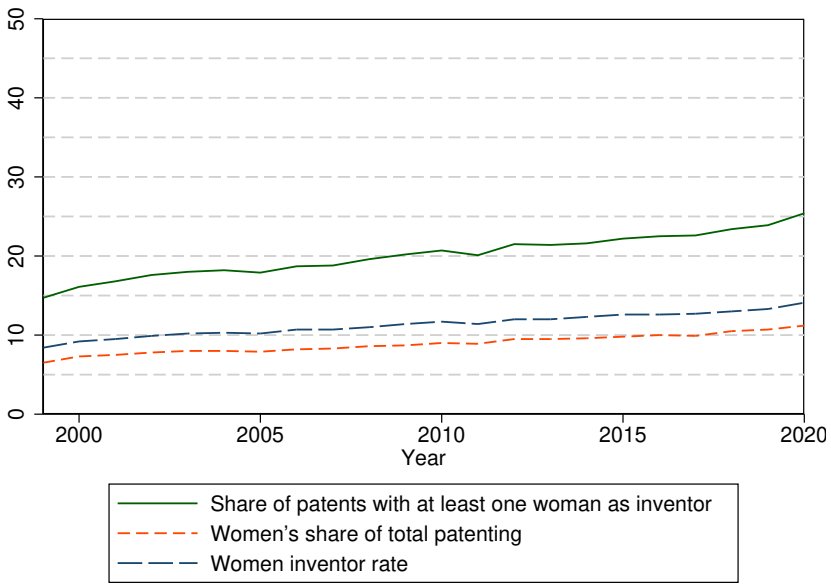


Figure A17: Three indicators of women contribution to patenting in Latin America and the Caribbean

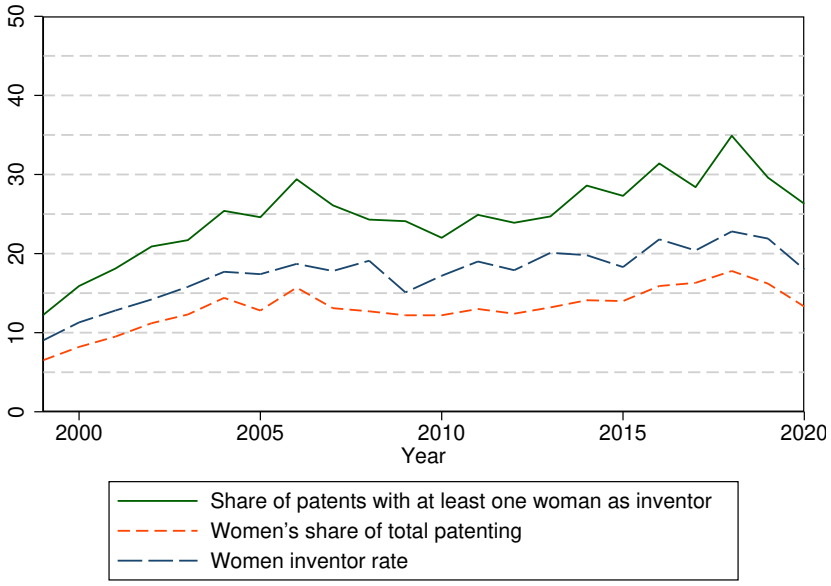


Figure A18: Three indicators of women contribution to patenting in Northern America

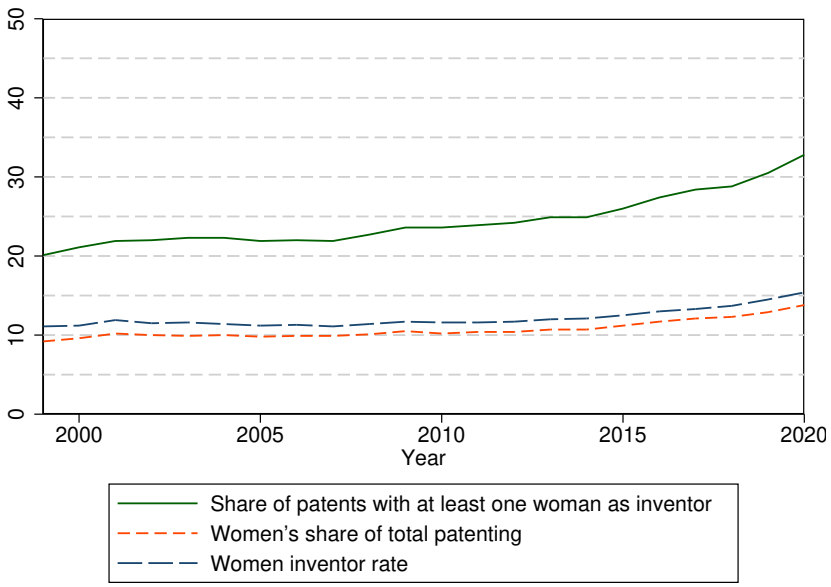


Figure A19: Three indicators of women contribution to patenting in Oceania

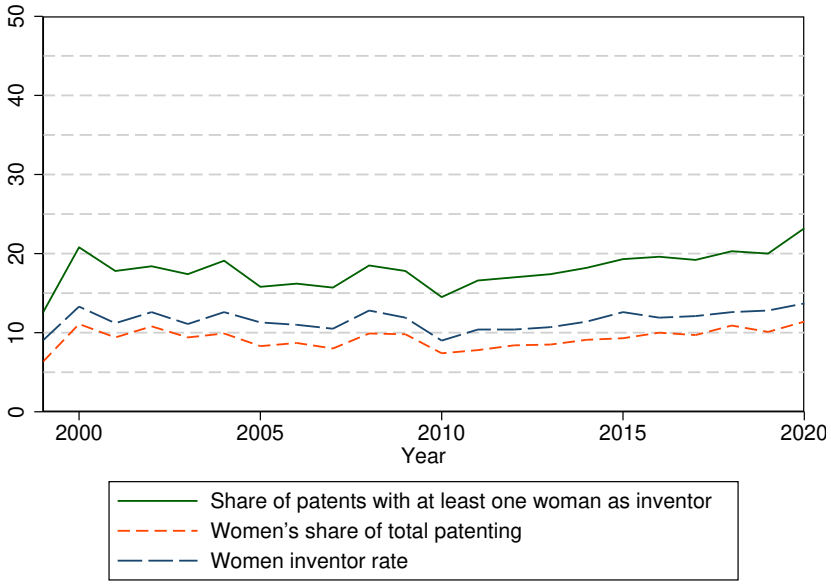


Figure A20: Women inventor rate (WIR) in each industry in Africa (2016-2020)

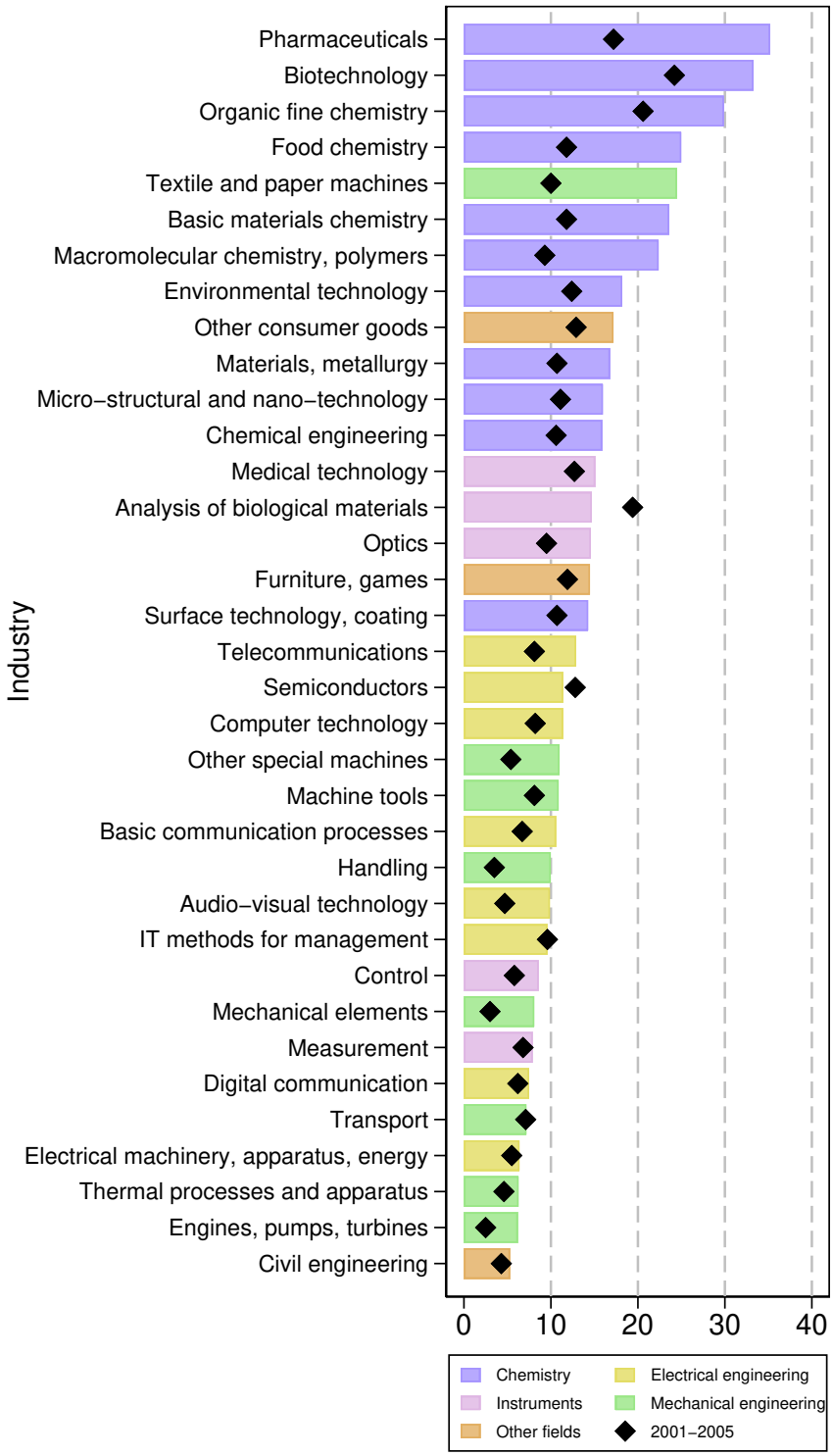


Figure A21: Women inventor rate (WIR) in each industry in Asia (2016-2020)

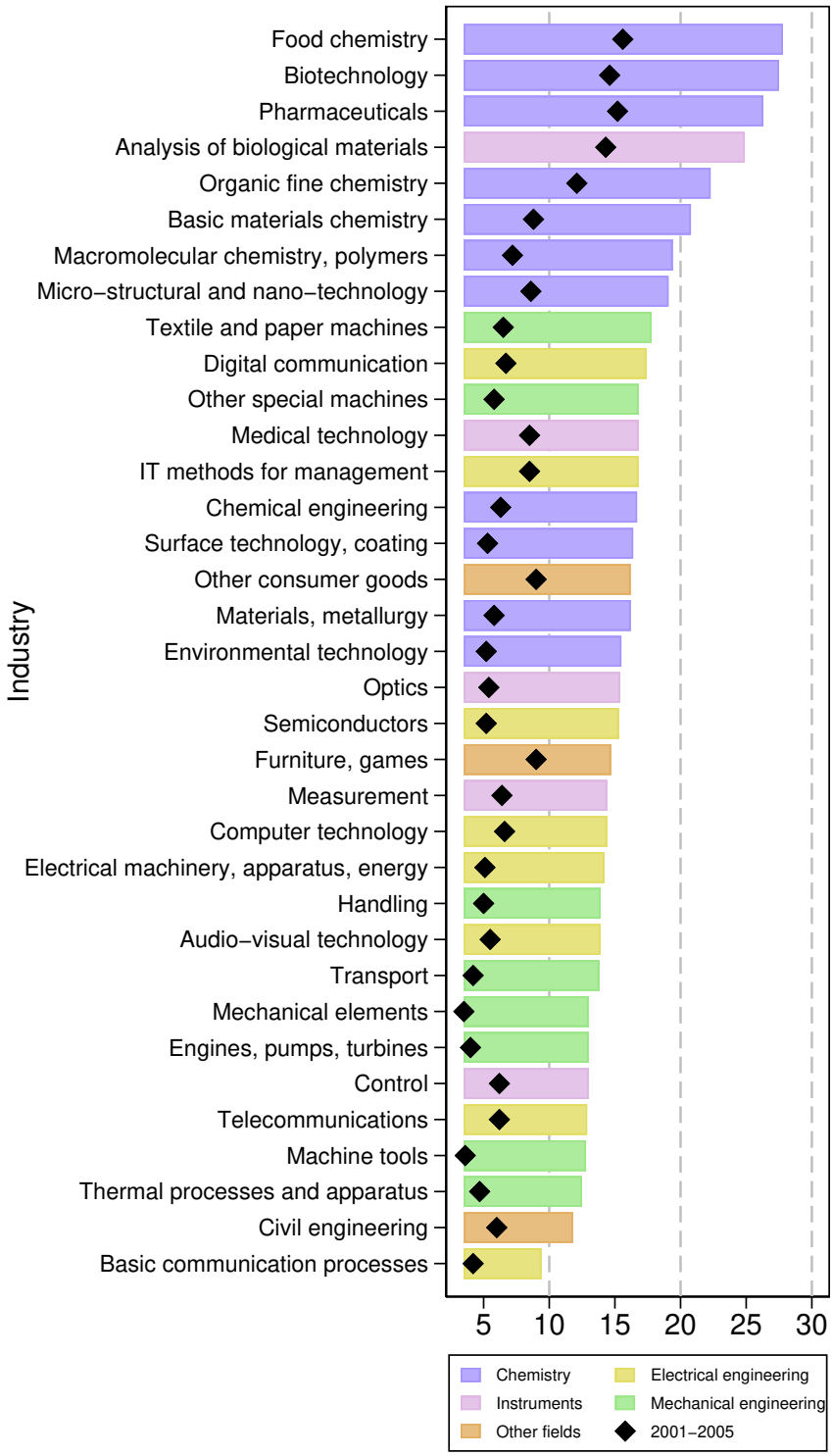


Figure A22: Women inventor rate (WIR) in each industry in Europe (2016-2020)

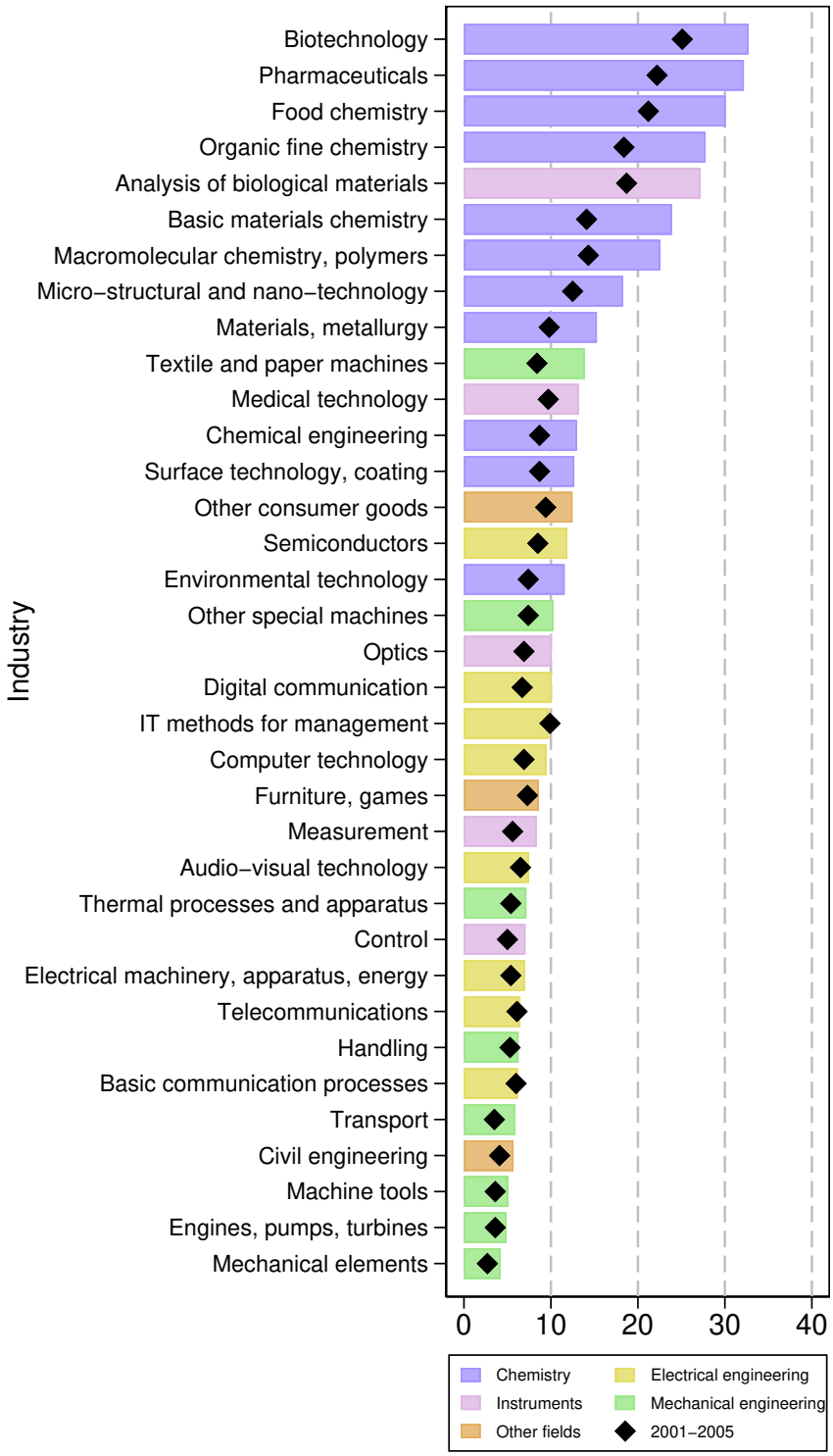


Figure A23: Women inventor rate (WIR) in each industry in Latin America and the Caribbean (2016-2020)

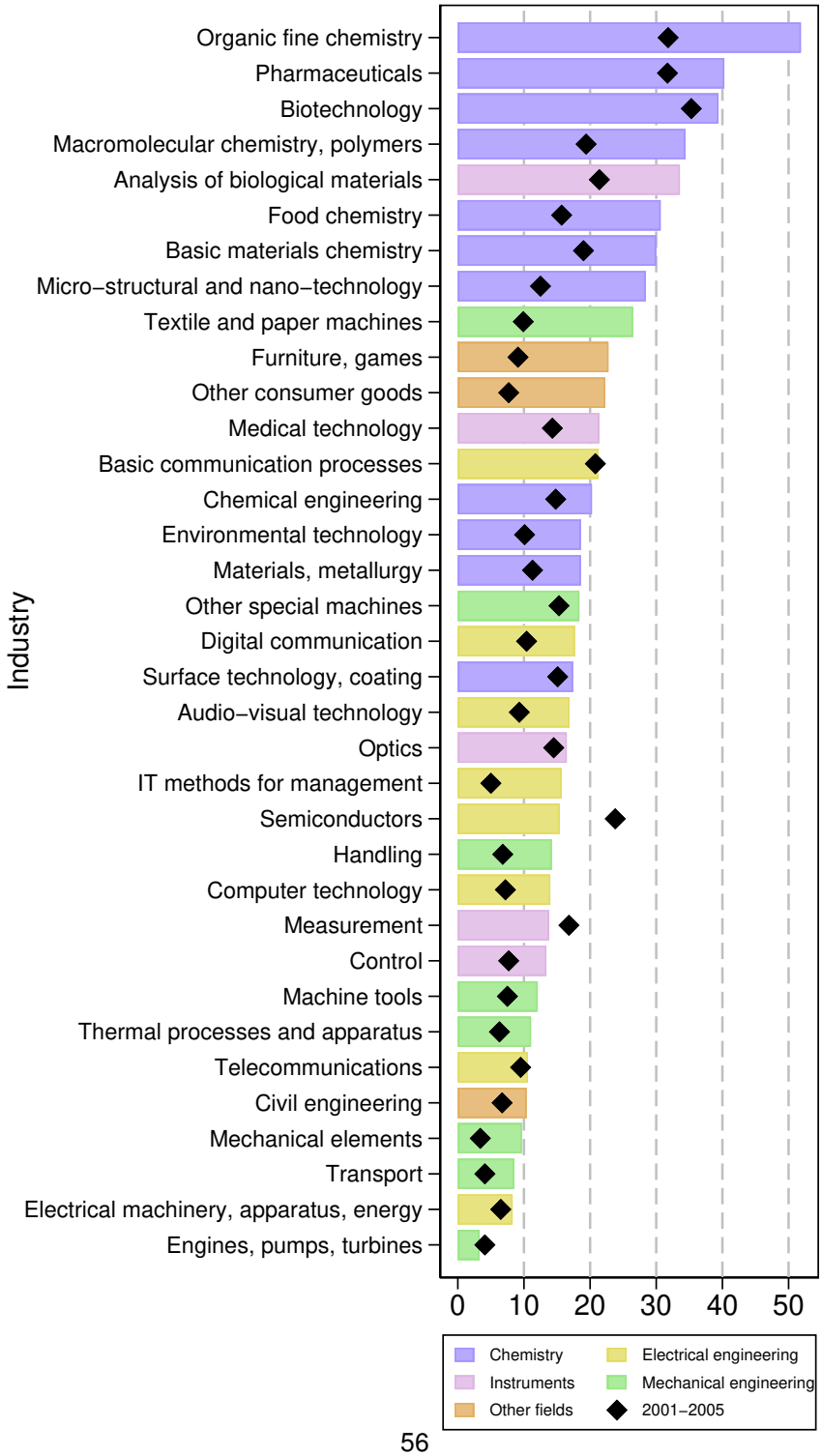


Figure A24: Women inventor rate (WIR) in each industry in Northern America (2016-2020)

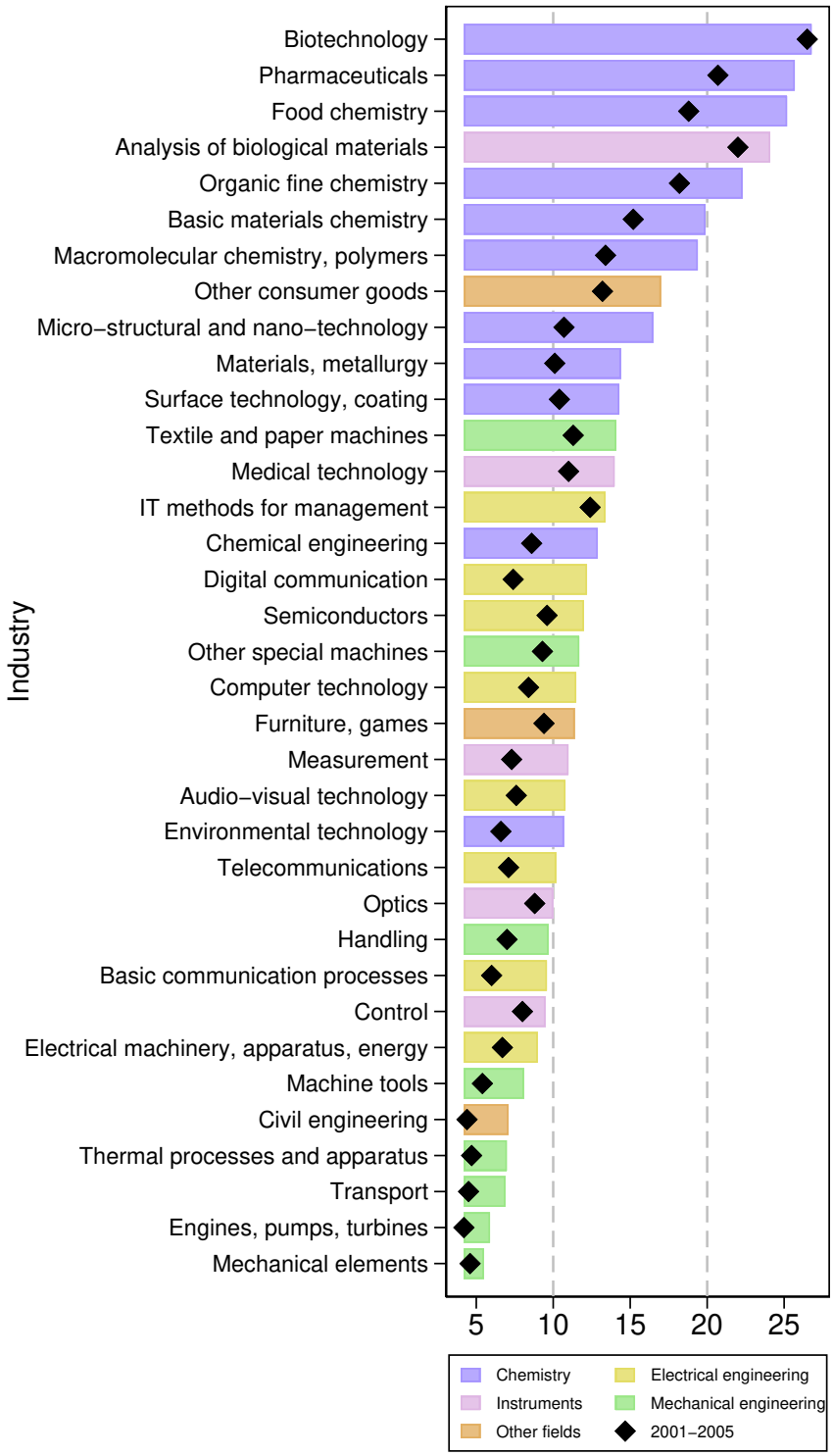


Figure A25: Women inventor rate (WIR) in each industry in Oceania (2016-2020)

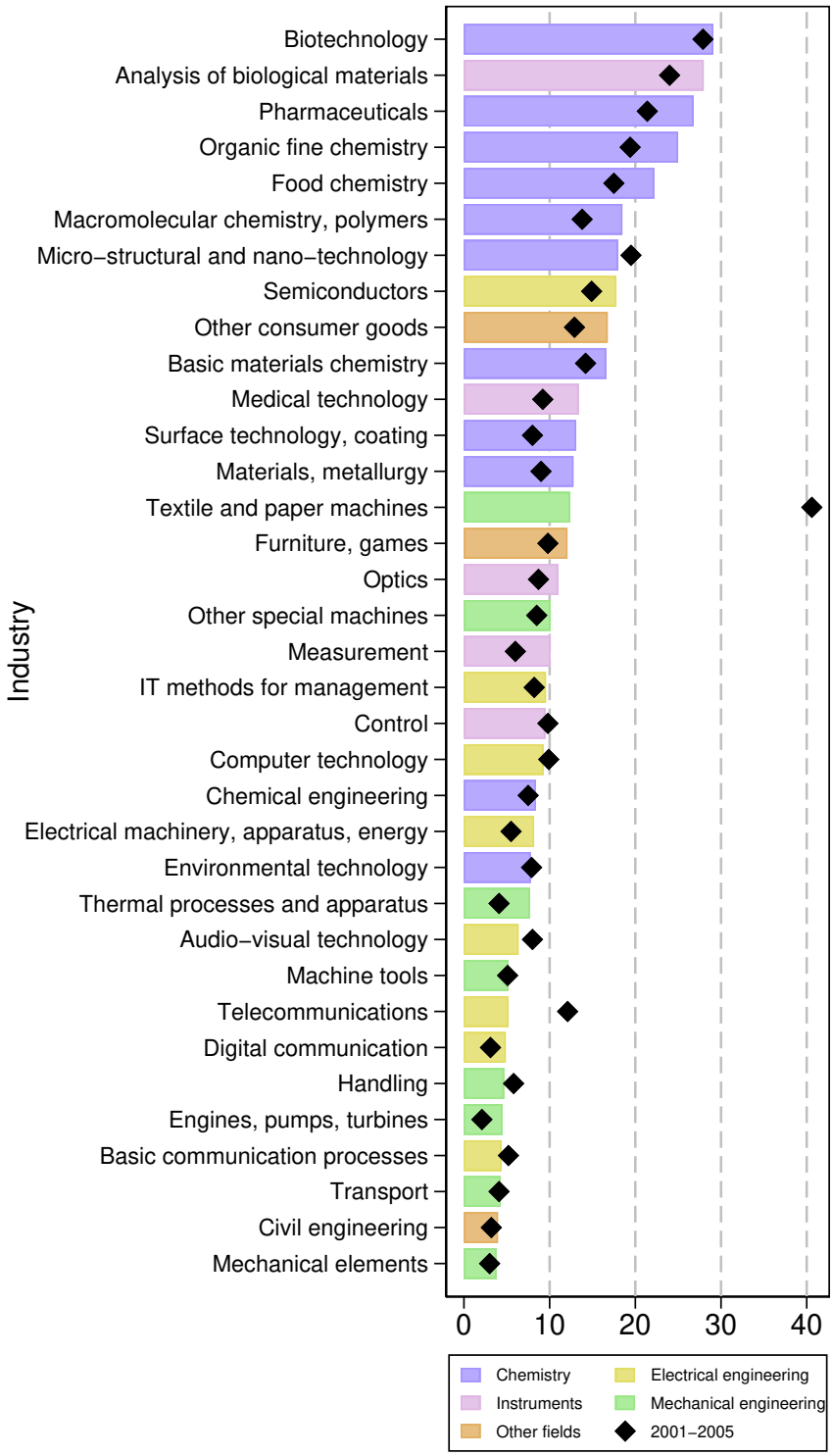


Figure A26: Women inventor rate (WIR) in Africa, by sector and over time

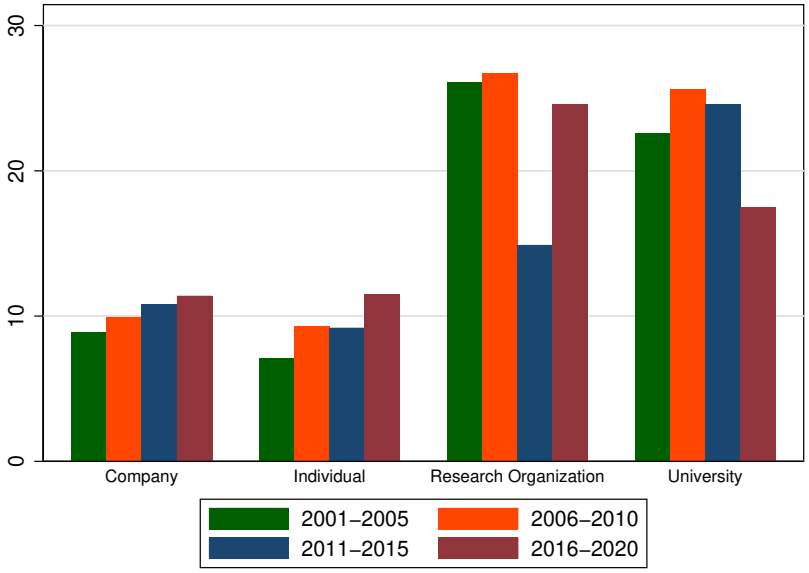


Figure A27: Women inventor rate (WIR) in Asia, by sector and over time

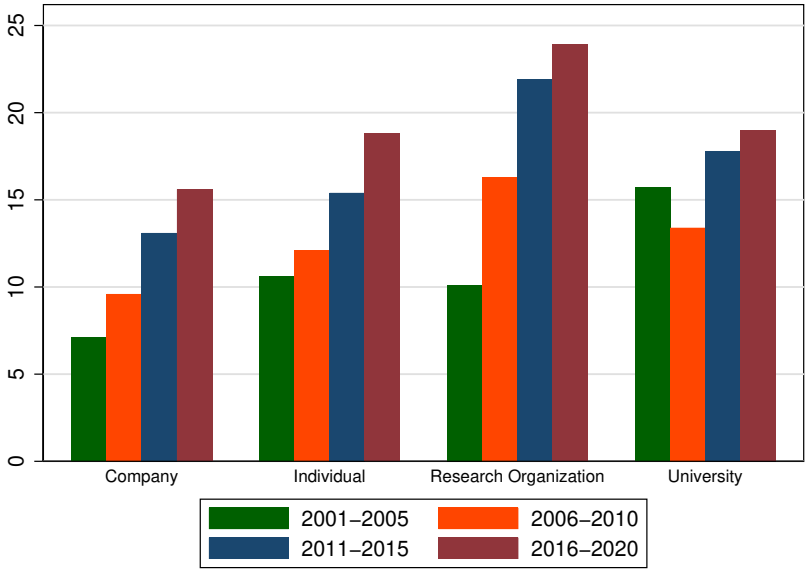


Figure A28: Women inventor rate (WIR) in Europe, by sector and over time

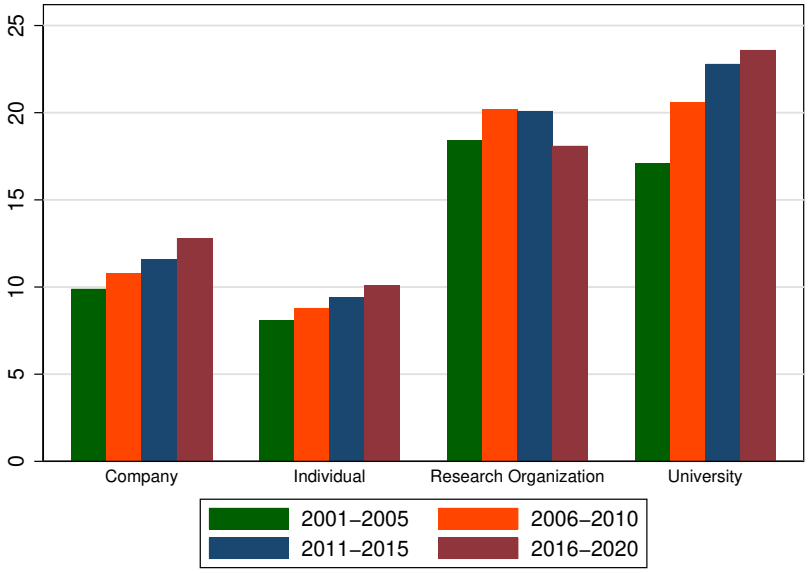


Figure A29: Women inventor rate (WIR) in Latin America and the Caribbean, by sector and over time

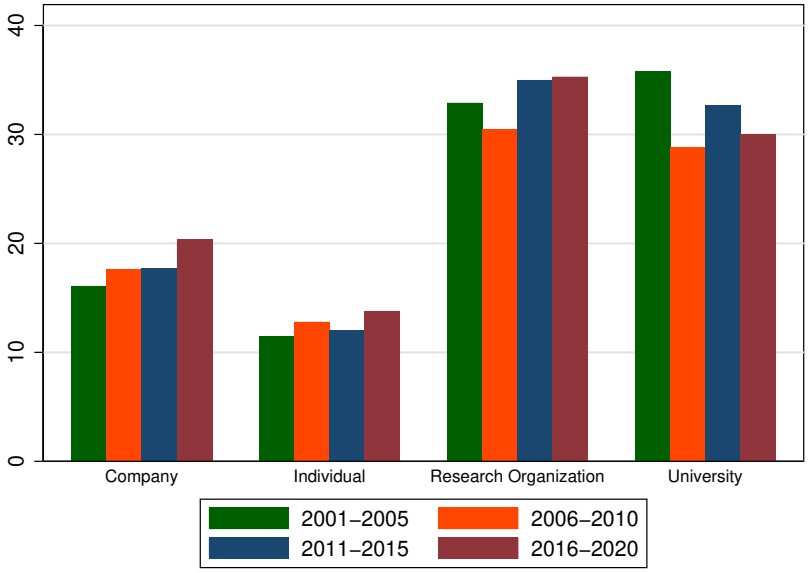


Figure A30: Women inventor rate (WIR) in Northern America, by sector and over time

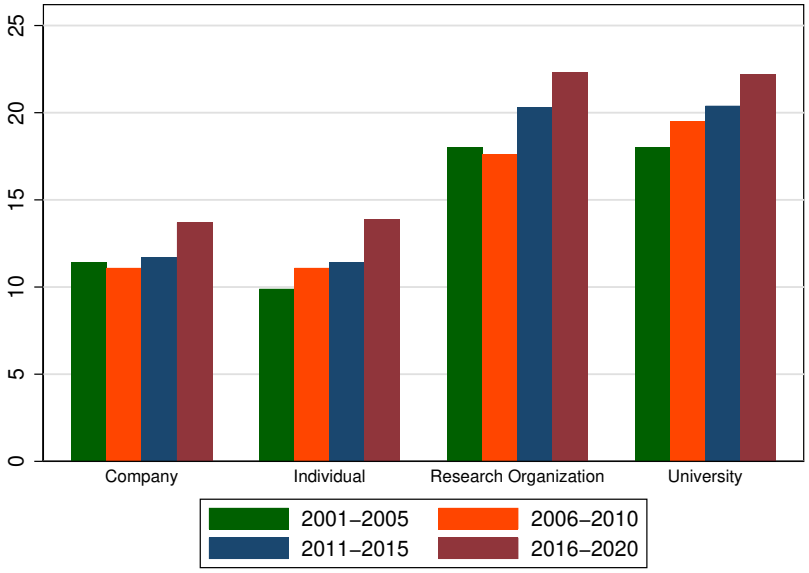


Figure A31: Women inventor rate (WIR) in Oceania, by sector and over time

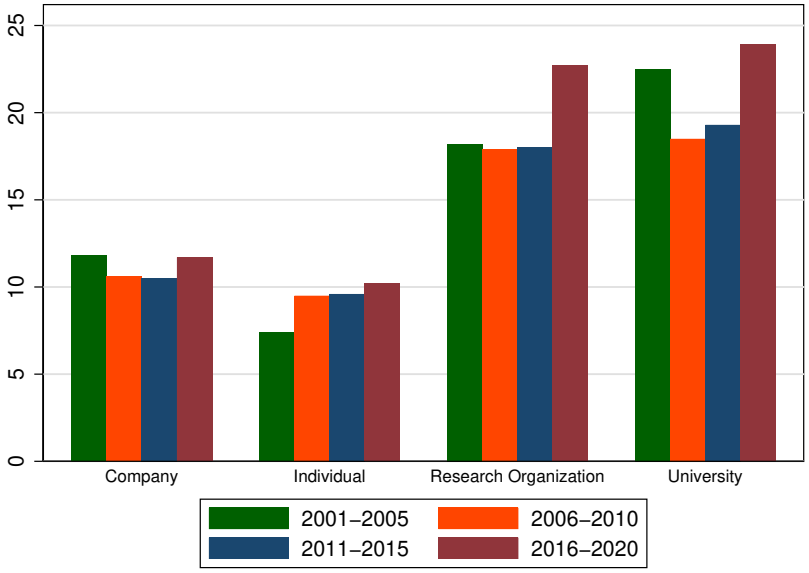


Figure A32: Share of patents by inventor's gender composition over time in Asia

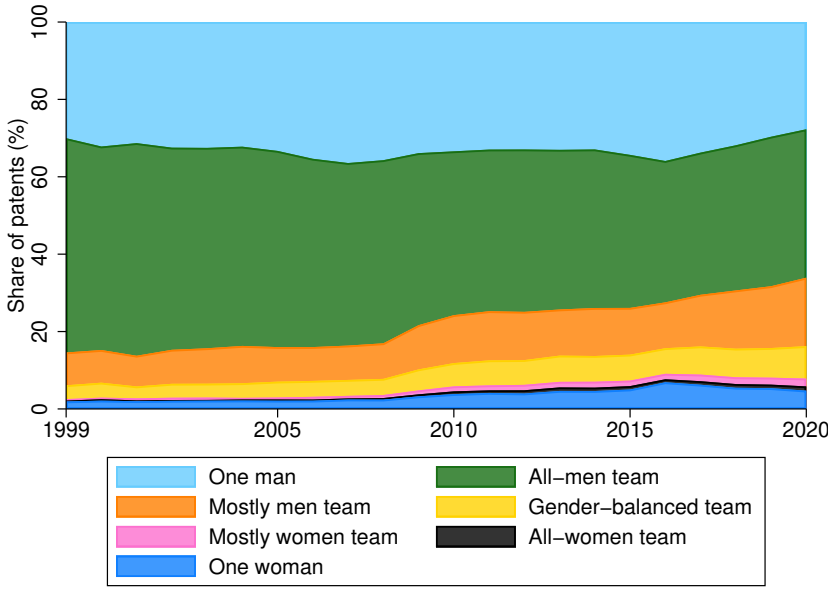


Figure A33: Share of patents by inventor's gender composition over time in Africa

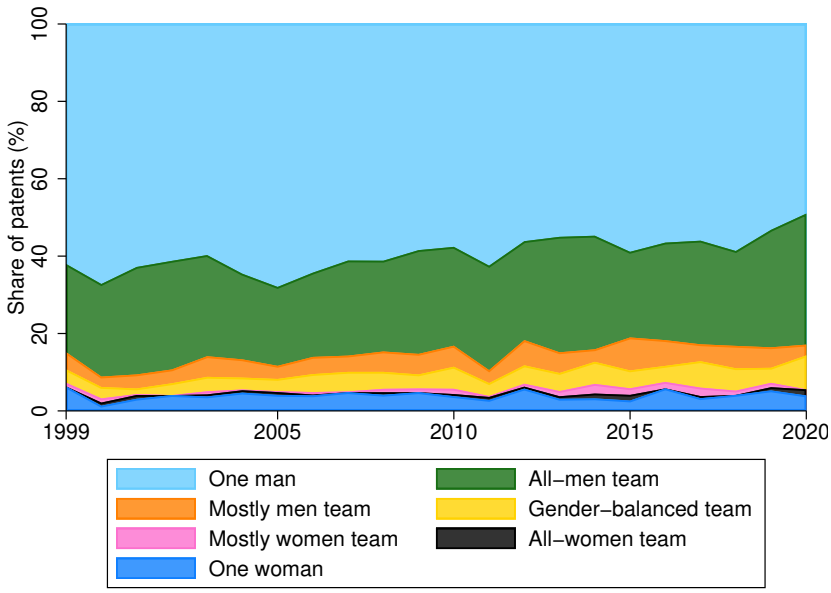


Figure A34: Share of patents by inventor's gender composition over time in Europe

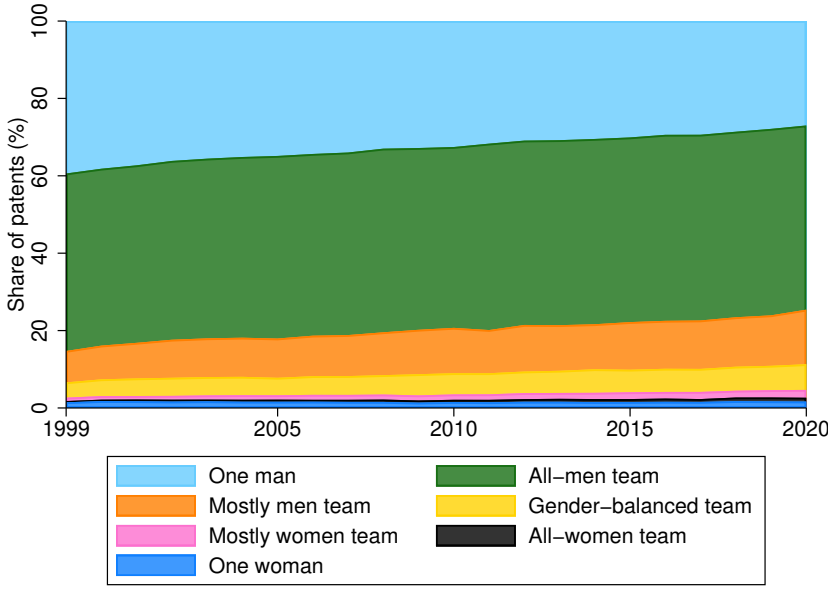


Figure A35: Share of patents by inventor's gender composition over time in Latin America and the Caribbean

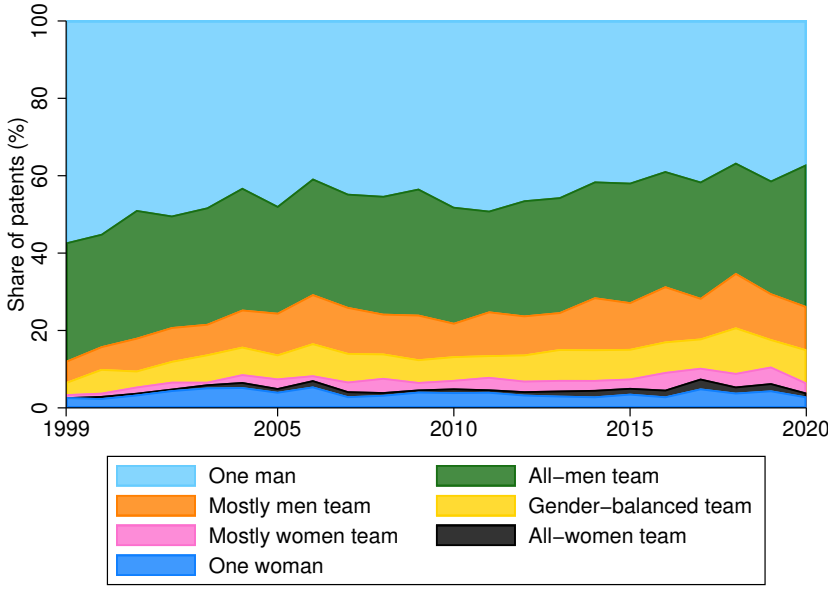


Figure A36: Share of patents by inventor's gender composition over time in Northern America

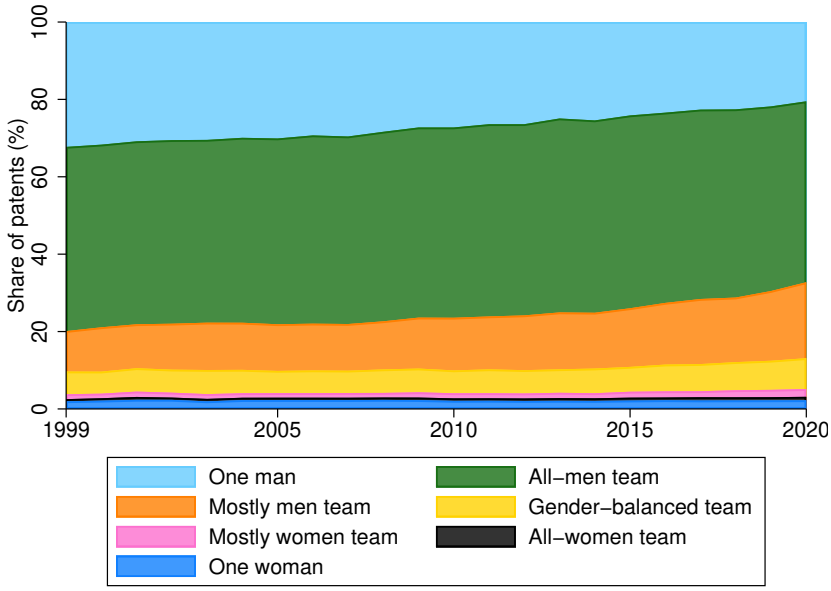
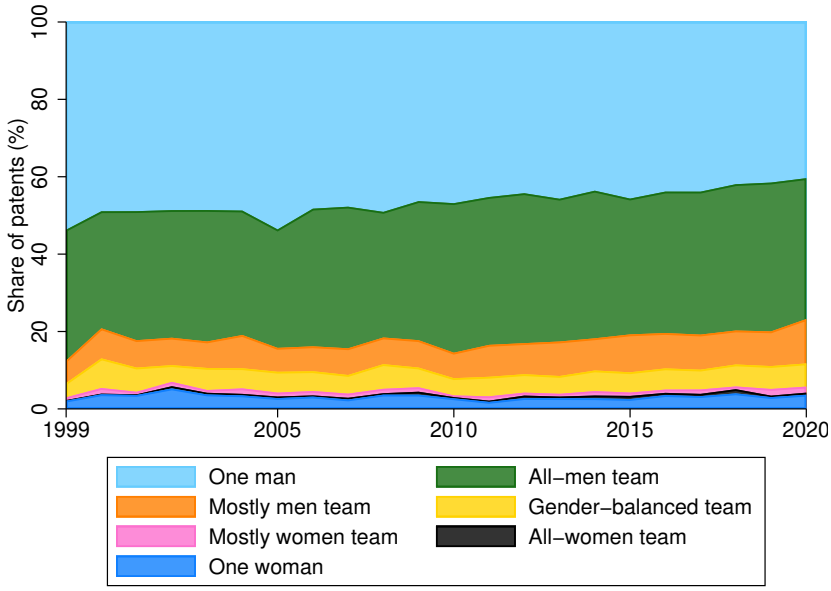


Figure A37: Share of patents by inventor's gender composition over time in Oceania



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CH-1211 Geneva 20, Switzerland

Suggested citation: WIPO (2023). The Global Gender Gap in Innovation and Creativity: An International Comparison of the Gender Gap in Global Patenting over Two Decades. Development Studies Series. World Intellectual Property Organization, Geneva, Switzerland.

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