

**## DIGITIZATION: A DOUBLE-EDGED SWORD IN BRIDGING THE GENDER GAP IN ENTREPRENEURSHIP**

CZU: 004.89:338.22-055.2

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**Abstract.** Although Europe is one of the most economically developed geographical areas, the gender gap in entrepreneurship is still very high. Digitalization can be a tool that motivates a woman to become an entrepreneur as it facilitates the reconciliation of work and family life. This empirical study relates the gender gap in entrepreneurship to key digitalization indicators in 23 European countries between 2014 and 2022. The methodology used is a panel data GMM. The findings highlight how the improvement of women's skills in information and communication technologies (ICT) or the participation of women in technology companies motivates female entrepreneurs as they enable them to develop businesses in digital environments. The context in which women operate is also relevant to their decision to become entrepreneurs, especially, the increase in the number of “digital” companies. However, much work remains to be done. Women are still far from achieving parity in ICT companies, which should be encouraged through public policies.

**Keywords:** Gender Gap, Female Entrepreneurship, Digitization, Panel data models, GMM.

**JEL Classification:** C33, J16, L26, O31, O35.

**Introduction**

According to the *Global Gender Gap Report (2023)* published by the World Bank, Europe is the world region with the highest gender parity. However, in the section on Economic Participation and Opportunity, Europe dropped to third place behind North America and East Asia and Pacific. In fact, the proportion of senior positions held by women has declined and only 10 countries have a parity of at least 60% in senior management positions. With regard to the gender pay gap, in Europe as a whole, in 2022, women's gross hourly earnings were on average 12.7% below those of men. Another example of the gender gap can be seen in the employment rate. Although women account for 51% of the EU population, the employment rate of men in the EU was 80.0% in 2022, exceeding that of women by 10.7 points (69.3%). In the field of entrepreneurship, there is also a glaring gap between men and women. According to the *Woman's Entrepreneurship 2022/2023 report: Challenging Bias and Stereotypes* (Global Entrepreneurship Monitor, 2022), women face inequality at home, bearing a greater burden of family responsibilities, which contributes to increase economic dependency and reduced interpersonal power and privilege undermining their entrepreneurial activity. This is despite the fact that this report states that women continue to play an important role in driving economic growth and advancing social development in their countries and communities. Gender equality and female entrepreneurship are key factors for economic development (Sarfaraz, Faghih and Majd, 2014) since they help in the creation of sustainable social value, acting considerately with the environment, supporting social inclusion and cohesion and territorial development (Sanchez-Espada et al., 2018). Moreover, women are able to generate new professional opportunities for themselves and others,

offering numerous solutions for managing business problems and exploiting new opportunities (Khyareh, 2018). That is, female entrepreneurship is not only important from the point of view of women empowerment but also from the economic point of view. Although entrepreneurship gender gap data show a reduction in the differences between men and women, it persists and women are constantly forced to break through the glass ceilings of the business world.

The gender gap in entrepreneurship is especially high in Europe. According to the Global Entrepreneurship Report (hereafter, GEM report), Europe has the lowest rates of female entrepreneurship, including entrepreneurial intention, entrepreneurial activity rate, and the highest gender gap, which, in 2023 was 0.73. This means that for every 100 male entrepreneurs, there are 73 female entrepreneurs, although European female entrepreneurs are more successful as their dropout rate is lower than in other regions, bringing greater stability to their entrepreneurial activity.

The factors that determine the gender gap in entrepreneurship are very diverse. Mazas and Alexeeva (2023) detail geographical, sectoral, and technological factors that help to reduce the differences between men's and women's entrepreneurship. One aspect that has been frequently referred to in the literature is access to finance (Minniti and Arenius, 2003; Brush and Manolova, 2004; Verheul et al., 2006; Canning et al., 2012; Guzman and Kacperczyk, 2019) and others as diverse as the capabilities available to women entrepreneurs (Manzanera-Román and Brändle, 2016), the social and economic environment (Mroczek-Dąbrowska and Gaweł, 2020; MacNeil et al., 2022), family responsibilities (Tur-Porcar et al., 2016) or women's participation in political and in political and economic spheres and the efficiency of business regulation (Vracheva and Stoyneva, 2020).

The GEM report (2022) also states that gender stereotypes and prejudices are often some of the difficulties women face in running their own business and that technology can play a key role in neutralizing these negative effects, so that women entrepreneurs can develop their activity, for example, by establishing better access to financing. Although Europe leads the entrepreneurship gender gap, it also has the highest rate of women entrepreneurs in the ICT sector and more than a quarter of European women entrepreneurs reported using these digital tools even before the pandemic. However, less than half of female entrepreneurs plan to incorporate digital tools into their businesses, which still puts them far behind men. This controversy between the reduction of the entrepreneurship gender gap and the use and training in digital tools has been pointed out by several authors, who offer opinions in one or another direction. Rajahonka and Villman (2019) and Bhowal (2020) consider that the application of ICTs in business can generate opportunities for female entrepreneurs and that the increase in digital social media will facilitate the management of communication between work and family environments. In the study conducted by Olson and Bernhard (2020), women entrepreneurs themselves consider that having knowledge in the use of social networks is desirable for the survival of their businesses. In opposite terms are the studies of authors such as Kamberidou, I. (2020), and Olsson, A., & Bernhard, I. (2020). The formers consider the limitations that women entrepreneurs have in acquiring digital competencies, and the latter determine that digitalization not only does not reduce the gender gap in entrepreneurship, but increases it. Mazas (2022) shows evidence of the relationship between entrepreneurship and some of the main indicators on the digital economy and society in a sample of 17 European countries and the results are not conclusive. Although there is a correlation between some of the ICT indicators and the reduction of the gender gap in entrepreneurship, the relationship is very weak.

In this study, and taking into account previous work by Mazas (2022) and Mazas and Alexeeva (2023), we study, through a panel data model, the relationships between the gender gap in entrepreneurship and digitization in the main European countries over the last 10 years.

#### **Data and methods**

The analysis is based on two types of data: on the one hand, the indicators on entrepreneurship and on digitization in Europe from 2014 to 2022 in 23 European countries. The data were obtained from the Eurostat database, specifically, from the sections related to the Economy and Finance; Science,

Technology and Digital Society; and Employment and Social Policies indicators. The digitalization variables have been grouped into two blocks. Firstly, the indicators that deal with the training of employees who have received ICT training, employees working in ICT companies, and the use of the Internet, in which data are collected for men and women as a percentage. On the other hand, variables that reflect digitalization in companies have been selected, such as the percentage of companies that have incorporated digitalization in their operations (e-commerce, online sales, etc.). Finally, a context variable has been selected, which is the unemployment rate by gender.

To measure entrepreneurship, the TEA (Total early-stage Entrepreneurial Activity) indicator has been used, defined by the GEM as the percentage of the adult working-age population between 18 and 64 years of age that is in the process of creating a new business.

Some of the above statistics are disaggregated by sex (ICT training, ICT employees, Internet use, unemployment rate, and TEA), so the gender gap has been calculated as the ratio of female to male data. If the value of the gender gap indicator is equal to 1, it indicates equity between men and women; when the indicator is less than 1, it means underrepresentation of women relative to men; and if it is greater than 1, then women are more represented than men in that particular field. Table 1 shows the descriptive statistics of the mean values of the entire sample for the 23 countries and the period considered. Briefly analyzing the results in Table 1, we can see that, firstly, there is a great inequality between European men and women in terms of the number of people employed in ICT companies and the training they receive in digitization. This fact is reflected in the gender gap, in the second part of the table, which shows that for every 100 men employed in ICT companies, there are only 23 women, and that, for every 100 men who receive training in digitization-related subjects, only 24 women opt to receive this training. On the other hand, this inequality in access to employment in ICT companies or to training in digitization, however, does not translate into access to new technologies. There is great parity between men and women in terms of Internet access, which in both cases is more than 90%. This requires further clarification, although it is true that access to the Internet is very equal, it should be borne in mind that entrepreneurship requires additional knowledge beyond that of a mere user. To start up a business with online sales, maintain a website, or install electronic invoicing, it is necessary to have additional knowledge which, as the data in Table 1 shows, is not accessible to women.

In terms of entrepreneurship, there is still a large gap between men and women in Europe. The average for the years under study, 2014-2022, shows that we are still far from achieving equality in entrepreneurial intentions between men and women, recording that, on average, for every 100 male entrepreneurs, there are only 64 women. Moreover, the path to achieve parity between men and women in Europe is erratic. As Figure 1 shows that the reduction of the gender gap in entrepreneurship in Europe has followed a progressive reduction between 2014 and 2018, but there have been years in which this evolution has been truncated. In terms of entrepreneurship, in Europe, there is still a large gap between men and women. It should also be noted that there is a large disparity in terms of gender inequality in entrepreneurship in the 23 European countries studied. Table 2 shows the averages of the gender gap in entrepreneurship in the period considered, in which, it can be observed that the countries with the greatest inequality are Norway and Italy, where women entrepreneurs do not even reach 50% of male entrepreneurs. At the opposite extreme are Spain (0.82) and Bulgaria (0.77).

One of the elements, which is sometimes taken into account to determine female entrepreneurship, is the lack of job opportunities in other fields. To highlight this issue, the unemployment rate and the difference between men and women have been incorporated. As can be seen in Table 1, equality between men and women in access to a job, although not total, is much lower than in other aspects, such as ICT training.

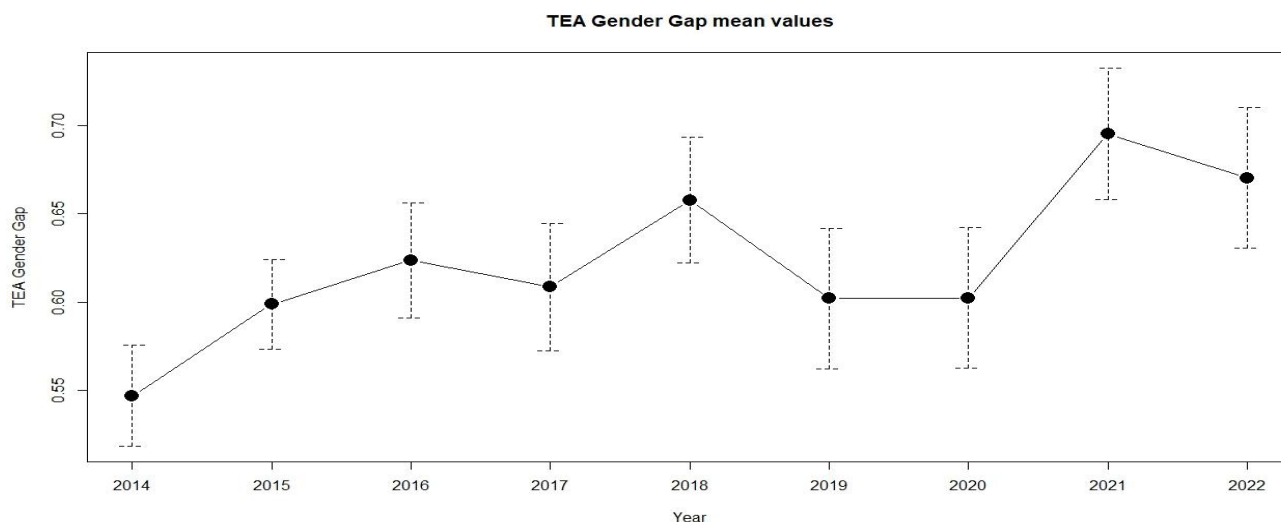
Finally, variables that reflect the panorama of business digitalization in Europe, i.e. innovation and digitalization of companies, have been incorporated to find out the context in which women

entrepreneurs develop their activity and to find out whether a digital environment favors female entrepreneurship. Some of the data provided in Table 1 are as follows: companies with e-commerce account for 17.90 % of the total number of companies, 15.23 % have electronic invoicing, 15.39 % have online sales and, in the case of B2B companies, this percentage is 10.43%. Significantly, only 4.36 % of companies have electronic data interchange.

**Table 1. Descriptive Statistics of digitalization and entrepreneurship**

Digitalization and entrepreneurship indicators						
	Mean	Std. Dev	IQR	Min	Median	Max
Employee ICT training (women)	18.94	6.78	10.90	6.10	17.80	36.90
Employee ICT training (men)	81.78	6.86	10.10	63.10	83.55	93.90
Employee ICT (women)	18.23	3.92	5.15	9.70	17.60	31.50
Employee ICT (men)	81.77	3.92	5.15	68.50	82.40	90.30
Use of the Internet (women)	83.08	11.21	16.43	51.79	84.88	99.82
Use of the Internet (men)	84.98	9.77	14.84	56.41	86.28	99.58
Unemployment Rate (women)	5.27	2.99	2.50	1.60	4.55	15.40
Unemployment Rate (men)	5.79	2.83	3.05	2.00	5.25	16.80
TEA Female	6.27	2.59	3.26	0.90	5.87	14.35
TEA Male	10.33	4.32	5.68	1.50	10.22	24.51
Digitalization and entrepreneurship indicators Gender Gap						
	Mean	Std. Dev	IQR	Min	Median	Max
Employee ICT training Gender Gap	0.24	0.11	0.17	0.06	0.22	0.58
Employee ICT Gender Gap	0.23	0.06	0.08	0.11	0.21	0.46
Use of the Internet Gender Gap	0.98	0.04	0.04	0.82	0.98	1.04
Unemployment rate Gender Gap	0.90	0.15	0.20	0.58	0.89	1.34
TEA Gender Gap	0.62	0.15	0.19	0.31	0.59	1.07
Indicators of digitalization in companies						
	Mean	Std. Dev	IQR	Min	Median	Max
Companies with e-commerce	17.90	6.86	11.05	6.50	16.50	36.60
Companies with ecommerce invoicing	15.23	6.78	9.50	4.80	14.10	33.50
Company with online sales	15.39	5.84	9.70	5.80	14.30	31.20
Companies with online sales B2B	10.43	4.37	7.60	3.30	9.50	21.50
Electronic Exchange companies	4.36	2.77	3.00	0.60	3.60	14.50

*Source: Own elaboration.*



**Figure 1.** TEA Gender Gap mean values 2014-2022

*Source: Own elaboration.*

**Table 2.** TEA Gender Gap mean by Country.

Country	Mean	Std. Dev	IQR	Min	Median	Max
Austria	0.73	0.09	0.04	0.57	0.76	0.82
Bulgaria	0.77	0.08	0.10	0.70	0.76	0.87
Croatia	0.57	0.03	0.03	0.50	0.58	0.61
Cyprus	0.54	0.08	0.06	0.42	0.56	0.65
Estonia	0.58	0.01	0.01	0.56	0.58	0.59
Finland	0.62	0.13	0.12	0.47	0.68	0.72
France	0.63	0.17	0.28	0.44	0.65	0.85
Germany	0.64	0.14	0.11	0.50	0.60	0.87
Greece	0.67	0.13	0.10	0.45	0.68	0.87
Hungary	0.57	0.09	0.12	0.46	0.57	0.66
Ireland	0.58	0.13	0.10	0.44	0.55	0.82
Italy	0.46	0.12	0.21	0.31	0.47	0.60
Latvia	0.58	0.05	0.06	0.51	0.57	0.66
Luxembourg	0.59	0.11	0.13	0.45	0.56	0.75
Netherlands	0.67	0.18	0.17	0.32	0.71	0.89
Norway	0.48	0.05	0.05	0.41	0.48	0.54
Poland	0.73	0.17	0.16	0.48	0.71	1.07
Portugal	0.58	0.04	0.04	0.54	0.59	0.62
Romania	0.72	0.23	0.23	0.53	0.66	0.98
Slovakia	0.61	0.11	0.18	0.47	0.63	0.80
Slovenia	0.56	0.15	0.21	0.39	0.54	0.85
Spain	0.89	0.08	0.12	0.79	0.86	1.04
Sweden	0.55	0.09	0.15	0.42	0.51	0.72

*Source: Own elaboration.*

To determine the relationship between the TEA gender gap and digitization indicators, a panel data model is constructed and the estimation is performed using the Generalized Method of Moments (GMM). Considering that several of the variables may be related, this estimation technique has been chosen because it is especially useful to deal with possible problems of endogeneity, measurement



error, or omitted variable bias that are frequent in this type of data. This model is widely used to estimate dynamic panel data that allows to deal with autocorrelation and heteroscedasticity (Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998, 2000) and generates consistent and efficient estimates using instrumental variables and a set of moment conditions derived from the data itself. The model to describe the behaviour of TEA gender gap is as follows:

$$\begin{aligned} TEAGG_{it} = & \beta_0 + \beta_1 TEAGG_{it-1} + \beta_2 Employee\ ICT\ GG_{it} + \beta_3 ICT\ training\ GG_{it} \\ & + \beta_4 ICT\ training\ GG_{it-1} + \beta_5 Companies\ e - commerce_{it} \\ & + \beta_6 Companies\ e - commerce_{it-1} + \beta_7 Companies\ with\ online\ sales_{it} \\ & + \epsilon_{it} \quad (1) \end{aligned}$$

Where  $i = 1, \dots, 23$  is the subscript that indicates the country and  $t$  is the subscript that denotes the year, so that  $t = 2014, \dots, 2022$ . The variable  $TEAGG_{it}$  is the dependent variable and represents the TEA gender gap for the  $i$ -th country and the  $t$ -th year. To determine the explanatory variables and, after a model selection process, the variables in Table 1 with the greatest explanatory capacity for the dependent variable were selected. To be specific, the explanatory variables of model (1) are  $TEAGG_{it-1}$ , which is the lag of the dependent variable; *Employee ICT GG*, which represents the gender gap in employees working in European ICT companies; *ICT training GG*, which is the gender gap in ICT training in European companies, and also its lag is included. Also considered as independent variables are *Companies e-commerce*, which is the variable that represents the percentage of European companies that develop e-commerce, and *Companies with online sales*, which is the percentage of companies that have Internet sales.  $\beta$ 's are the coefficients that relate the dependent variable and the explanatory variables and  $\epsilon$  is the error term.

To validate the estimated model, three statistics have been considered. To detect over-identification and, therefore, the validation of the instruments used, the Sargan test was carried out. The global significance of the model, which determines that the variables included in it are relevant when explaining the behavior of the dependent variable, the Wald test has been applied and finally to rule out second-order autocorrelation, the Arellano-Bond autocorrelation test was applied.

### Results

Table 3 shows the GMM estimation of model (1). The Arellano and Bond statistic does not reject the null hypothesis of no serial correlation of second order, so the model is correct in terms of autocorrelation (AR(2)). The  $\chi^2$  statistic of the Sargan test does not reject the null hypothesis of no relationship between the instruments and the error term. Finally, the Wald test rejects the null hypothesis that the  $\beta$  coefficients are considered statistically equal to zero, so the model, as a whole, is valid for explaining the behavior of the dependent variable.

The results obtained in Table 3 can be grouped into three blocks; the first relates to women's participation in ICT companies and women's training in new technologies, the more or less digitized business environment in which European women entrepreneurs develop their activity, and the evolution of female entrepreneurship in Europe. With respect to the first block, the relationship between the TEA gender gap and the representation of women in the ICT sector is significant (p-value = 0.0000). According to the results obtained, the greater the equality in women's participation in the ICT sector, the greater the equality between male and female entrepreneurs.

There is also a direct relationship between ICT training and the reduction of the TEA gender gap. The positive and significant coefficient (+0.2120) suggests that the gender gap in ICT training for employees in the previous period has a direct effect on the current gender gap in entrepreneurship. Conversely, reducing the inequality between European men and women in innovation and technology training will result in more female entrepreneurs. That the first lag is significant (p-value=0,0070) indicates that there is a causal relationship between training and future entrepreneurship. To contribute to the training of European women in ICT is to generate a pool of future entrepreneurs, who are likely to develop their business activity in a digital environment. Moreover, these are tremendously significant elements where there is a long way to go. Considering the huge gender gap

between men and women in participation in ICT companies as well as in ICT training, as shown in Table 1, making an effort to reduce this gap may result in a boost to female entrepreneurship.

These findings are in line with those of Oggero et al. (2020), who suggest the importance of financial literacy and digitization in promoting female entrepreneurship, Hudek et al. (2019), who assert through a European cross-sectional study the need for more skilled ICT specialists in almost all sectors of the economy in order to benefit from technological innovations, and Suhkla et al. (2021), which considers that the role of ICT has successfully transformed the way of doing business and if women have the right Internet skills, i.e. operational, informational and creative skills, their entrepreneurial intentions will be high.

The environment in which they carry out their activities is also important for women entrepreneurs. The digitalization of businesses promotes the reduction of the gender gap in entrepreneurship; the positive and significant coefficient of the lag of the variable *Companies e – commerce* suggests that the presence of e-commerce in the previous period is associated with a smaller gender gap in entrepreneurship in the current period. The interpretation is as follows: the higher the percentage of companies with e-commerce, the higher the value of the variable *TEAGG*, that is, the greater the equality between men and women entrepreneurs because the indicator approaches 1, which is the parity value. Although in Europe we are far from having most companies incorporate digital tools, promoting these types of environments encourages an increase in women entrepreneurs, who in many cases view digitalization as a flexible tool that allows them to balance family and professional life. In a study conducted in Asia, Masroor et al. (2020) highlights the contribution of e-commerce to the economy and its benefits in facilitating female entrepreneurship. He also points to this tool as a fundamental tool for implementing public policies, ensuring the elimination of inequalities and removing many of the barriers faced by women entrepreneurs. Zhao et al. (2023) point to micro e-commerce (MEC) as a major tool for creating income and employment for the poorest strata of society, especially women. Many other authors have highlighted the importance of e-commerce; for example, in the empowerment of rural women in China (Yui and Cui, 2019), Dutta and Shivani (2023) on female entrepreneurship in India and Qasim et al. (2019) on those in Jordan.

The other variable included in the model to determine the digitization of the environment is *Companies with online sales*. Although the coefficient is positive and indicates that there is a direct relationship between the percentage of companies with online sales and the reduction of the gender gap in entrepreneurship, the coefficient accompanying the variable is not statistically significant. This lack of significance implies that the effect is uncertain or too small to be detected with this dataset.

Finally, the lag of the variable *TEAGG* is not statistically significant too. This is consistent with the evolution of the TEA gender gap shown in Figure 1, where a reduction in the gender gap in entrepreneurship may be preceded by an increase of the same variable which makes it difficult for a single coefficient to capture the trend.

**Table 3.** GMM estimacion of model (1)

	Estimate	
Lag(TEA Gender Gap)	-0.0364	(0.6697)
Employee ICT Gender Gap	1.4359	(0.0000) ***
Employee ICT training Gender Gap	-0.0114	(0.9349)
Lag(Employee ICT training Gender Gap)	0.2120	(0.0070) ***
Companies with e-commerce	-0.0201	(0.2826)
Lag(Companies with e-commerce)	0.0084	(0.0000) ***
Companies with online sales	0.0306	(0.1806)
AR(2)		0.5031
Sargan		9

Wald Test 53267.66 \*\*\*

*Note: The z-statistic coefficient is shown in brackets; \*\*\* means a significance level of 1 %, \*\* means a significance level of 5 %, \* means a significance level of 10 %.*

*Source: Own elaboration.*

Overall, the GMM results indicate that certain factors, like the ICT gender gap among employees and the lagged ICT training gender gap, have a statistically significant positive impact on the entrepreneurship gender gap. On the other hand, other factors like the current ICT training gender gap and companies with online sales do not have significant effects. The model appears well-specified, with no evidence of autocorrelation, and the instrumental variables seem valid. The Wald test confirms that the independent variables, in aggregate, significantly affect the entrepreneurship gender gap.

### Conclusions

This study explores the relationship between the gender gap in entrepreneurship and digitization in the European context. Using the main available digitization indicators published by Eurostat and data on entrepreneurship extracted from GEM publications, we first perform a brief descriptive statistical analysis and then estimate a panel data GMM model to analyze entrepreneurship and digitization data for a sample of 23 European countries between 2014 and 2022.

Among the initial results are the erratic evolution of the gender gap in entrepreneurship in Europe over the years of the study which, far from having followed an upward trend, is still far from parity between men and women, and the large difference between the countries of the sample. There is also a great inequality in the participation of women in ICT companies and in the digital skills training they have in new technologies, which barely exceeds that of men by 25%.

As for the relationship between the gender gap in entrepreneurship and inequality between men and women in the ICT sector, both in participation and training, the GMM model estimate shows a direct and significant relationship; the greater the equity in the digitalization sector, the smaller the gender gap in entrepreneurship. Therefore, there is no time to lose; ICT training today can encourage the women entrepreneurs of tomorrow and, therefore, in Europe it seems necessary to contribute more strongly to this type of public policies if we want to make progress in reducing the gender gap in entrepreneurship.

The digitization of companies in Europe is also a factor that favors the number of European female entrepreneurs, for this reason, it seems appropriate to promote greater digitization of all European companies; e-commerce, online invoicing, etc., since a digitized environment also favors the reduction of the gender gap in entrepreneurship. Furthermore, in sight of the data on European digitization, there is still a long way to go.

Limitations of this study are related to the sample, as digitalization indicators are still scarce and the time series are limited. In addition, future lines of research focus on further developing indicators on digitization that are more adjusted to entrepreneurial activity and particularly if they are disaggregated by sex.

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