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# The Role of Geography and Gender in Telecommunications Standards Participation

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Do meeting locations shape who influences telecom standards? Using quasi-random variation generated by 3GPP rules that rotate venues across cities, we study attendance at 2,241 working-group meetings (1999–2018). In a gravity-style linear probability model, geographic distance and national borders sharply reduce individual participation, even after controlling for role, seniority, and inventive activity. Crucially, the distance penalty is substantially larger for women and cannot be explained by differences in experience or technical expertise. By contrast, participation by core firms and senior technical leaders is comparatively insensitive to travel frictions. These results show that, despite cheaper communication and abundant air connections, spatial barriers still govern access to standard-setting and can tilt representation in a key arena of innovation policy.

**KEYWORDS**
Telecom standards, Standard-setting organizations, International Meeting locations, Travel frictions, Gender gap participation.

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# El rol de la geografía y el género en la participación en estándares de telecomunicaciones

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¿Influye la ubicación de las reuniones en quién tiene voz en los estándares de telecomunicaciones? Aprovechando la variación cuasi-aleatoria generada por las reglas de 3GPP para rotar sedes por región, analizamos la asistencia a 2.241 reuniones de grupos de trabajo (1999–2018). En un modelo de probabilidad lineal tipo gravedad, la distancia geográfica y las fronteras nacionales reducen marcadamente la participación individual, aun controlando por rol, antigüedad y actividad inventiva. De manera crucial, la penalidad por distancia es sustancialmente mayor para las mujeres y no se explica por diferencias de experiencia o expertise. En contraste, la participación de las firmas núcleo y de líderes técnicos senior es relativamente insensible a fricciones de viaje. Los resultados muestran que, pese a menores costos de comunicación y más conexiones aéreas, las barreras espaciales siguen condicionando el acceso al proceso de estandarización.

## 1 | INTRODUCTION

Standardization plays a crucial role in the development of many modern technologies; and in particular for telecommunication technologies. The different generations of mobile telecommunications technology (2G, 3G, 4G, 5G, etc.) are defined by complex technical specifications that are developed in industry-driven Standards Development Organizations (SDOs). The most important forum for the standardization of mobile telecommunications technology is the 3GPP (Third Generation Partnership Project).

Through 3GPP, experts and representatives from various organizations collaborate to establish and improve 3GPP's Technical Specifications (TS). The technical work for the development and improvement of TS is primarily carried out in 3GPP's working groups, which meet multiple times per year. The importance of these meetings lies in their ability to bring together knowledge and experience from different parts of the world, ensuring that the standards developed are technologically advanced and widely accepted by the industry.

In recent years, the frequency and scope of these meetings have increased significantly. This growth reflects the rapid evolution of telecommunications technology and the constant need to update and improve existing standards. Furthermore, the group of participating organizations has significantly increased, driven by new powers like China and smaller countries, as will be discussed later.

As a result, attendance at these meetings has become increasingly important. However, the growing frequency of meetings and the global distribution of 3GPP's active participants have made it more challenging for everyone to attend all relevant meetings. In this article, we exploit variation in meeting locations due to 3GPP rules to examine the factors influencing the decision to attend or not attend a standardization meeting, with a particular focus on how geographical distance affects meeting attendance. We pay special attention to how these effects vary across different groups, highlighting distinct patterns between men and women, as well as among senior employees and inventors.

Several studies in the geography and innovation literature have shown that improving connectivity—whether through new roads (Agrawal et al., 2017; Berger and Prawitz, 2024) or more direct flights (Bahar et al., 2023)—significantly increases scientific collaboration by reducing interaction costs. However, even in 2024, despite more direct flights than ever, distance remains a barrier to collaboration, particularly for certain groups. Our paper further contributes to this literature by demonstrating that distance still influences collaboration decisions, with the impact being especially significant for women.

Our approach draws on the gravity equation commonly used in trade literature, which emphasizes the role of geographic proximity and shared borders in shaping trade patterns (Bernard et al., 2007; Tinbergen, 1962). Although the gravity equation is traditionally applied to firm export behavior, we adapt it to estimate a linear probability model that examines how distance, borders, and cultural factors influence individuals' decisions to attend international meetings. Similar to the gravity model, our participation model functions as a reduced-form model of a static partial equilibrium for attendance decisions Bergstrand (1985). In this model, firms and individuals maximize their indirect utility by deciding which worker to send or whether to attend a meeting, based on both meeting and individual characteristics.

Using administrative records from 3GPP standardization meetings from 1999 to 2018, we estimate a linear probability model for individual attendance at meetings. Our final dataset covers 2,241 meetings across 35 different working groups, including 125,492 individual attendance records with attendee details, such as name, role at the meeting (e.g., delegate or chair), organization (3GPP member company), and phone number. We supplement 3GPP records with information on attendees' country of origin and gender, inferred from their phone numbers and first names (Wais, 2016). Additionally, we have 19,876 records of individuals who registered but ultimately did not attend. The dataset is further expanded to 227,804 observations by including individuals who neither attended nor registered but, based on past attendance in the same working group, could have potentially participated. We also incorporate information on attendees' patent activity from the OECD database, which is matched with the Searle Center's Database of Declared SEPs (Baron and Spulber, 2018). Finally, we add data on cultural proximity between countries from the Centre d'Études Prospectives et d'Informations Internationales (CEPII).

Our initial analysis shows that the farther potential attendees live from the meeting location, the less likely they are to attend. Furthermore, even after accounting for distance, attendees are more likely to participate if the meeting is held within their country of residence or in a country where they share a common language.

Nevertheless, these chilling effects of borders and distance are not experienced by all 3GPP participants. We find that distance plays a greater role for women's participation in 3GPP meetings, which could condition their future career opportunities. Importantly, while distance has a less significant effect on the participation decisions of more senior individuals and more accomplished technical experts; the fact that women's participation is more elastic to distance cannot be explained by differences in experience or technical expertise between women and men. Furthermore, both distance and border effects do not affect the participation decisions of the employees of the organizations that are most involved in 3GPP.

**Related Literature.**

Our paper contributes to several strands of literature. First, it relates to the economics and management of standardization in telecommunications, particularly the role of standardization bodies' rules in shaping participation and representation. Closer to our research, (Chiao et al., 2005) and (Lerner and Tirole, 2006) examine how an SDO's support for technology developers or adopters influences institutional partners' participation, while (Farrell and Simcoe, 2012) explores how institutional incentives shape participation through a war of attrition. To the best of our knowledge, this is the first paper to examine individual participation in global SDO meetings, highlighting how meeting locations influence participation and potentially affect the representation and decisions on telecommunications standards.

Second, our paper relates to gravity models, which consistently explain various flows, particularly trade (Tinbergen, 1962; Bernard et al., 2007; Helpman et al., 2008), as well as migration (Ortega and Peri, 2013; Bertoli and Moraga, 2013), commuting (Cavalleri et al., 2021), and tourism (Santana-Gallego et al., 2010; Khadaroo and Seetanah, 2008). Recent studies apply this to innovation, showing that technical standards impact hydrogen trade by reducing barriers (Ashari and Blind, 2024) and complementing findings on standards as trade facilitators or barriers (Fontagné et al., 2015). We contribute to this gravity-innovation literature by using gravity models to explain attendance at international innovation-related meetings.

Third, our paper contributes to research on connectivity and innovation collaboration. Since Jaffe et al. (1993) showed that innovation spillovers are geographically constrained, much research has examined how connectivity enhances these spillovers. Studies find that improving connectivity, such as through new roads (Agrawal et al., 2017; Berger and Prawitz, 2024) or direct flights (Bahar et al., 2023), boosts scientific collaboration by reducing interaction costs. In 2024, however, distance remains a barrier for certain groups. Our paper highlights that distance still influences collaboration, with effects more pronounced for women.

Finally, the literature on gender inequalities extensively documents how mobility and willingness to travel affect professional opportunities and the gender wage gap. Studies show that women often prefer shorter commutes, which can lead to lower wages (Liu and Su, 2024; Le Barbanchon et al., 2021). These mobility choices, shaped by disproportionate family responsibilities, create barriers to travel-required events like conferences and meetings (Kwan, 1999; Fan, 2017), limiting access to professional development and leadership roles and reinforcing gender gaps (Lee and McDonald, 2003; Aguilera, 2008). While much of this literature focuses on traditional work settings, our study examines how mobility affects women's participation in technology standardization meetings, where mobility barriers impact women in a high-paying, specialized field.

The article is structured as follows: The next section discusses the institutional context. Section 3 presents the database used for our estimates, as well as general descriptive statistics. Section 4 presents descriptive findings regarding observed geographic patterns in meeting attendance. Section 5 discusses the empirical model and identification strategy; Section 6 presents the model results; and finally, Section 7 discusses potential mechanisms, implications, and avenues for further research.

## 2 | INSTITUTIONAL CONTEXT

Within 3GPP, experts and representatives from various organizations participate in *Working Groups (WG)* to discuss and develop specific Technical Specifications (TS). Individuals have to be authorized by a company or organization that is a member of 3GPP to participate in a WG as delegates on their behalf.[1] Each WG focuses on a particular aspect of the technology or a specific technical area. Individuals contribute documents containing ideas and technical solutions aimed at developing or enhancing a standard. These contributions are discussed in meetings organized by the group, where consensus is sought on the TS to be included in the next version of the standard .

*Standardization Meetings (Meetings)* are events organized by the working groups within the 3GPP framework, where delegates from member organizations convene to discuss, decide on technical contributions submitted by WG members prior to each meeting. In some WGs, WG members may submit *change requests (CR)*; which are formal requests to make specific changes to a TS. In this case, the different CRs received by a group are debated during the meeting, and some CRs are approved and forwarded to the Technical Specification Group (TSG) plenary for final approval. In other WGs, individual delegates submit discussion papers with their views on necessary changes to a TS; and a specification editor drafts a CR once a consensus in the group has emerged. In either case, WG meetings are crucial for the standardization process as they allow participants to defend their contributions, review and discuss other participants' contributions, and participate in the final decision making on technical specifications. Approval of standards is achieved through consensus, meaning there should be no sustained opposition from participating members. These meetings ensure that the standards developed are technically sound and widely accepted by the industry.

*Meetings' location*. Most 3GPP meetings are held in countries or regions where 3GPP individual members are based (Europe, North America, Asia). According to 3GPP documents, meeting locations are chosen to reflect the geographical diversity of participants. Each working group selects its meeting location based on the following 3GPP rules: (1) within a series of up to six regular meetings, a working group should not meet in the same country more than once per year; (2) airports in the region must provide a minimum of 50 flights in and out per day; and (3) if the airport is not an international hub, it should be served by at least two different international hubs.[2]

[1] A small number of individuals may also serve in administrative roles as representatives of 3GPP itself.

[2] For a comprehensive list of the rules and recommendations for meeting locations, please visit `https://www.`

Table 1 shows the distribution of meetings from 1999 to 2018 for the top 20 cities. Overall, cities hosting meetings are spread across the global north, and apart from Sophia Antipolis in France and San Francisco in the United States, they hosted a relative similar number of meetings (Column 3). Columns 4 and 5 show that the probability of attending a meeting does not vary significantly between cities, based on both the original 3GPP records (Column 4) and our extended sample (Column 5).

*[Insert Table 1 here]*

## 3 | DATA AND DESCRIPTIVE STATISTICS

### 3.1 | Data

We use administrative records of 3GPP standardization meetings from 1999 to 2018. The final dataset used for our analysis covers a total of 2,216 meetings of 35 different working groups. For each meeting, we have information on the meeting location (at the city level), and the date the meeting occurred. We also use 125,492 individual attendance records; including the name and surname of the attendee, their role at the meeting (e.g. delegate or chair), the organization they represent (a company that is a member of 3GPP), and their phone number. We also have 19,876 observations of individuals who registered for the meeting, but ultimately did not attend. We expand the dataset to include individuals who did not attend and did not register to participate in a particular meeting, but who (based on past attendance in the same WG) could potentially have participated ,as explained in Section 5, thus increasing the dataset to 227,804 observations.

We complement the 3GPP records by adding information on attendees' country of residence and gender. We use telephone number prefixes (country codes) to assign attendees to a country of residence. In the case of Canada, the US, and China, we match them with a region or state within the country. If an attendee did not report any phone number for a given meeting, the last known phone number within the previous two years was used to assign individuals to a country of residence.[3] Attendees' gender was inferred from their first names, using the genderizeR package (Wais, 2016; Baron et al., 2024).

Additionally, we use data from CEPII (Centre d'Études Prospectives et d'Informations Internationales), focused on research in gravity equations, to include common cultural factors between the country of the potential attendee and the meeting location. These variables control for aspects such as shared primary language, predominant religion, and historical colonial ties between countries, which are used as controls and robustness checks in the analysis. CEPII is a leading French research center in international economics, founded in 1978, that provides detailed data widely used in academic research and policy evaluations, such as (Fontagné et al., 2015) and (Chaney, 2018).

Finally, we also use data on patents for which the individuals in our attendance records data are listed as inventors. We use the *OECD Triadic Patent Families Database*; which includes a dataset of the individuals listed as inventors of patents that belong to triadic patent families.[4] We matched this dataset with the *Searle Center's Database of Declared SEPs* (Baron and Pohlmann, 2018). A company that believes that a patent it owns may be or

`3gpp.org/delegates-corner/meetings/hosting-a-meeting`

[3] We generally use the latest known number. In cases where individuals switched back and forth between multiple phone numbers during the past two years, we used the most frequently reported number.

[4] A *patent family* is defined as a group of patents originating from the same invention; whereby a *triadic patent family* is a patent family which includes patents that were granted by at least the US Patent and Trademark Office (USPTO), the Japanese Patent Office (JPO), and the European Patent Office (EPO). Inventions protected by such triadic patent families are usually particularly valuable and important inventions.

become *essential* to a 3GPP TS must declare this patent to 3GPP. Declared (potential) SEPs are patents that are particularly relevant to standards development at 3GPP. Following Baron and Pohlmann (2018), we also use the CPC classification of declared SEPs to identify technology classes that are particularly relevant to 3GPP standards.

**Empirical measures.** Our main variable of interest is the distance between a meeting attendee's place of residence and the meeting's location. We construct this variable by computing the geodesic distance between the center of the attendee's country of residence and the city where the meeting took place. In the case of individuals residing in the US, Canada, or China, we observe the place of residence more exactly using the region code in the phone number (and accordingly define the place of residence as the geographic center of that region). In order to account for border effects we construct a dummy variable that takes value 1 if the meeting happens in the same country where the attendee lives and 0 otherwise. Additionally, to control for cultural distance, we include dummy variables for common language, shared religion, and former colonial relationships.

To account for attendees' characteristics, we construct three different measures. First, we compute their seniority as the number of years since the first meeting they ever attended. Second, using patent data, we compute the total number of patents for each inventor within the broader relevant technical field. Third, we compute the number of patents in the 3GPP-related technology classes for which each attendee was listed as an inventor; which is a general measure of an individual's technical expertise and accomplishments as telecommunications engineer. We also calculate the number of declared SEPs for which the individual was listed as an inventor; this variable more directly indicates an individual's contribution to the development of technologies standardized within 3GPP.

Participation decisions are likely determined not only (and perhaps not primarily) at the level of the individual 3GPP participant, but at the level of the 3GPP member organization (i.e. individual participants' affiliations). Affiliations differ in many respects, e.g. companies may have different incentives than public research institutes, and companies that primarily participate in 3GPP in order to learn how to implement 3GPP standards have different incentives from companies that participate in order to contribute their technological inventions to 3GPP standards. At this stage of the research project, and following Baron and Kanevskaia (2023), we focus on a very general measure, a dummy variable indicating whether a company is among the *Top 10 stakeholders* of 3GPP. Top 10 stakeholders are defined as the ten organizations most represented in 3GPP meetings (highest all-time attendance counts in our dataset).[5] This measure captures both the fact that these companies are large and powerful within the realm of 3GPP standardization, and that these companies have significant stakes in 3GPP standards development (i.e. while there are other, larger companies in the dataset, these other companies are less invested in 3GPP standards development).

Table 2 shows the main descriptive statistics for our variables in 3GPP records.

*[Insert Table 2 here]*

## 4 | GEOGRAPHIC PATTERNS IN 3GPP MEETING'S ATTENDANCE

We begin our analysis by documenting geographic patterns in meeting attendance. We document three key patterns: changes in meeting locations over time, changes in the composition of the attendee population in terms of country of residence, and the representation of women among attendees over time and across regions.

[5]The Top 10 stakeholdersa are Alcatel-Lucent, Ericsson AB, Huawei Technologies, LG Electronics, Motorola (incl. Motorola Solutions), NEC Corporation, Nokia, NTT, Qualcomm, and Samsung Electronics.

### 4.1 | Meeting Locations

First, as documented in Figure 1, nearly 80% of 3GPP meetings took place in the US, China, Europe, and the UK. While this percentage remained relatively stable from 1999 to 2018, the distribution among these countries evolved over time. In particular, Chinese companies significantly increased the number of meetings hosted, from almost none in the 2000s to hosting nearly 15% of the total meetings in 2018. In contrast, companies in the EU and the UK transitioned from hosting nearly 60% of meetings in the 3G era (the 2000s) to less than 20% in 2018. U.S. companies remained stable, hosting approximately 20% of the meetings throughout the entire period (see Figure 2).

*[Insert Figure 1 here]*

*[Insert Figure 2 here]*

### 4.2 | Country of Residence of Attendees

Second, half of the meeting attendees reside in the US, China, or Europe (including the UK). At the start of the period, nearly 80% of attendees lived in Europe or the US. However, by 2018, around 15% of attendees lived in China and almost 40% lived in other countries. This increase is primarily explained by the participation of individuals living in South Korea, India, and Taiwan.

Figure 3 shows the total number of attendees by country of residence from 1999 to 2018. While the majority of 3GPP meeting attendees reside in only a few countries , we can observe a lower concentration compared to the distribution of meeting locations. Throughout the entire period, attendees residing in Europe accounted for 19%, those in the U.S. for 18%, those in China for 12.25%, and those residing elsewhere made up the remaining half.

*[Insert Figure 3 here]*

Figure 4 shows the share of attendees by country of residence out of the total attendees from 1999 to 2018. While a significant number of attendees still reside in the US, China, the EU, or the UK, there is a noticeable increase in participation from individuals residing in other countries. This increase in participation is primarily driven by individuals living in South Korea, whose representation increased from 3% to 6%; in India, which surged from 0.01% to over 1%; and in Taiwan, where participation rose from 0.02% to over 2%.

*[Insert Figure 4 here]*

### 4.3 | Share of Women Among Attendees

Third, women represent only an average 12% of total attendees during our sample period. Even though we observe a slight increase of women participation over the years, increasing from 9% in 1999 to around 14% in 2016-2019, women are still underrepresented in 3GPP meetings. While the genders disparities are common across all countries of residence, they are particularly pronounced among individuals living in Europe and the US (with a share of female attendees of only around 10%), whereas 30% of attendees living in China are female.

Figure 5 shows the number of male and female attendees by country of residence from 1999 to 2018 for the US, China, Europe, and the UK. Appendix Figures A.1 and A.2 show the attendance of men and women from around the world.

*[Insert Figure 5 here]*

### 4.4 | Travel Behavior of Individuals Over Time

Fourth, over time, individuals attend more 3GPP meetings and travel greater distances to attend them. From 1999 to 2017, individuals, on average, double the number of 3GPP meetings they attend and increase the number of kilometers they travel by 45%.

Panel (a) in Figure 6 displays the average distance, in thousands of kilometers traveled per attendee per meeting from 1999 to 2017. On average, an individual traveled 4,500 kilometers to attend a 3GPP meeting in 1999, while they traveled around 6,500 kilometers in 2018, representing an increase of almost 40%. This trend is observed for both men and women. Although women are less likely to attend (Figure 5), conditional on attending, men and women travel approximately the same distance on average.

Panel (b) in Figure 6 shows the average number of meetings attended by individuals from 1999 to 2017. Both men and women attend significantly more meetings in 2018 than in 1999. Women increased their participation from an average of almost 5 meetings per year in 1999 to almost 11 in 2018, doubling their participation. Men also doubled the average number of meetings per year, from almost 6 meetings per year in 1999 to almost 11 in 2017. While during the first years of our sample period the attended meetings gap increased between men and women, at the end of our period men only attend, on average, one more meeting than women per year, that is, they attend on average 10% more meetings.

*[Insert Figure 6 here]*

Appendix Figures A.3 shows the distribution of the number of attended meetings per year for both men and women. When comparing both distributions, we observe a longer right tail for men and a higher density accumulated around less than 5 meetings per year in the case of women, suggesting sex heterogeneities in the distributions of the number of attended meetings.

## 5 | EMPIRICAL STRATEGY

### 5.1 | Creating a Panel

The registration records of 3GPP meetings provide certain information about individuals who registered for the meetings. While this data covers individuals who registered for a meeting but ultimately did not attend, this group represents only about 15% of the total number of registrations. Individuals who registered to participate in a meeting but ultimately decided not to attend are likely to be different from individuals who knew from the outset that they would not participate in a meeting. To conduct a comprehensive analysis of participation decisions within the context of 3GPP meetings, it is essential to also consider individuals who did not register for the meeting, but had the potential to attend (counterfactual observations).

To identify these non-attendance decisions, we define potential attendees as individuals who have engaged in a minimum of two meetings within the working group over the past two years. By defining this criterion, we can pinpoint those who have a consistent involvement in the group's activities and thus possess a genuine likelihood of attendance. For these potential attendees, we maintain continuity by assigning them the same attributes they exhibited during their last observed participation, such as their phone number and affiliation. This approach allows us to gain a more thorough understanding of attendance dynamics and factors influencing meetings' participation decisions.

Our estimation sample consist of an unbalanced panel of 227,804 observations at an individual-meeting level, encompassing data on over 5,300 individuals and 2,200 meetings.

Table 2 shows the main descriptive statistics of our new sample. The observed attendance rate in our dataset is approximately 60%. This is a remarkably high rate - for every WG meeting, more than half of the individuals who are *at risk* of participating (i.e. who have shown interest in the WG in the past) actually participate. This attendance rate has also significantly increased over time as indicated in Figure 6, contributing to increasingly demanding travel schedules in the population of 3GPP participants.

Table 4 presents descriptive statistics of our estimation sample by sex and t-tests for the mean difference. In our estimation sample, similar to the original sample, women attend significantly fewer meetings on average compared to men. However, when considering those who attend, both genders travel almost the same distance. Furthermore, women exhibit statistically significantly less experience than men, patent fewer inventions, and are listed as inventors in fewer SEPs. Additionally, we find no evidence to reject the null hypothesis of equal means for the probability of working in a top 10 company, suggesting that men and women have equal likelihoods of working in such firms.

*[Insert Table 3 here]*

*[Insert Table 4 here]*

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### 5.2 | Identification Strategy

To asses the importance of distance in meeting's attendance we rely on the variation of meetings location due to 3GPP rules and apply a high dimensional fixed effect strategy that leverages the panel structure of the data as well as variation in meetings and attendees location.

We exploit this variation and estimate a linear probability model by Ordinary Least Squares (OLS), at the individual($i$)- meeting($m$) level:

$$Attended_{im} = \alpha + \gamma distance_{im} + \beta_j \theta X_{im} + \mu_i + \mu_m + \epsilon_{im} \tag{1}$$

where $Attended$ is a dummy variable that takes value 1 if individual $i$ attended meeting $m$ and 0 otherwise. The variable $distance$ accounts for the distance in thousands of kilometers between the meeting and the individual's location. $X$ is a set of control variables including a dummy variable that takes vale 1 if the meeting occurred in the same country where individual $i$ resides and 0 otherwise ($SameCountry$), a dummy variable that takes value 1 if the individual is a women and 0 otherwise ($Female$) ; years since the individual start attending 3GPP meetings ($Seniority$), the count of patents in the relevant field ($Patents$); and the count of SEPs invented by individual $i$ at the time of meeting $m$ ($SEP$). Controls vary depending on the specification and interaction terms between controls in $X$ and $distance$ are also included. Additionally, we include individual-working groups, month, year and country of the meeting fixed effects. All variables are defined as in Section 3 Finally, $\epsilon$ is the error term in the model.

The inclusion of multiple sets of fixed effects allows us to control for many potential confounding factors. In particular, individual-working group pair fixed effects encompass individual [attendee] fixed effects, which control for different individuals' different propensity to participate in 3GPP meetings. Furthermore, these fixed effects encompass working group fixed effects, thus controlling for differences between working groups in terms of average attendance (which may reflect differences in relevance). Finally, and perhaps most importantly, individual-working group pair fixed effects control for the overall propensity of an individual 3GPP participant to participate in the meetings of a particular working group, thus controlling for the relevance of a WG to a particular individual. Meeting country fixed effects capture any effects that make a particular meeting location more or less attractive to all potential participants (irrespective of where they live); year fixed effects account for any time trends; and month fixed effects control for possible seasonality in attendance rates. These extensive and granular sets of fixed effects dispense us of the need to include additional control variables.

The parameter $\gamma$ assesses the degree to which individuals respond to the distance to the meeting location. Conditional on all individual and meeting varying controls and fixed effects, an increase of one thousand kilometers in an individual's distance to the meeting location results, on average, in a change of $\gamma$ percentage points in the probability of attendance.

While we recognize the limitations of employing Linear Probability Models (LPM) for modeling dummy variables, opting for nonlinear models like Probits or Logits would not be feasible when implementing a high-dimensional fixed effect strategy to identify our parameters. For a more in-depth discussion on this topic, the reader may refer to Lancaster (2000).

### 5.3 | Potential Violation to The Identification Strategy

A potential concern for the proper identification of the $\gamma$ parameter is the non random allocation of meetings. It could be the case that most important meetings are host by big companies near to their headquarters making distance bigger for individuals leaving further from those cities.

Appendix Table A.1 shows that, conditional on having hosted a meeting before, the probability of a city hosting a future meeting is around 1%–2%, except for Sophia Antipolis in France (8%) and San Francisco (3%). This reflects the significant rotation of cities hosting meetings over time, as stipulated by 3GPP rules.

Furthermore, when we analyze the locations of the headquarters of the top 10 companies and where meetings are held, Appendix Table A.2 shows that less than 9% of meetings take place in cities where these top 10 companies have their headquarters. Additionally, Appendix Table A.3 shows that, of the more than 55,000 attendees representing the top 10 companies, only 10% attend a meeting in the same country where they reside

## 6 | RESULTS

Table 5 presents the estimates of Equation 1. Column (1) shows the results for distance alone, Column (2) shows the results of a model only including the same country dummy, and Column (3) shows the estimation results when both distance and the same country dummy variable are included simultaneously.

Column (1) shows a significant and negative effect of distance on the probability of attendance. Conditional on any factors captured by the individual-working group pair, year, month and country where the meeting takes place, an increase of one thousand kilometers in the distance to the meeting location leads to a decrease in the probability of attendance by 0.007. Column (2) shows an increase in the probability of attendance of 0.096 if the meeting takes place in the same country where the individual resides. Column (3) shows that distance matters less when we control for the same country effect. Controlling for this factor, an increase of one thousand kilometers now results in an average decrease in the probability of attendance by 0.003. Nevertheless, both factors are individually statistically significant; i.e. distance matters not only because of border effects, and borders matter not only because of distance. To ensure the robustness of our results, we re-ran the analysis excluding Sophia Antipolis, the main meeting city. Appendix Table A.4 confirms that the results hold.

*[Insert Table 5 here]*

Figure 7 shows estimates of a dynamic version of Equation 1. In this version of Equation 1, we interact year fixed effects with distance and with the same country dummy to assess changes in those parameters over time. Panel (a) indicates that each year, the negative effect of distance on attendance is reduced. Specifically, an increase of one thousand kilometers from individuals' residence to the meeting location reduces the average probability of attendance by 0.014 in 2001 and only by 0.004 in 2017. Panel (b) shows that this is not true for the same country effect. When interacting the same country dummy with the time fixed effects, we find that the estimation of the parameter does not change steadily over time. These results suggest that the distance between the meeting location and the country of residence has gradually become less important for explaining participation decisions, whereas the effect of having to cross borders to participate in the meeting has not.

*[Insert Figure 7 here]*

As documented previously, women are underrepresented in 3GPP meetings. One potential explanation is that women may be less likely to travel when it involves longer distances. To assess this hypothesis, we include a female dummy variable and its interaction with distance in our model. It should be borne in mind that, since we are including individual-working group fixed effects, the female effect is absorbed by these fixed effects. We thus do not attempt to measure to what extent being female impacts the overall participation decision; rather, we attempt to measure whether the impact of borders and geographic distance are moderated by potential participants' gender.

Table 6 shows the estimates of Equation 1 when including the female dummy and its interaction terms. Column (1) shows a negative and significant coefficient of -0.003 for the interaction term between distance and the female dummy. The magnitude of this term is quite significant and accounts for almost half of the effect of distance on the attendance probability for men. While for men, an increase of one thousand kilometers reduces the likelihood of attending a meeting by 0.006 on average, for women, it reduces this likelihood by 0.009. Column (2) shows that this effect still holds when controlling for the same country dummy.

Column (3) shows that while women are more elastic to distance, they are not more sensitive to the same country effect. Consistent with the results in Table 5, when the meeting occurs in the same country in which the individual resides, the probability of attendance increases on average by 0.09, and this effect is not significantly different between men and women.

*[Insert Table 6 here]*

The significance of border effects, beyond simple geographic distance, may be attributed to factors such as cultural barriers, ease of communication, and visa requirements, among others. While visa requirements can pose a significant barrier to meeting attendance, as discussed in Section 7, limited time variation within countries on these requirements prevents us from identifying their specific impact on attendance. Therefore, we focus on the cultural mechanisms underlying the border effect. To this end, we include three dummy variables indicating common language, common religion, and former colonial relationships. Table 7 presents estimates results.

Table 7 presents estimates of Equation 1, incorporating the common language dummy and its interaction with the female dummy. In an alternative specification of our main equation, we also included dummies for shared religion and former colonial ties but found no significant results. Column (1) of Table 7 shows that, controlling for distance and border effects, sharing a common language increases the probability of attendance by 0.021 percentage points, a statistically significant effect. Column (2) indicates that the language effect does not differ significantly between men and women.

*[Insert Table 7 here]*

Another potential dimension affecting an individual's decision to attend a meeting may be the size of the company they represent, and the company's level of interest in 3GPP standards development. Larger companies have more resources and are less constrained in affording business trips, including business class flights and top-ranked hotels. At the same time, companies with significant stakes in 3GPP standards development are willing to devote more significant resources to ensure that they are well represented in standards development. In addition to being more willing to pay for their employees' travel costs, these companies may exert more pressure on their employees to attend these meetings since they have higher stakes.

While we cannot separate these effects, we can estimate the impact of representing a top 10 company on an individual's probability of attendance. Given that we are controlling for individual-working group fixed effects, the identification of these parameters comes from individuals who change companies. Therefore, our estimates in Table 8 should be interpreted as how the probability of attendance for a given individual changes when representing a top 10 company compared to representing a non-top 10 company.

Column (1) in Table 8 shows that, conditional on the distance to the meeting, representing a top 10 company significantly increases an individual's probability of attendance. Additionally, this effect also depends on the distance. On the other hand, individuals representing a top 10 company are not significantly elastic to the distance to the meeting. When adding the estimates of the $\gamma$ parameter with the distance-top company interaction term estimate, we find a net effect of zero. This result is supported by the findings in Column (3), where we estimate Equation 1 only for top 10 companies and find no effect of distance on meeting attendance.

Column (2) show estimates of Equation 1 using only individuals who do not represent a top 10 company. When representing a smaller company, individuals are more sensitive to both distance and the same country effect. For an individual not working in a top 10 company, the probability of attendance decreases on average by 0.004 for each additional thousand kilometers, and increases by an average of 0.054 if the meeting occurs in the same country where they reside.

*[Insert Table 8 here]*

Another important variable determining attendance is the seniority of the individual. As described in Section 3, we measure seniority by the number of years between the year the meeting $m$ occurred and the year the individual attended their first meeting. Table 9 reports estimates of Equation 1 with these controls included.

Column (1) of Table 9 shows that more senior individuals are less sensitive to distance. For individuals without experience, the probability of attendance decreases by an average of

0.009 for every thousand kilometers that their distance from the meeting increases. However, this decrease is, on average, reduced by 0.0005 for each year of experience.In particular, after 10 years of experience, the impact of distance on attendance probability is nearly halved. This finding is consistent with the idea that more senior individuals play more significant roles at 3GPP meetings, making them less likely to be absent. Column (2) shows that the results remain consistent when controlling for the same country effects, and this effect does not change with seniority.

Finally, as we observe that women are more sensitive to distance while senior workers are less sensitive, we aim to test whether the greater distance elasticity demonstrated by women could be attributed to seniority selection. Table 4 indicates that men are more senior than women. While the average seniority for women is 2.14 years, for men it is 2.47 years. To assess this potential selection effect, we will estimate Equation 1 by including the interaction term between female and seniority, as well as the triple interaction involving distance, the female indicator, and seniority.

Column (3) in Table 9 shows the estimation results. First, consistent with previous results, women exhibit greater sensitivity to meeting distance. For each additional thousand kilometers from their residence to the meeting, the probability of attendance decreases by 0.0024 compared to men (-0.0063). The interaction term parameter between female and seniority is not statistically different from 0, indicating that the effect of seniority on attendance probability does not vary between men and women. The estimate for the triple interaction parameter is 0 and lacks statistical significance, indicating that the seniority-distance effect does not differ by gender. In other words, each year of experience reduces the adverse impact of distance on the probability of attendance by an average of 0.0005 for both men and women.

*[Insert Table 9 here]*

*[Insert Table 10 here]*

In order to account for the importance of being an inventor in the probability of attending a meeting, we estimate Equation 1 while including control variables that account for individuals' inventiveness. Specifically, we include the number of patents in the relevant fields in which the individual is listed as inventor, $\mathtt{Inventor}$, as well as $\mathtt{NumberofSEPs}$ which represents the number of SEPs for which the individual is listed as an inventor. Both variables are constructed as specified in Section 3.

Column (1) in Table 10 shows the estimated results when accounting for inventorship. While being a prolific inventor does not change the probability of attendance, its interaction with distance seems to have a statistically significant effect on it, but its coefficient is almost zero. Column (2) indicates that, as with regular patents, being a prolific SEP inventor does not change the probability of attendance, but its interaction with distance seems to have a statistically significant effect. For each additional thousand kilometers further away the meeting occurs, non-SEP inventors are 0.0068 less likely to attend, while individuals listed as inventors in one SEP are only 0.0068 less likely to attend.

Column (3) and Column (4) in Table 10 show the estimated results when adding seniority as a control. Column (3) indicates that the effect of being a prolific inventor on the distance elasticity vanished when controlling for seniority, indicating that more prolific inventors are more senior. However, it is seniority, the variable explaining the decrease in distance elasticity. Column (4) indicates that this is not the case for prolific SEP inventors. While more senior individuals are less sensitive to distance, the interaction term between the number of SEPs for which the individual is listed as inventor significantly reduces their sensitivity to distance. Specifically, being listed as an inventor in one SEP reduces the average distance effect on attendance from -0.0092 to -0.0091.

*[Insert Table 11 here]*

## 7 | DISCUSSION OF POTENTIAL MECHANISMS

**Female Attendance.** While we observe that women are more reluctant to attend meetings further from home, we also observe that senior individuals are less affected by distance, as are SEP inventors and individuals working in top attendance companies. Table 4 indicates that women are less senior than men and are listed in a smaller number of Patents or SEPs as inventors. To assess whether women's greater sensitivity to distance is driven by this selection, we estimate Equation 1 including the interaction term between distance and female, controlling for each of the variables potentially driving the selection.

Table 12 indicates that the significant and negative estimation for the interaction term parameter between distance and female still holds when holding constant seniority (absorbed by the individual Fixed Effect), the probability of working for a top 10 attendance company, and the number of SEPs in which they are listed as an inventor. While the point estimate is slightly lower than the estimate without these controls, it remains statistically significantly different from zero.

*[Insert Table 12 here]*

One potential mechanism behind this result is that women may be less available for long-distance business travel, because women are oftentimes more likely to be considered the primary caregivers in their households. Moreover, women may also experience a lower personal return to participating in particular, social networking opportunities may be less valuable for women in an environment that is 87% male. Another potential reason may be that women may find it more difficult to convince their employers to pay for their travel cost, compared to men with similar experience, expertise, etc. We plan to unpack these different potential mechanisms in future versions of this draft.

**Why do borders matter?** Beyond the cultural mechanism discussed in Section 6, we explore two other mechanisms that may underlie border effects.

First, we hypothesize that crossing borders may limit participation if a visa is required. Using the DEMIG VISA database (Czaika et al., 2017), we created a binary variable indicating whether a visa was needed for travel, assuming the country of residence matches citizenship. We address possible confounding factors, such as individuals' general reluctance to travel to certain countries for reasons like language or safety concerns. For example, we observe that Chinese residents attend meetings in China more frequently, potentially due to visa issues or cultural and political factors.

To isolate the visa requirement effect, we include fixed effects for each country-of-residence and country-of-meeting pair, capturing only within-pair variation due to visa relaxation. This specification shows no significant effects, possibly due to limited within-pair visa changes and the DEMIG VISA database's restriction to 2013, reducing observations. Our binary visa variable may also oversimplify; the impact of visa requirements likely varies depending on factors such as e-Visas, long-term visas, or differences between residency and citizenship.[6]

Second, we consider the *China Effect*. Our data indicate that Chinese residents are less likely to travel abroad, while non-Chinese attendees are less likely to attend meetings in China, controlling for distance and same-country effects. However, even excluding

[6] Visa requirements vary; for instance, e-Visas or visas upon arrival are less restrictive than cases requiring in-person applications and high denial risks. Also, mismatches between residence and citizenship data may bias our estimates.

Chinese residents and China-based meetings, the same-country dummy remains significant, showing that border effects are not solely driven by the China Effect.

**Why does distance only affect marginal stakeholders?** The participation of employees of top stakeholders is inelastic to distance. On one hand, this could be expected: for these companies, the returns to participation are sufficiently great that the financial cost of attendance is not relevant. Given how important it is for the employer, individuals do not have the option to decline attendance. Additionally, the willingness and ability to attend all relevant 3GPP meetings may be a requirement for employment with these companies (individual ability to travel matters at the extensive margin—certain individuals just can't take these jobs that require extensive business travel). While these companies have extensive staff in different countries, we do not observe a significant substitution effect (attendance does not depend on the distance between the meeting location and other employees' place of residence).

**The Seniority Effect.** We find evidence that distance matters less to more senior individuals and more qualified experts (inventors). More senior individuals are overall less likely to attend, but their participation is less conditional on distance - both the value and the opportunity cost of attendance (time spent in the meeting) increase with seniority. Some own preliminary results suggest the financial cost of travel is less likely to tilt the balance. This may indicate that the negative effect of distance is not primarily driven by individuals' distaste for traveling far - one would expect more senior individuals to be more able to resist. We also found that more relevant experts are more likely to attend, and their participation is inelastic to distance - these individuals are less replaceable (there could be no substitution with other employees), the value of their participation is the greatest, so companies pay the cost. Moreover, these individuals may also particularly value the personal payoffs from participating (human and social capital), so they are more likely to overcome the personal inconvenience of traveling far.

**Changes over time.** One the reason behinds the increase in participation and traveled distance is that within our observation period (pre-Covid and before the escalation of geopolitical tensions between Chinese and Western governments/entities) 3GPP has become substantially more global. We observe that the population of attendees and locations of meetings are significantly more diverse and that people travel significantly longer distances to attend 3GPP meetings (both on average per meeting and cumulatively per year). We also show that distance becomes less relevant for determining participation - not only is the average meeting farther away from place of residence, but attendance has become less depending on distance. Yet, borders have not become less relevant during this period (though we expect they have become significantly more relevant in the four most recent years) This could reflect increasing stakes, or decreasing costs of long distance travel. Further analysis should be run in order to disentangle the forces dirving these results.

## 8 | CONCLUSION

In this paper, we have analyzed the effect of geographic distance and national borders on individuals' decision to attend a standardization meeting at 3GPP. We find that distance matters, but its effects are heterogenous and unevenly felt by different 3GPP participants: the effects of distance are more pronounced for women and for individuals from developing countries (including China), and they are less pronounced for senior employees, accomplished technical experts, and the employees of 3GPP's main commercial stakeholders. We also show that the effects of distance gradually decreased over time between 1999 and 2017, without disappearing altogether. We also find that borders matter for participation decisions above and beyond the effect of geographic distance; and that these border effects did not decrease over time.

We have discussed multiple potential mechanisms that may explain *why* distance and borders may matter for individuals' participation decisions. The monetary costs of attendance for companies certainly increase in the geographic distance. The hypothesis that distance effects may be attributed to monetary travel costs is consistent with the finding that geographic distance is relevant for "marginal" stakeholders, but not the top 10 stakeholders of 3GPP. Nevertheless, more work is necessary to fully corroborate this hypothesis.

Attending meetings far away from individuals' country of residence may also present other types of cost, e.g the inability to return home at night and the stress and discomfort of frequent business travel. These costs are largely borne by individuals. While the fact that women's participation is more elastic to distance may point to individual-level mechanisms that could explain the role of geographic distance, the fact that the participation of more senior and technically more accomplished individuals is less sensitive to distance casts doubt on the suggestion that individuals' preferences to avoid long distance travel are significant drivers for our results.

Overall, further empirical work is needed to shed light on the mechanisms behind our results. Understanding the mechanisms behind our findings is important in order to better understand their implications. In particular, as standards organizations (similar to many other workplace environments, in particular those related to science and technology) attempt but often struggle to offer fully equal opportunities to women and men, it is important to better understand whether differences in participation patterns of women and men are rooted in participants' families, the companies that employ them, or in the standards organizations themselves. In order to level the playing field between participants from developing and developed countries, it is also important to better understand what factors causally contribute to reduce the participation of individuals from developing countries; potentially including the monetary cost of participation, political factors (for which visa requirements are just an exemplification), and differences in cultural and social norms.

It is also important to study the *consequences* of the observed distance and border effects. In particular, can the (monetary or non-monetary) cost of travel explain why female 3GPP participants attend fewer meetings? Does the fact that female participants are less assiduous contribute to the observed under-representation of female participants in 3GPP plenary meetings and working group leadership positions? Does the fact that many meetings take place in just a few countries causally contribute to the over-representation of residents of these countries in 3GPP standards development? Does reducing the cost of meeting attendance for individuals from developing countries materially affect the ability of organizations from these countries to impact 3GPP standards?

Overall, this empirical analysis represents a first step in understanding the determinants of participation in global telecommunications standardization meetings and the role of geography in these decisions. Our findings show that *where* meetings are held significantly influences *who* attends. Standardization bodies (SDOs) should therefore adopt clear guidelines on meeting locations to ensure adequate rotation, as 3GPP does, to foster broader global participation. Hosting meetings in the Global South could also help bridge the standardization gap between the Global North and South. Additionally, targeted policies are necessary to support women's participation in international standardization, particularly when meetings are held far from their countries of origin, to promote gender balance.

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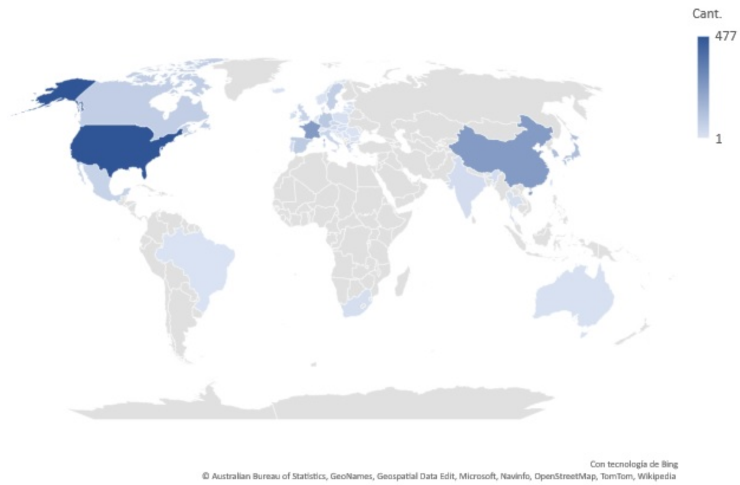
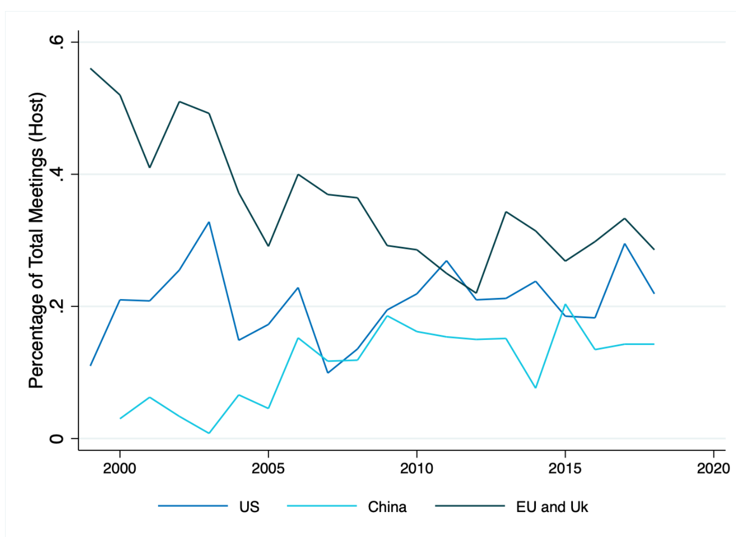
## 9 | FIGURES AND TABLES

**FIGURE 1** Total Number of Meetings by Country: 1999-2018



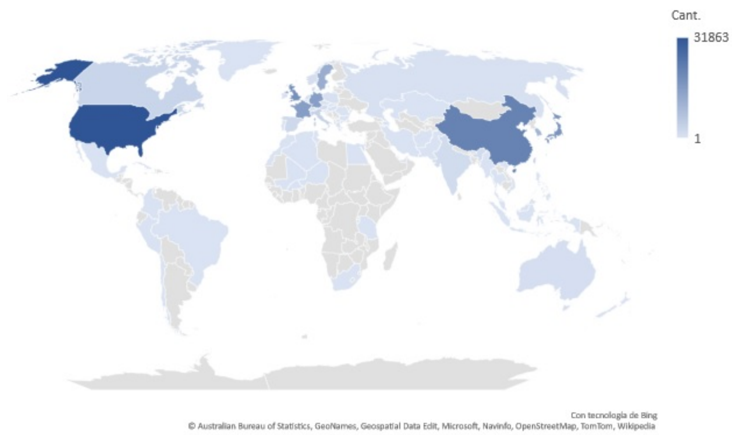

*Notes:* The figure shows the total number of meetings hosted by country from 1999 to 2018. Data from 3GPP records.

**FIGURE 2** Share of Meetings by Country and Year



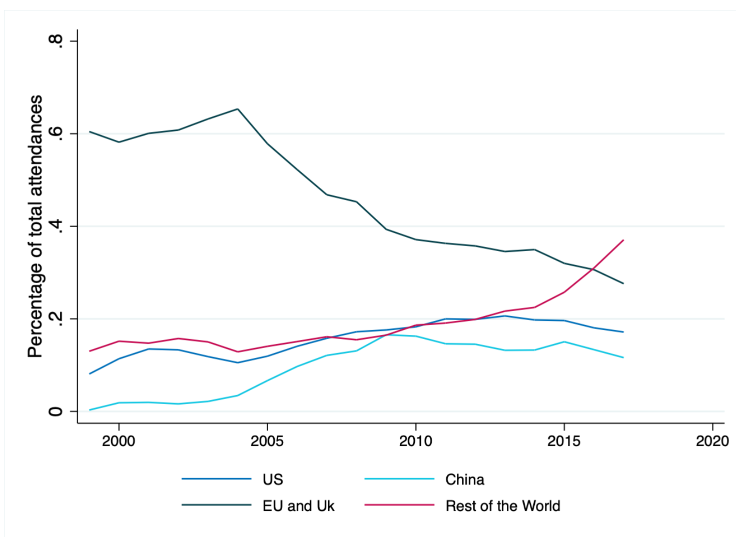

*Notes:* The figure shows the share of meetings hosted by US, Chinese and EU and the UK companies with respect to total meetings, by year, from 1999 to 2018. Data from 3GPP records.

**FIGURE 3** Total Attendees by Country of Residence: 1999-2018



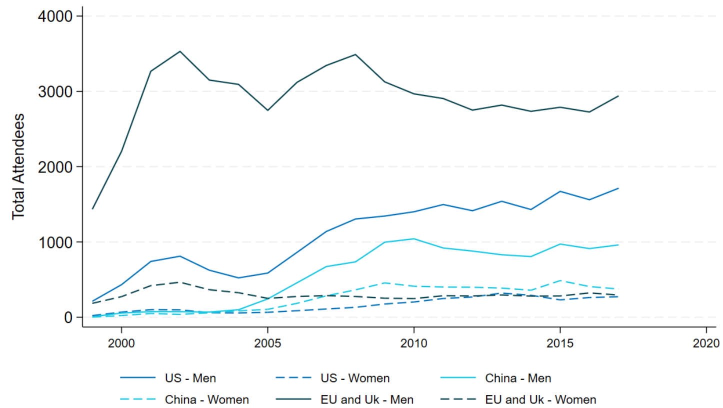

*Notes:* The figure shows the total number of attendees by country of residence from 1999 to 2018. The country of residence is determined based on phone numbers. Data from 3GPP records.

**FIGURE 4** Share of Attendees by Country of Residence and Year




*Notes:* The figure shows the share of attendees by country of residence out of the total attendees from 1999 to 2018. The country of residence is determined based on phone numbers. Data from 3GPP records.

**FIGURE 5** Attendance by Sex and Country of Residence: 1999-2018




*Notes:* The figure shows the total number of male and female attendees by country of residence from 1999 to 2018. The sex of the attendee is determined based on their name, while the country of residence is determined based on phone numbers. Data from 3GPP records.

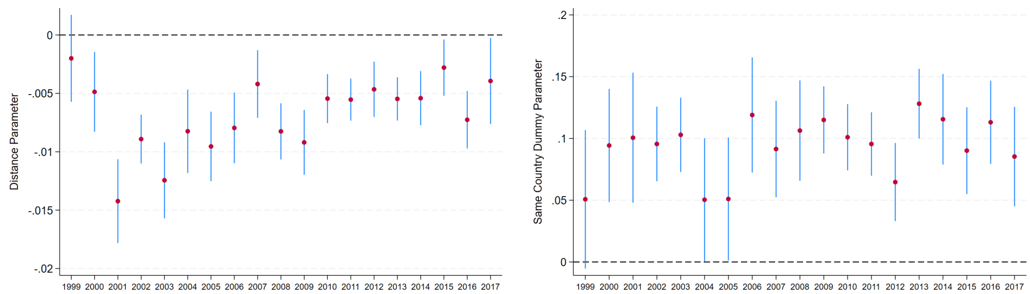
**FIGURE 6** Number of Meetings and Distance to Meetings in 3GPP by Sex


(a) Average Distance Traveled per Meeting, by Year

(b) Number of Meetings Attended per Individual, by Year

*Notes:* The figures show the number of 3GPP meetings attended by individuals and the average distance traveled, from 1999 to 2017. The sample was drawn from 3GPP records.

**FIGURE 7** Distance and Border Effect over Time




(a) Dynamic Model Estimates of the Distance Parameter ($\gamma$)

(b) Dynamic Model Estimates of the Same Country Dummy Parameter

*Notes:* The Figures show (Panel a) estimates of a dynamic version of Equation 1 including a set of interaction term between distance and year fixed effects, and estimates of a dynamic version of Equation 1 including a set of interaction term between $\mathtt{samecountty}$ dummy and year fixed effects (Panel b). All specifications include individual-working group FE, Year, Month and Country of meeting FE. 95% confidence intervals bands computed using clustered standard errors at a company level.

**TABLE 1** Total Meetings and Attendance Means by City and Country

| | Country | Total Meetings | Attendance Mean (Original) | Attendance Mean (Extended) |
|---|---|---|---|---|
| Sophia Antipolis | France | 180 | 0.887 | 0.533 |
| San Francisco | US | 66 | 0.811 | 0.486 |
| Seoul | South Korea | 47 | 0.849 | 0.451 |
| Athens | Greece | 45 | 0.773 | 0.480 |
| Prague | Czech Republic | 43 | 0.845 | 0.496 |
| Beijing | China | 42 | 0.855 | 0.516 |
| Helsinki | Finland | 31 | 0.894 | 0.586 |
| Shanghai | China | 10 | 0.842 | 0.475 |
| Montreal | Canada | 28 | 0.694 | 0.406 |
| Ljubljana | Slovenia | 10 | 0.849 | 0.445 |
| Reno | Austria | 27 | 0.840 | 0.696 |
| Malta | Malta | 17 | 0.863 | 0.479 |
| Vienna | US | 26 | 0.892 | 0.583 |
| Berlin | Germany | 25 | 0.859 | 0.602 |
| San Diego | US | 13 | 0.802 | 0.420 |
| Shenzhen | China | 20 | 0.877 | 0.490 |
| Vancouver | Canada | 25 | 0.903 | 0.574 |
| Jeju Island | South Korea | 24 | 0.855 | 0.488 |
| Budapest | Hungary | 23 | 0.849 | 0.533 |
| Dublin | Ireland | 23 | 0.886 | 0.491 |

*Notes:* The table shows the twenty cities that hosted the highest number of meetings between 1999 and 2018. Column 3 lists the number of meetings held in each city, while Columns 4 and 5 display attendance percentages for both our original and extended samples.

**TABLE 2** Original Sample Descriptive Statistics

| | Mean | Median | Min | Max | SD | N |
|---|---|---|---|---|---|---|
| Observed Attendance | 0.85 | 1.00 | 0 | 1 | 0.357 | 147,586 |
| Distance to meeting, thousands Kms | 6.07 | 7.49 | 0 | 19 | 3.924 | 147,586 |
| Female | 0.13 | 0.00 | 0 | 1 | 0.334 | 147,586 |
| Distance Traveled by Men | 5.99 | 7.45 | 0 | 18 | 3.911 | 109,717 |
| Distance Traveled by Women | 6.14 | 7.48 | 0 | 17 | 3.922 | 15,680 |
| Same Country | 0.11 | 0.00 | 0 | 1 | 0.316 | 147,586 |
| Common Language (Dummy) | 0.07 | 0.00 | 0 | 1 | 0.261 | 147,586 |
| Common Religion (Dummy) | 0.14 | 0.04 | 0 | 1 | 0.182 | 146,819 |
| Colony Relationship (Dummy) | 0.00 | 0.00 | 0 | 1 | 0.043 | 147,586 |
| Top 10 company | 0.43 | 0.00 | 0 | 1 | 0.495 | 147,586 |
| Seniority | 4.88 | 4.00 | 0 | 20 | 4.416 | 147,586 |
| Number of Patents | 7.40 | 0.00 | 0 | 585 | 25.827 | 147,586 |
| Number of Sep | 2.51 | 0.00 | 0 | 166 | 9.459 | 147,586 |

*Notes:* The Table presents the means, medians, minimums, maximums, standard deviations, and valid observations for the main characteristics of the estimation sample. The sample was drawn from 3GPP records and covers meetings from 1999 to 2018.

**TABLE 3** Estimation Sample Descriptive Statistics

| | Mean | Median | Min | Max | SD | N |
|---|---|---|---|---|---|---|
| Observed Attendance | 0.85 | 1.00 | 0 | 1 | 0.357 | 147,586 |
| Attendance (including counterfactual) | 0.55 | 1.00 | 0 | 1 | 0.497 | 227,804 |
| Distance to meeting, thousands Kms | 6.26 | 7.64 | 0 | 19 | 3.906 | 227,804 |
| Female | 0.13 | 0.00 | 0 | 1 | 0.338 | 227,804 |
| Same Country | 0.10 | 0.00 | 0 | 1 | 0.298 | 227,804 |
| Common Languange (Dummy) | 0.07 | 0.00 | 0 | 1 | 0.262 | 227,804 |
| Top 10 company | 0.28 | 0.00 | 0 | 1 | 0.449 | 227,804 |
| Seniority | 4.97 | 4.00 | 0 | 20 | 4.323 | 227,804 |
| Number of Patents | 7.27 | 0.00 | 0 | 585 | 24.443 | 227,804 |
| Number of Sep | 2.44 | 0.00 | 0 | 166 | 8.996 | 227,804 |

*Notes:* The Table presents the means, medians, minimums, maximums, standard deviations, and valid observations for the main characteristics of the estimation sample. The sample was drawn from 3GPP records and covers meetings from 1999 to 2018.

**TABLE 4** Descriptive Statistics by Sex

| Variable | Men | Women | (W-M) |
|---|---|---|---|
| Attendance (including counterfactual) | 24.082 | 19.239 | -4.843*** |
| Distance traveled | 6.074 | 6.260 | 0.186*** |
| Top 10 company | 0.299 | 0.298 | -0.001 |
| Seniority | 2.470 | 2.146 | -0.324*** |
| Number of Patents | 4.305 | 2.733 | -1.572*** |
| Number of SEP | 1.235 | 0.686 | -0.549*** |

*Notes:* The table presents a t-test for the mean differences of the 5,379 individuals in our sample. Attendance includes all meetings attended during the sample period. The sample was drawn from 3GPP records and includes the counterfactual observations described in Section 5, covering meetings from 1999 to 2018

**TABLE 5** Distance Elasticity and Same Country Effect

| | Attended | Attended | Attended |
|---|---|---|---|
| Distance to meeting, thousands Kms | -0.007*** | | -0.003*** |
| | (0.00) | | (0.00) |
| Same country (dummy) | | 0.096*** | 0.072*** |
| | | (0.01) | (0.01) |
| Obs. | 227804 | 227804 | 227804 |
| R-squared | 0.343 | 0.343 | 0.386 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.

**TABLE 6** Distance Elasticity by Sex

| | Attended | Attended | Attended |
|---|---|---|---|
| Distance to meeting, thousands Kms | -0.006*** | -0.003*** | |
| | (0.00) | (0.00) | |
| Distance x Female | -0.003*** | -0.002*** | |
| | (0.00) | (0.00) | |
| Same country (dummy) | | 0.072*** | 0.094*** |
| | | (0.01) | (0.01) |
| Same Country x Female | | | 0.002 |
| | | | (0.01) |
| Obs. | 227804 | 227804 | 227804 |
| R-squared | 0.385 | 0.386 | 0.386 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.

**TABLE 7** Distance Elasticity, Border and Common language

| | Attended | Attended |
|---|---|---|
| Distance to meeting, thousands Kms | -0.003*** | |
| | (0.00) | |
| Same country (dummy) | 0.076*** | 0.097*** |
| | (0.01) | (0.01) |
| Common Languange Dummy | 0.021*** | 0.027*** |
| | (0.01) | (0.01) |
| Common Languange x Female | | -0.011 |
| | | (0.01) |
| Obs. | 227804 | 227804 |
| R-squared | 0.386 | 0.386 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.

**TABLE 8** Distance Elasticity in Top 10 Companies

| | All | Not top 10 companies | Top 10 companies |
|---|---|---|---|
| | Attended | Attended | Attended |
| Distance to meeting, thousands Kms | -0.006*** | -0.003*** | 0.000 |
| | (0.00) | (0.00) | (0.00) |
| Top 10 company | 0.659*** | | |
| | (0.03) | | |
| Distance x Top 10 | 0.006*** | | |
| | (0.00) | | |
| Same country (dummy) | | 0.066*** | -0.006 |
| | | (0.01) | (0.01) |
| Obs. | 227804 | 163704 | 63428 |
| R-squared | 0.508 | 0.462 | 0.371 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.

**TABLE 9** Distance Elasticity and Seniority by Sex

| | Attended | Attended | Attended |
|---|---|---|---|
| Distance to meeting, thousands Kms | -0.0091*** | -0.0055*** | -0.0052*** |
| | (0.00) | (0.00) | (0.00) |
| Distance x Seniority | 0.0006*** | 0.0005*** | 0.0005*** |
| | (0.00) | (0.00) | (0.00) |
| Same country (dummy) | | 0.0774*** | 0.0770*** |
| | | (0.01) | (0.01) |
| Same country x Seniority | | -0.0012 | -0.0012 |
| | | (0.00) | (0.00) |
| Seniority x Female | | | -0.0011 |
| | | | (0.00) |
| Distance x Female | | | -0.0017 |
| | | | (0.00) |
| Distance x Seniority x Female | | | -0.0000 |
| | | | (0.00) |
| Obs. | 227804 | 227804 | 227804 |
| R-squared | 0.387 | 0.388 | 0.388 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.

**TABLE 10** Distance Elasticity and Inventorship

| | Attended | Attended | Attended | Attended |
|---|---|---|---|---|
| Distance to meeting, thousands Kms | -0.0066*** | -0.0067*** | -0.0092*** | -0.0092*** |
| | (0.00) | (0.00) | (0.00) | (0.00) |
| Number of Patents | -0.0000 | | 0.0000 | |
| | (0.00) | | (0.00) | |
| Distance x Number of Patents | 0.0000*** | | 0.0000 | |
| | (0.00) | | (0.00) | |
| Number of Sep | | -0.0005 | | -0.0002 |
| | | (0.00) | | (0.00) |
| Distance x Number of Sep | | 0.0001*** | | 0.0001** |
| | | (0.00) | | (0.00) |
| Distance x Seniority | | | 0.0005*** | 0.0005*** |
| | | | (0.00) | (0.00) |
| Obs. | 227804 | 227804 | 227804 | 227804 |
| R-squared | 0.385 | 0.385 | 0.387 | 0.387 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.

**TABLE 11** Distance Elasticity, Inventorship, and Top 10 Companies

| | Attended | Attended | Attended | Attended | Attended |
|---|---|---|---|---|---|
| Distance to meeting, thousands Kms | -0.0085*** | -0.0063*** | -0.0063*** | -0.0085*** | -0.0085*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Distance x Seniority | 0.0005*** | | | 0.0005*** | 0.0004*** |
| | (0.00) | | | (0.00) | (0.00) |
| Top 10 company | 0.6576*** | 0.6598*** | 0.6600*** | 0.6579*** | 0.6581*** |
| | (0.03) | (0.03) | (0.03) | (0.03) | (0.03) |
| Distance x Top 10 | 0.0058*** | 0.0057*** | 0.0057*** | 0.0058*** | 0.0057*** |
| | (0.00) | (0.00) | (0.00) | (0.00) | (0.00) |
| Number of Patents | | -0.0002 | | -0.0002 | |
| | | (0.00) | | (0.00) | |
| Distance x Number of Patents | | 0.0000*** | | 0.0000 | |
| | | (0.00) | | (0.00) | |
| Number of Sep | | | -0.0005 | | -0.0003 |
| | | | (0.00) | | (0.00) |
| Distance x Number of Sep | | | 0.0001*** | | 0.0000* |
| | | | (0.00) | | (0.00) |
| Obs. | 227804 | 227804 | 227804 | 227804 | 227804 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.

**TABLE 12** Distance Elasticity, Heterogeneities by Sex

| | Attended |
|---|---|
| Distance to meeting, thousands Kms | -0.0022*** |
| | (0.00) |
| Distance x Female | -0.0017** |
| | (0.00) |
| Top 10 company | 0.6916*** |
| | (0.03) |
| Number of Sep | 0.0001 |
| | (0.00) |
| Same country (dummy) | 0.0478*** |
| | (0.01) |
| Obs. | 227804 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.

# APPENDIX: Additional Figures

## A.1 | Gender Attendance

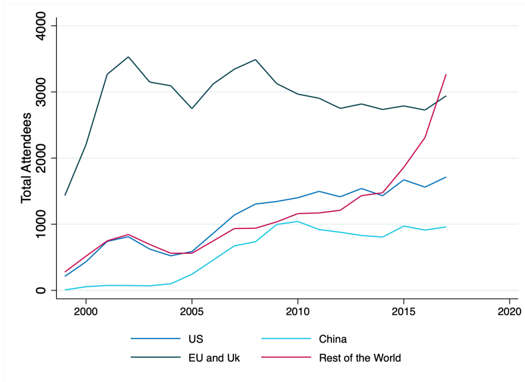



**FIGURE A.1** Men Attendance

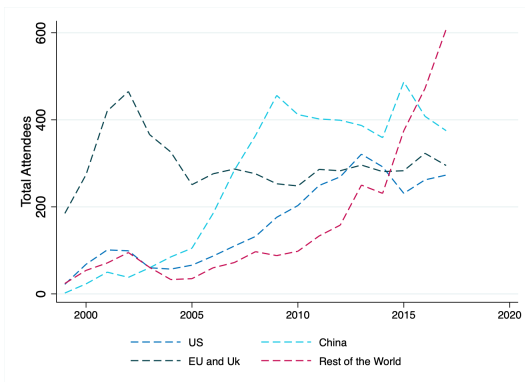
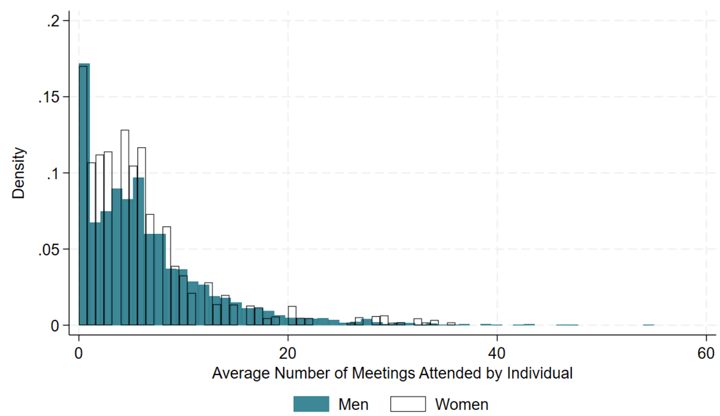



**FIGURE A.2** Women Attendance

**FIGURE A.3** Distribution of Number of Meetings Attended per Individual per Year, by Sex




*Notes:* The figure shows the density of the number of meetings per year attended by men and women from 1999 to 2018. Data from 3GPP records.

**TABLE A.1** Probabilities for different meeting towns

| **Meeting Town** | **Prob** |
|---|---|
| Sophia Antipolis | 0.0877 |
| San Francisco | 0.0321 |
| Seoul | 0.0229 |
| Athens | 0.0219 |
| Prague | 0.0209 |
| Beijing | 0.0205 |
| Helsinki | 0.0151 |
| Shanghai | 0.0141 |
| Ljubljana | 0.0136 |
| Montreal | 0.0136 |
| Reno | 0.0132 |
| Malta | 0.0132 |
| Vienna | 0.0132 |
| San Diego | 0.0127 |
| Berlin | 0.0127 |
| Shenzhen | 0.0122 |
| Vancouver | 0.0122 |
| Jeju Island | 0.0117 |
| Budapest | 0.0117 |
| Dublin | 0.0112 |

*Notes:* The table shows the probability of each city to host a meeting, calculates as the number of times a city hosted a meeting over the total number of meetings between 1999 and 2018.

**TABLE A.2** Attendance by Home Countries of Top 10 Companies

| | Attendance | | |
|---|---|---|---|
| | Other Country | Home Country | Total |
| ALCATEL-LUCENT S.A | 3,606 | 433 | 4,039 |
| ERICSSON AB | 10,304 | 606 | 10,910 |
| HUAWEI TECHNOLOGIES | 6,424 | 1,143 | 7,567 |
| LG ELECTRONICS | 1,583 | 156 | 1,739 |
| MOTOROLA SOLUTIONS, INC. | 2,486 | 370 | 2,856 |
| NEC CORPORATION | 3,737 | 215 | 3,952 |
| NOKIA | 10,899 | 794 | 11,693 |
| NTT | 3,896 | 360 | 4,256 |
| QUALCOMM INC | 3,834 | 866 | 4,700 |
| SAMSUNG ELECTRONICS | 3,393 | 364 | 3,757 |
| **Total** | **50,162** | **5,307** | **55,469** |

*Notes:* The table shows the number of participants who attended a meeting in their home country for each of the ten largest companies in the sample.

**TABLE A.3** Attendance at Meetings Held in Cities with Top 10 Companies' Headquarters

| | Percentage of Attendance |
|---|---|
| Attendance at Meetings in the City Where Their Firm's Headquarters Are Located | 8.54% |
| Attendance at Meetings in Other Cities | 91.46% |
| **Total Meetings Attendance** | **100.00%** |

*Notes:* The table shows the percentage of attendees from the 10 largest companies in our sample who attended a meeting in the city where their respective headquarters are located.

**TABLE A.4** Distance Elasticity and Same Country Effect Excluding Sophia Antipolis

| | Attended | Attended | Attended |
|---|---|---|---|
| Distance to meeting, thousands Kms | -0.006*** | | -0.003*** |
| | (0.00) | | (0.00) |
| Same country (dummy) | | 0.098*** | 0.074*** |
| | | (0.01) | (0.01) |
| Obs. | 215572 | 215572 | 215572 |
| R-squared | 0.345 | 0.346 | 0.387 |

*Notes:* All specifications include individual-working group FE, Year, Month and Country of meeting FE. Standard errors clustered at the company level in parentheses. ***significant at the 1% level, **5% level, *10% level.