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Evolution of the internet gender gaps in Spain and effects of the Covid-19 pandemic

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ABSTRACT

There is a widely accepted belief in new technologies that the digital divide in using a service will disappear as the service reaches an advanced level of maturity. The work presented here shows that this idea is debatable. Data from Spain, a country where daily internet users are 75.9 percent of the population, prove that the gender gap still exists. The paper explores if this gap can be entirely explained by the socioeconomic differences between men and women. We build a micropanel model and incorporate a set of socioeconomic variables (age, education, income, employment status, digital skills, and resident population) that allow us to isolate the effects of gender on the decision to become a daily Internet user. The results conclude that the Internet gap is a phenomenon with a specific gender component. Other things being equal a woman negatively affects the probability of using the Internet. Applying a similar model to 15 Internet services, we obtain that gender is always significant to explain the likelihood of being a user of each service. However, in some services (7 out of 15), the effect is favorable to women, and for other services (8), the gender effect favors men. The work concludes by analyzing the impact of the first wave of the Covid-19 pandemic on the use of Internet services, paying particular attention to its possible implications for the gender gap.

1. Introduction

Traditionally, women have been behind men in the use of the Internet, with each gender using it for different purposes. The slower incorporation of women is commonplace when it comes to adopting new technologies (ICTs), and the case of the Internet is not an exception. However, there is a widely accepted belief regarding ICTs that the digital divide in the use of any service will disappear as the service reaches an advanced level of maturity. There are several studies whose results support this thesis. Examples are the papers by Bimber (2000) and Ono and Zavodny (2003) that do not find gender differences in terms of access with data from the late 1990s in the U.S.; nevertheless, they obtain that women use the Internet less frequently and use fewer services, than men. Thus, even if there were no gender gaps in access to the Internet, these authors suggest that the study of the digital gender gap should continue by analyzing the factors that trigger the lower frequency and diversity of uses by women.

According to previous literature and given that the use of the Internet in Spain is widespread, with a penetration rate of 75.9\% of the total population using the Internet daily, it would be expected that there would not be a gender gap. So, we will start the work by

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exploring if there is currently a gender gap in using the Internet in Spain. To do this, we will use microdata from the ICT-H Survey for 2007–2020. Then, we will see if there are gender differences in Internet use and, if that is the case, whether these differences have narrowed during the period.

If the data reveals a gender gap, we want to identify the possible causes of the divide, such as age, education, digital literacy, employment status, income, the population of residence, and household members. In addition, the results will allow us to find out if the gender digital divide in the use of the Internet is explained by sociodemographic differences between genders or, on the contrary if there is a gender-specific component.

Concerning the gender-specific component, many studies have tried to find out the reasons for the lower tendency of women to use the Internet. Some authors suggest that this is because the Internet is a technology created by men and for men (Green et al., 1993; Weiser, 2000). Others, such as Guadagno and Cialdini (2002), suggest that gender differences are based on gender role differences in communication styles. Following the Social Role Theory (Eaggly, 1987), the gaps could be explained by the different social behavior of men and women. For instance, women prefer mutual communication where social interaction prevails, while men prefer more status-asserting and text-based communication. This circumstance would explain why women did not have many incentives to participate in the early years of the Internet when communication was almost exclusively via text. However, in recent years, as tools that allow intercommunication (face-to-face, social networks, etc.) were further developed, women have been participating more actively.

If biases are still observed in favor of men, closing the digital gender divide may be a social priority. Overcoming the digital gender gap is the way to ensure that women benefit from the developmental capacity of ICTs. As Dixon et al. (2014) state: “These digital gaps may exacerbate existing inequalities between social groups because new technologies provide opportunities to access information, a necessary tool for participating in a democratic society, as well as access to trade, education, job opportunities, health care information, and information about government programs.” Moreover, narrowing the gender divide is a significant opportunity for growth in today’s economy. In that sense, in-depth knowledge of the triggers of the digital divide can be helpful to policymakers in their task of narrowing the gaps.

Mariscal et al. (2019) analyze at a global level the significant challenges in ensuring that women are included in the transformation to a digital society, which will enhance productivity and social development if overcome. Palomares et al. (2021) analyze the case of the digital gender gap at the university level in Spain. They explore the gap in undergraduate studies by the branch of education. They conclude that there are no statistically significant gender differences in academic performance in their sample. Finally, Aissaou (2021) provides a useful survey on the digital divide and future research in light of COVID-19.

As an indication of the importance that international institutions attach to gender equality in the use of the Internet, see European Parliament (2016, 2018), ITU (2017), OECD (2018).

This paper wants to explore gender differences in Internet use from different perspectives. To do so, we will answer the following research questions:

RQ 1. Is there an Internet gender gap in Spain? If the answer is yes.

- How has it evolved recently?
- What are the possible causes?
- Does this gap have a specific gender component?

RQ2. What is the gender gap in using each of the 15 considered services? In the cases where there is a gap.

- Who does it favor (men or women)?
- Is it narrowing?
- Do these gaps have a specific gender component?

RQ3. How has the pandemic affected the gender gap in the use of the Internet? Has it helped narrow the gap?

The rest of the work is organized as follows. Section 2 is devoted to answering RQ1. Using the ICT-H Survey data for 2007–2020, first, we will present an overview of the current situation of the Internet gender gap in Spain and its recent evolution. Then we will show the models used to study the determinants of the decision of the individual to participate or not in the use of the Internet, highlighting whether gender is a relevant factor. Section 3 is dedicated to responding to RQ2. Using data from 15 Internet services, we analyze the penetration rates of each of them and see if there are different patterns of use based on gender. Then, after verifying that a gender divide exists, we analyze if the gap is a consequence of the socioeconomic and demographic conditions of the men and women or if, on the contrary, there is a specific gender component that is necessary to consider. Section 4 analyses the effects of the first wave of the COVID-19 pandemic on the Internet gender gap. The goal is to see whether the pandemic has contributed to narrowing the gender gap or not. Finally, the conclusions, policy recommendations, and future research lines are in Section 5.

2. Internet gender gap

2.1. Size and evolution of the gap

The first part of the work analyses whether there is a gender gap in Internet use in Spain and, if it exists, to quantify and test whether it decreases over the years. To carry out the work, we will use microdata from the ICT-H Survey for 2007–2020. Those data are publicly available on the National Statistics Institute of Spain (INE) website. From the annual cross-sections of dwellings provided by INE, we
developed a panel of individuals. We had to identify the repeated individuals in each wave to do this. It has been a challenging and
time-consuming task, but it allows us to improve the results obtained so far in the literature. According to Hsiao (2007), panel data
increase the capacity to model the complexity of human behavior, control the impact of omitted variables, improve the efficiency of
econometric estimates, and allow more accurate inference.

Our data set is appropriate for the objectives and the hypotheses of the present study since it provides information on the usage of
the Internet and many other sociodemographic characteristics of the individual. Moreover, the ICT-H survey provides a relative weight
for each respondent. In this manner, the data are representative of the national and autonomous community levels.

First, we define penetration rate. In general, the Internet penetration rate is the percentage of individuals in a country/region that
are Internet users. The differences occur when deciding the requirements for a person to be considered an Internet user. For example, a
widely used definition considers an Internet user to be anyone who has used the Internet at least once in the last three months. However, in this paper, we will only consider Internet users, those individuals who have used the Internet daily (at least five days a
week) during the last three months.

Another issue to emphasize is that we will present penetration rates calculated for the total population instead of considering only
individuals up to 74 years of age, which most international statistics estimate, for example, EUROSTAT. Nevertheless, the data justify
considering this group of citizens over 74 (older adults). First, people above 74 represent 9.7 percent of the total Spanish population.
Furthermore, this group needs special attention because of the low Internet penetration rate (17.1 percent are daily users) and the large
gender gap favoring men. See Campos-Castillo (2021), which deals with gender divides found in older U.S. adults during COVID-19.

Considering all the above, in 2020, the Internet penetration rate measured the percentage of the total population that used the
Internet daily was 75.9 percent (76.5% for males and 75.2% for females). This calculation considers the gender gap as the difference
between the Internet user penetration rates for both genders, with a gender gap of 1.8% for the females’ Internet user penetration rate.
Fig. 1 shows the fourteen-year evolution between 2007 and 2020. The left axis represents penetration rates, and the axis on the right is
for the gender gap. The gender divide (yellow line) has narrowed significantly over the period (from 36.5% in 2007 to 1.8% in 2020),
but it still exists. To highlight the magnitude of the change, suffice it to say that during the 2007–2020 period, the gap narrowed by
95.1 percent, which represents an average cumulative variation rate of ~20.8 percent.

Although the gender gap on average does not seem significant, relevant differences arise when considering certain age groups or
geographical areas.

Using 2020 data, Fig. 2 shows the Internet adoption rates by individuals according to age groups. The figure indicates that age
makes a big difference in Internet use and that penetration decreases with age (especially after 65). Regarding the gender gap, it is
worth noting that this difference favors women in the category of people between the ages of 35 and 74. For the oldest people, there is a
pronounced gender gap favoring men. But the most important item given in Fig. 2 is that the gap in Internet use among older adults
continues to exist and is still significant (8% for the group 75–84 and 55% for the group 85 or older). Therefore, a political objective
should be to promote Internet use among older adults and reduce the gap between men and women. Currently, the Internet represents
a barrier to the full integration of older individuals and erodes their quality of life.

Fig. 3 shows the geographic heterogeneity of the gender gap. Here, it can be observed how the gender gap is 1.8 in favor of men at
the level of the whole country. The differences between autonomous communities range from 11.3% in favor of men in Aragón and
8.8% in favor of women in Extremadura.

Finally, data availability for 2020 has allowed us to analyze the effects of the first wave of the COVID-19 pandemic on Internet use.
In this sense, it should be noted that between 2019 and 2020, the Internet penetration rate grew by 7.6%, and the gender gap narrowed
by 21.7% (both rates very similar to those experienced in recent years).

2.2. Determinants of the gender gap: data and models

Although the Internet may not be an agent of change itself, it is important enough not to be forgotten. It has become integral to our
social lives and forms part of other social, cultural, economic, and political arenas as well. Therefore, policies and practices should aim
to achieve results that foster gender equality in these interactive sectors. To guide these policies, knowledge of the factors that
determine Internet use is essential, which is the purpose of this section.

The graphs presented in Figs. 2 and 3 indicate that penetration rates depend on the population group considered. For example,
Internet penetration is not the same for young people as for those over 65, for people with elementary studies as for Ph.D. holders, nor
for people who live in a big city versus a small town.

This section aims to determine whether the gender gaps presented above result from socioeconomic and demographic differences
between men and women or, conversely, they also have to do with gender-specific issues. We use a series of explanatory variables to
control the effects of socioeconomic and demographic differences between men and women, isolating the impact due to gender.

As women lag behind men in some other respects (education, employment status, income, etc.), we can conclude that not all the
differences between the observed values of participation and use of the Internet are strictly due to the gender of the individual.

We will study to what extent gender plays a significant role in becoming an Internet user. To isolate the effects of gender on the
probability of being a frequent Internet user, we built a model where, in addition to gender, we incorporate as explanatory variables
a series of socioeconomic and demographic characteristics of the individual that may also be conditioning said probability. Thus, the

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1 The penetration rate when considering only individuals between the ages of 16–74 is 83.1 percent (82.4% for males 83.8% for females).
The dependent variable (becoming or not becoming an Internet user) is binary. Moreover, the variables that would reflect the socioeconomic environment of the individual would be gender, age, educational level, number of household members, family income level, employment situation, digital skills, and the number of inhabitants of their municipality of residence. Models of this type have been previously used to study the adoption of several Internet services in Spain (Garín-Muñoz, López, et al., 2019 and 2019b). The model is as follows:

\[
\text{INT\_USER}_i = f(GENDER_i, \text{AGE}_i, \text{EDUCATION}_i, \text{DIG\_SKILLS}_i, \text{HH\_MEMBERS}_i, \text{EMPLOYM\_SIT}_i, \text{HABITAT}_i, \text{INCOME}_i, \text{YEAR}_i)
\]  

(1)

where subscript \(i\) represents the individual and subscript \(t\) refers to the year.

Fig. 1. Penetration rates of the Internet by gender and gender gap (2007–2020)
Self-elaborated. Source: ICT-H (INE).
Penetration rates: Percentage of individuals using the Internet at least five days a week during the last three months.
Gender Gap = \frac{\text{Penetration rate males} - \text{Penetration rate females}}{\text{Penetration rate females}}

Fig. 2. Internet penetration rates and gender gaps by age groups (2020).
The dependent variable is a binary variable taking the value 1 if the individual has used the Internet at least five days a week during the last three months; 0 otherwise.

The explanatory variables are the following categorical variables:
- **GENDER**: 1 if male; 0 if female.
- **AGE**: seven age groups: 16–24; 25–34; 35–44; 45–54; 55–64; 65–74; 75 or more.
- **EDUCATION**: Four education groups: Primary or less; Secondary; Bachelor; Ph.D./Master.
- **DIG_SKILLS**: Four groups according to the level of digital skills.
- **HH_MEMBERS**: Five categories according to household members: 1; 2; 3; 4; 5 or more.
- **EMPLOYM_SIT**: Six categories: employed; unemployed; retired; student; housekeeper; others.
- **HABITAT**: Five categories according to the number of residents of the municipality: <10,000; 10,000–20,000; 20,000–50,000; 50,000–100,000; >100,000.
- **INCOME**: Four groups by the monthly net income of households.
- **YEAR**: Temporal dummies to control the effect of time.

We have a panel for the years 2007–2020. However, for our models, we excluded 2007 due to the unavailability of household income data. As a result, we ended up with an unbalanced panel with 87,509 individuals and 175,415 observations. The empirical model is as follows:

$$\text{INT\_USER}_i = \beta_1 \text{GENDER}_i + \beta_2 \text{AGE}_i + \beta_3 \text{EDUCATION}_i + \beta_4 \text{DIG\_SKILLS}_i + \beta_5 \text{HH\_MEMBERS}_i + \beta_6 \text{EMPLOYM\_SIT}_i + \beta_7 \text{HABITAT}_i + \beta_8 \text{INCOME}_i + \beta_9 \text{YEAR}_i + \alpha_i + \mu$$

In equation (1), $t$ stands for years, and $i$ stands for individuals.

Table 1 presents the estimation results obtained using the econometric package STATA 17. Two models have been used: the linear probability model and the logit model. The first thing worth noting is that the joint significance of each of the two models is very high, obtaining the expected signs of the coefficients, and they are mostly individually significant. As can be observed in the table, the results of both models are coherent. The estimated coefficients have the same sign in both columns, and the significance of the variables is similar.

The gender variable is significant and positive in both models and favors men, with estimated coefficients of 0.09 in the linear probability model and 0.135 for the logit model. This circumstance would indicate that the differences in the behavior of men and women in terms of Internet users have a gender-specific component. Furthermore, this gender-specific component would suggest that the gender divide in Internet use would not disappear even when controlling for the rest of the socioeconomic and demographic characteristics of the individual. Otherwise, the coefficients obtained from the rest of the variables introduced as explanatory have the expected signs according to economic theory.

We only deal with the linear probability model in the rest of this section for conciseness and easiness of interpretation.

The variable age negatively affects the probability of being a daily Internet user, with estimates between $-0.038$ and $-0.246$ for the different age groups. This means 3.8% and 24.6%, respectively, below the base category of age 16–24. These could be some of the reasons behind it. On the one hand, it is possible that when a person gets older, they have less interest in the use of the services offered

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2 Other definitions of Internet penetration rate have been used before in this literature but, nowadays, we consider it more appropriate to be more restrictive when classifying an individual as an Internet user. In this case we consider an Internet user as an individual entering daily. In other papers, individuals entering just once during the last three months were catalogued as Internet users.
An individual’s level of studies has a positive and significant impact on using the Internet regularly, with estimates between 0.06 and 0.15, 6% and 15% above the base category of primary studies. Therefore, since the new generations do not show a lower educational level for women, the gender gap associated with this factor will presumably disappear in the coming years.

The individual’s digital skills turn out to be a highly significant and prominent factor in explaining the probability of being an Internet user, with estimates between 39.8% and 56.7% above the base category of low digital skills. The greater the digital skills of individuals, the more likely they are to use the Internet frequently.

| Table 1                                                                 | LINEAR PROBABILITY MODEL | LOGIT MODEL |
|-------------------------------------------------------------------------|---------------------------|-------------|
|                                                                         | Coefficient | t    | Coefficient | z    |
| **GENDER (Female)**                                                     | Male         | 0.09 | 4.80       | .135 | 5.38 |
| **AGE (16–24)**                                                        |              |      |            |      |
| 25-34                                                                  | -.038        | -6.68| -.436      | -6.16|
| 35-44                                                                  | -.072        | -12.67| -1.864     | -12.60|
| 45-54                                                                  | -.095        | -16.38| -1.182     | -16.97|
| 55-64                                                                  | -.126        | -20.76| -1.590     | -21.61|
| 65-74                                                                  | -.154        | -23.09| -2.044     | -23.96|
| 75-84                                                                  | -.204        | -30.47| -3.219     | -33.46|
| 85+                                                                    | -.246        | -35.70| -4.421     | -31.65|
| **EDUCATION (Primary studies)**                                        | Secondary studies | .060 | 25.90      | .873 | 28.07|
|                                                                         | Bachelor’s degree | .101 | 28.02      | 1.223 | 27.48|
|                                                                         | Master or PhD  | .150 | 40.00      | 1.955 | 40.09|
| **DIGITAL SKILLS (Low)**                                               | Medium       | .398 | 110.88     | 2.726 | 83.31|
|                                                                         | High         | .538 | 149.73     | 4.118 | 94.61|
|                                                                         | Very high    | .567 | 151.27     | 5.529 | 67.41|
| **HOUSEHOLD MEMBERS (One person)**                                     | Two          | -.005 | -2.01     | -.026 | -.072|
|                                                                         | Three        | -.013 | -4.36     | -1.21 | -3.04|
|                                                                         | Four         | -.014 | -4.31     | -1.20 | -2.81|
|                                                                         | Five or more | -.024 | -5.36     | -2.34 | -4.05|
| **EMPLOYMENT SITUATION (Employed)**                                    | Unemployed   | -.023 | -7.15     | -.270 | -4.75|
|                                                                         | Retired      | -.056 | -15.43    | -.518 | -10.79|
|                                                                         | Student      | .047 | 7.94       | .711 | 8.15|
|                                                                         | Housekeeper  | -.064 | -17.88    | -.614 | -13.37|
|                                                                         | Other        | -.055 | -11.87    | -.518 | -8.88|
| **INCOME (Low)**                                                       | Medium       | .020 | 9.49       | .420 | 14.24|
|                                                                         | Medium-High  | .056 | 20.09      | .817 | 22.88|
|                                                                         | High         | .080 | 21.85      | 1.205 | 24.24|
| **HABITAT (≥100,000)**                                                 | 50,000-100,000| .004 | 1.08       | .000 | 0.00|
|                                                                         | 20,000-50,000| -.007 | -2.54    | -1.31 | -3.45|
|                                                                         | 10,000-20,000| -.015 | -5.26     | -.253 | -6.55|
|                                                                         | <10,000      | -.025 | -11.39    | -.408 | -13.29|
| **YEAR (2008)**                                                       | 2009         | -.002 | -0.86    | -.096 | -2.12|
|                                                                         | 2010         | .032 | 10.13      | .439 | 9.46|
|                                                                         | 2011         | .039 | 11.59      | .535 | 10.66|
|                                                                         | 2012         | .038 | 10.63      | .439 | 8.17|
|                                                                         | 2013         | .086 | 23.54      | 1.141 | 22.05|
|                                                                         | 2014         | .102 | 27.69      | 1.358 | 25.17|
|                                                                         | 2015         | .160 | 42.09      | 2.179 | 40.00|
|                                                                         | 2016         | .181 | 48.15      | 2.456 | 45.12|
|                                                                         | 2017         | .180 | 47.37      | 2.432 | 44.60|
|                                                                         | 2018         | .164 | 43.78      | 2.182 | 39.37|
|                                                                         | 2019         | .237 | 60.73      | 3.217 | 56.14|
|                                                                         | 2020         | .259 | 63.66      | 3.629 | 58.61|
| **CONSTANT**                                                           |              | .178 | 26.17      | -3.148 | -36.00|
| **N. Observations**                                                    |              | 175,415 | 175,415 |
| **N. Groups**                                                          |              | 87,509 | 87,509 |
| **Wald ch2(42)**                                                       | 473,503.22   | 19,031.76 | 19,031.76 |

The dependent variable takes the values 1 or 0 depending on whether the individual has used the Internet at least five days a week during the last three months or not.

* Heteroskedasticity consistent standard errors.

(for example, younger people feel a greater need for communication services, while many older individuals lack the habit).

An individual’s level of studies has a positive and significant impact on using the Internet regularly, with estimates between 0.06 and 0.15, 6% and 15% above the base category of primary studies. Therefore, since the new generations do not show a lower educational level for women, the gender gap associated with this factor will presumably disappear in the coming years.

The individual’s digital skills turn out to be a highly significant and prominent factor in explaining the probability of being an Internet user, with estimates between 39.8% and 56.7% above the base category of low digital skills. The greater the digital skills of individuals, the more likely they are to use the Internet frequently.
Regarding income, the effect on the probability of using the Internet has a positive and significant impact, estimated as 2%, 5.6%, and 8% above the base category. The effects are relevant, as suggested by the economic theory. As we move up in income level, individuals are more likely to be daily Internet users.

The results show that the individual’s habitat is a significant determinant of the probability of using the Internet. Individuals residing in more populated municipalities are more likely to be frequent Internet users. The estimated coefficients suggest adverse, but minor effects for the less populated areas of −7.7%, −1.5%, and −2.5% over the base category.

Before concluding, it is necessary to point out that, in this article, we are not dealing with the intensity of Internet use or its specific services. Our data do not provide us with information on the individual’s time on the Internet. For this reason, we only can discriminate between people who use the Internet versus those who do not.

The estimated coefficients for the dummies of years indicate that individuals with the same characteristics have a higher probability of being engaged in daily use of the Internet as time passes. One possible reason behind this is the increasing supply of online services every year. However, it could also be due to the carry-over effect caused by a growing number of Internet users. That is to say, the Internet produces network externalities in the sense that the more the consumer derive utility from its use, the more users are connected.

3. The gender gap in the use of Internet services

After studying Internet penetration, we deal with the users’ activities online. Previous work reveals that gender differences, more than in general use of the Internet, are that men and women use it for different things (Kimbrough et al., 2013). In the same sense, Fallows (2005) no longer reported gender differences in the overall amount of Internet use. Instead, there were differences in motivation and utilization of time spent online.

Our database provides information on utilizing various Internet services by men and women. We analyze people’s acceptance of each service and the possible gender gap in their use from this information.

We will use the period 2007–2020, although, for some services, data are not available for all years. Sometimes, it is because the supply of certain services did not exist at the beginning of the period. Other times, some services are excluded from the questionnaire to include other new services without burdening the number of questions.

Table 2 shows the penetration rates and gender gaps for fifteen services for 2020. The services are ranked in descending order according to the gender gap. The table also presents the definition of the services and the reference period.

Given the available information, the penetrations of the considered services are very different from each other. For example, according to 2020 data, average penetration rates range from 12.6 percent of individuals using the Internet to sell goods or services (eSelling) to 82.1 percent who use the chat service. In the other hand, it is interesting that the divide favors men in eleven out of fifteen Internet services. These included the sale of goods or services, cloud computing, reading news, and eBanking, whose gender gaps in 2020 were 39.0, 18.9, 8.9, and 11.0. Moreover, some of the services with a gender gap against women are intimately related to their professional development. Staying behind would therefore imply a social exclusion of women with consequent effects on the country’s productivity and growth.

On the contrary, there are some online activities (last four rows) in which women are more active than men. For example, this happens when seeking health information, searching for a job, or participating in social networks, telephoning or video calls (with gaps of −12.9, −7.7, −1.9, and −0.4, respectively).

Notice that the more mature services (in our case, those with the highest penetration rates) are not those with the lower gender divide, as is often the case with ICTs.

Fig. 4 shows the penetration of each service by gender and the evolution of the gap during the period. In these graphs, the left axis represents the penetration rate. On the right axis is the gap (calculated as the difference between the penetration rates of men and women as a percentage of the penetration rate of women). Thus, the yellow line indicates the evolution of the gap over time.

Some comments that emerge given the graphs are the following:

- The gender gap has been closing in almost all services during the period.
- An exception is the case of searching for health information on the Internet, whose gap has increased. This service has always been more used by women than by men. Specifically, the gap had risen from −7.1% in 2007 to −12.9 in 2020.
- The gap in the VoIP service reversed sign during the period. For example, in 2007, it was 28.0 percent (favorable to men) and dropped to −0.4 percent in 2020 (in favor of women).

Once we have a picture of the use of the 15 Internet services disaggregated by men and women, the next step is to investigate to what extent the differences found are due to a specific gender component. We used a similar model to the previous section (presented in Table 1) when we studied the factors affecting the likelihood of an individual’s decision to use the Internet. Now we estimate one model for each of the 15 considered services. Then we test whether gender is still significant for explaining the individual’s decision to use a specific service after controlling for the rest of the explanatory variables.

Due to space limitations, the coefficients for gender are in Table 3. The services have been ordered from the lowest to the highest

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3 Data on eLeisure is from 2018 (the 2019 and 2020 questionnaires do not incorporate this question).

4 These figures correspond to the total population (without distinguishing males and females).
The evolution of the gender gap can be seen in the last column of Table 4. It should be noted that the gender gap (2019 vs. 2020) has narrowed in the case of five services (electronic commerce, reading news online, online sales, social networks, and voice over IP). The rest of the services shown at the end of the table, shaded in blue, are services in which, all other things being equal, the status of women has a positive impact on their use.

At first glance, it is striking that, after controlling for the socioeconomic and demographic characteristics of individuals:

- The gender variable is statistically significant in all the 15 services considered.
- There are seven services for which the effect of being a woman is positive and significant (shaded in blue at the bottom of the table).
- There are three services (Chat, eTourism, and eLearning) that, although throughout the period presented a gap in favor of men, when controlled for other variables, the effect of being a woman is positive and significant. The results obtained in the case of Chat are compatible with those obtained in previous works. As in the studies by Kimbrough et al. (2013) and Wasserman and Richmond-Abbott (2005), here we also found that, compared to men, women preferred social networks and video chat.

We could summarise these results by saying that the decision to use every one of the 15 considered services has a significant specific-gender component. However, this gender effect is sometimes favorable to women (7 out of 15) and others to men (8 out of 15).

### 4. Effects of the first wave of the COVID-19 pandemic on the internet gender gap

The coronavirus started spreading in Spain, with Germany’s first confirmed COVID-19 case on January 31, 2019. This first case was detected in La Gomera (Canary Islands), but it did not spread to the mainland until February 24, with outbreaks in Catalonia, Madrid, and Valencia. Given the virus’s rapid spread, on March 14, the Spanish government declared a complete lockdown, which was in force until April 28, when an asymmetric de-escalation plan began, starting with the least affected areas.

The health crisis resulted in intensive Internet use (teleworking, eLearning, and eCommerce were some of the critical services during the most challenging months of confinement). However, not all social groups were able to benefit in the same way from the help of the Internet. As a result, the digital gaps between citizens became evident and increased the need to use the Internet. We expect that the Internet penetration rate will increase during this period, with hopes that digital gaps narrowed.

However, while the isolation conditions imposed by the pandemic acted as a driver to increase Internet use, it also generated adverse economic conditions that mainly affected the most vulnerable groups of the population and, therefore, women. Consequently, the net effect of the pandemic on Internet use and its gender divide is unclear and is what we intend to analyze.

Previous literature exists on the effects of pandemics on inequalities between groups. However, the conclusions reached by the different authors do not coincide. Thus, for example, the economic historian Scheidel (2017), in his book “The Great Leveler,” considers that pandemics represent an opportunity for flattening the inequalities between groups. However, recent studies referring to the specific case of the COVID-19 pandemic have found the opposite result. Kristal and Yaish (2020) study the case of Israel and find that the economic downturn generated by the pandemic has affected women more than men, thus widening inequalities at all levels.

Here we will look at the gender gap in Spain and see whether it has narrowed. The available data indicates that between 2019 and 2020, the number of daily Internet users increased by 7.6%, and the gap between men and women narrowed by 21.7%. However, the use of the different Internet services has evolved unevenly during the first wave of the COVID-19 pandemic. As shown in Table 4, the growth in penetration rates ranges from 77.4% (in the case of eLearning) to −0.8% (online sales).

The evolution of the gender gap can be seen in the last column of Table 4. It should be noted that the gender gap (2019 vs. 2020) has been reduced in the case of five services (electronic commerce, reading news online, online sales, social networks, and voice over IP).
Fig. 4. Penetration rates of Internet services by gender (2007–2020). *

*For some services, data are not available for all years.
**The left axis contains the penetration rates. The axis on the right represents the gender gap. The yellow line is the evolution of the gap.

*For some services, data are not available for all years.

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Fig. 4. (continued).
The fact that eCommerce saw a gender gap reduction of 39.1%, is exciting for what it can represent in the future. However, will this mean a permanent change in shopping habits, or will it be just a temporary effect that will disappear with the pandemic?

5. Conclusions and policy recommendations

Given that the Internet is currently an essential tool in our lives, in this research, we want to study whether men and women are equally benefiting from its advantages. This is the reason, our work is a study of Internet use from a gender perspective.

We use data from the ICT-H Survey of the Spanish National Statistical Institute to carry out our work. From the Survey’s microdata for the period between 2007 and 2020, we have elaborated a panel that allows us to obtain consistent and efficient estimates. The use of a large and representative panel is one of the strengths of this work.

5.1. Main conclusions

Concerning RQ1, we address the gender gap in Internet use in the first part of the work. Our data shows that from 2007 to 2020, the gender gap (always in favor of men) has narrowed by 95.2 percent. At the level of the population as a whole, the gap has decreased from 36.5 percent to 1.8 percent. However, not everything is as positive as it might seem since there are age groups where the problem is still very pronounced. These are the elderly (75 or over) who have a gender gap of 55%.

Next, we analyze how much of that gap is due particularly to gender differences and what is explained by other individual...
characteristics (socioeconomic and demographic). We developed a model where the probability of being a daily Internet user depends on age, education, digital skills, income, employment status, the population of the place of residence, the number of household members, and gender. The results obtained support the existence of a specific gender component in favor of men. In other words, at least part (about 9%) of the gap in Internet use between men and women is related to gender.

To answer RQ2 and regarding Internet services, we can conclude that differences persist in the types of activities carried out on the Internet by men and women. Women show a preference for health and social issues (INE, 2019): seeking information on health issues (8.4 points more than men); participate in social networks (1.1 plus points); and make phone or video calls over the Internet (3.2 points). Men, however, show a greater tendency to read newspapers and magazines (5.9 points more than women), use storage space on the Internet (4.7 points more) and sell goods or services (4.1 points ahead).

On the other hand, the gap size throughout 2007–2020 has evolved in the right direction. It has narrowed for 14 of the 15 services considered. The only exception is the eHealth service, which has always had a gap favoring women and has widened over the years, going from 6.6 to 12.9 percent.

Then, we study whether these gender differences persist when controlling for other individual characteristics. The results (as in the case of daily Internet use) corroborate the existence of a gender-specific component. However, the sign of a gender impact on different services is not always the same. For example, services where being a woman reduces the probability of using them are: eGovernment, eBanking, eMail, eCommerce, iCloud, eNews, eLeisure, and eSelling. On the other hand, services where the condition of women increases the probability of using them are: eHealth, Social networks, eLearning, eTourism, Chat, VoIP, and Searching Job.

Finally, the conclusions referring to RQ3. They allude to the effects of the first wave of the COVID 19 pandemic on the gender gap. Between 2019 and 2020, the gender gap in Internet use narrowed by 21.7%. However, the evolution of the divide was not homogeneous in the different services. In some services, there was a narrowing of the gap between men and women. Electronic commerce, reading news online, online sales, social networks, and VoIP for example. Nevertheless, the pandemic had a pernicious effect (gap increase) on some other services. Services as relevant for daily life as eGovernment, eBanking, or eMail, which already had a gap against women at the beginning of the pandemic, saw the gap increase.

5.2. Policy recommendations

As the results of this study indicate, the Internet gender gap has narrowed considerably in Spain in recent years. Even so, there are still issues that need to be addressed. On the one hand, there are social groups where gender equality has not been achieved. This is the case of the elderly, as discussed in the article. On the other hand, although the gender gap in Internet access has narrowed, it has translated into a gender divide in digital skills in recent years.

Specific digital skills are needed to efficiently perform actions such as communicating, obtaining information, or carrying out transactions, such as making purchases, interacting with public administrations, or making a medical appointment. In this respect, Spanish authorities have designed a strategy called Digital Spain 2025, DS25 (Ministerio de Asuntos Económicos y Transformación Digital, 2022), which seeks gender equality in digital skills, among its other goals.

To that end, particular emphasis must be placed on training those groups who encounter the most difficulties in acquiring those skills (the elderly, the retired, people with low incomes, and people living in rural areas). The goal of DS25 is to train fifteen million people in basic skills by the end of 2025.

Another course of action would be to focus on eliminating gender stereotypes. It would be necessary to eradicate the idea that ICT use and that certain studies and professions are not “women-appropriate.” Reducing technophobia and gender stereotypes are critical factors in incorporating women in the use of new technologies and the Internet. This strategy may require the participation of educational institutions, teachers in various education stages, mass media, opinion leaders, and pedagogy in the family environment. As Sáinz et al., 2020 point out, there are already initiatives focused on attracting young girls to technological fields in Spain. Some of these programs include: Youngitgirls, Inspiring Girls, NoiesTIC, STEM Talent Girls, WomenTech, and Mujeres en Ingeniería, among others.

Another way to reduce the gender-specific component in the Internet divide is to increasingly consider women’s specific tastes, interests, and needs. For this, policymakers must work side by side with women and offer them the opportunity to express their concerns based on their everyday realities, which policies must reflect.

Finally, when women become ICT users and contribute to their development, services will be more tailored to their needs. Therefore, it is likely, that the specific gender gaps in Internet use will diminish substantially.

5.3. Caveats and further research

The availability of data has conditioned this study. Even though we have used a high quality database, we have missed information that allowed us to undertake a more exhaustive analysis. For example, it would have been desirable to have some information on the intensity of Internet use and the different services. For example, knowing how much time the individual spends on the Internet would allow us to better discriminate between individuals. Currently, we only know who uses it on a daily basis and who does not.

This also applies to the 15 services analyzed. We know who uses them and who does not, but we can not observe the intensity of use. As some of these questions are added to the questionnaire, new avenues of research will be opened. Once these results are obtained, they are likely to be revealing.

Finally, in the future, the work could be extended to include the years 2021 and 2022 as data become available. This work would allow a more accurate assessment of the pandemic’s effects.
Data availability

The authors do not have permission to share data.

Appendix

Two examples of models for Internet services: eBanking and eHealth

In this section, we want to clarify how gender affects an individual’s use of a particular service. To do this, we develop models in which, in addition to gender, other possible explanatory factors are considered.

The models (one for each of the 15 services) are similar to section 3 (results in Table 1). However, we want to highlight here that the dependent variable is the use or not of a particular service during a specific period (3 or 12 months, depending on the case).

In this Appendix, we deal with 2 of the 15 services for the sake of brevity. We have included a service in which the gap favors men (eBanking) and another which favors women (eHealth). The results are in Table A1.

Here, in addition to the effects of gender, we obtain the impact of other variables. Given the objective of the work, only gender effects have been transferred to the main text (shown in Table 3). However, the information obtained for these 15 services is relevant and would deserve a separate study.

Table A1
Determinants of the use of eBanking and eHealth services.

| LINEAR PROBABILITY MODEL | eBanking | eHealth |
|--------------------------|----------|---------|
|                          | Coefficient | z       | Coefficient | z |
| GENDER (Male)            |            |         |            |   |
| Female                   | -.027      | -8.97   | .127       | 38.83 |
| AGE (16-24)              |            |         |            |   |
| 25-34                    | .138       | 19.65   | .079       | 10.05 |
| 35-44                    | .165       | 24.06   | .137       | 17.77 |
| 45-54                    | .159       | 22.49   | .149       | 18.78 |
| 55-64                    | .156       | 20.36   | .144       | 16.71 |
| 65-74                    | .132       | 13.39   | .140       | 12.06 |
| 75-84                    | .096       | 7.58    | .105       | 6.91  |
| 85+                      | .054       | 2.46    | .058       | 2.07  |
| EDUCATION (Primary studies) |            |         |            |   |
| Secondary studies        | .043       | 9.75    | .043       | 7.51  |
| Bachelor’s degree        | .091       | 16.69   | .029       | 4.44  |
| Master or PhD            | .105       | 18.50   | -.001      | -0.10 |
| DIGITAL SKILLS (Low)     |            |         |            |   |
| Medium                   | .274       | 78.26   | .321       | 74.78 |
| High                     | .552       | 140.90  | .522       | 113.27 |
| Very high                | .708       | 163.74  | .684       | 133.69 |
| HOUSEHOLD MEMBERS (One person) |            |         |            |   |
| Two                      | -.007      | -1.66   | .018       | 3.57  |
| Three                    | -.024      | -5.08   | .032       | 6.01  |
| Four                     | -.036      | -7.32   | .030       | 5.49  |
| Five or more             | -.043      | -6.28   | .009       | 1.22  |
| EMPLOYMENT SITUATION (Employed) |            |         |            |   |
| Unemployed               | -.055      | -13.29  | .023       | 4.83  |
| Retired                  | -.000      | -0.04   | .066       | 8.28  |
| Student                  | -.178      | -23.71  | -.034      | -3.90 |
| Housekeeper              | -.061      | -9.68   | -.072      | 9.58  |
| Other                    | -.015      | -2.07   | .057       | 6.73  |
| INCOME (Low)             |            |         |            |   |
| Medium                   | .050       | 13.19   | .003       | 0.70  |
| Medium-High              | .088       | 20.92   | -.009      | -1.73 |
| High                     | .109       | 20.99   | -.032      | -5.20 |
| HABITAT (>100,000)       |            |         |            |   |
| 50.000-100.000           | .001       | .027    | .005       | 0.82  |
| 20.000-50.000            | -.005      | -1.19   | .008       | 1.56  |
| 10.000-20.000            | -.005      | -1.14   | -.004      | -0.82 |

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