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Climate change policy and entrepreneurial opportunities

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ABSTRACT

In the current era, the new climate change policy -based on the Sustainable Development Goals (SDGs)- is the inspiration for many types of entrepreneurship which combine value creation with conservation and social protection. In order to obtain a radiography of the European entrepreneurship associated to climate change policy, this paper proposes a study of 22 European countries between the years 2014 and 2017. This sample is obtained from two worthy databases -Eurostat and Global Entrepreneurship Monitor (GEM)- and some variables as contribution to the international 100bn USD commitment on climate related expending, eco-innovation ratio and total entrepreneurial activity (TEA) are used for identifying this kind of sustainable entrepreneurship. Logit modeling is the methodology used for relating the impact of circular economy to entrepreneurial opportunities. This paper concludes that: sustainable entrepreneurship in Europe does not follow a unique model due to the opportunities of Climate change are not taken advance of the same way.

1. Introduction

Climate change is unquestionable, and its adaptation process to answer to climate change is one of the most studied around the world. Coumou and Rahmstorf (2012) published interesting results in a paper cited more than 1300 times in only a few months. They identify extreme weather events, linking them to economic losses. For example, 2011 was a year of extreme weather in the United States – due to 14 events that caused losses in excess of US$1 billion each – and in France with the hottest and driest spring on record since records began in 1880 and which caused the French grain harvest to be 12% down.

Several works try to define the complex process of adaptative action (Carter et al., 1994; Smit et al., 2000; Smit and Wandel, 2006; Eriksen et al., 2015). Most of them distinguish between planned and unplanned through formal policy intervention and informal business behavior.

In this sense, the US Global Development Lab promotes an open innovation fund called Development Innovation Ventures (DIV) which invests funding in entrepreneurial solutions to global development challenges. Since October 2010, DIV has invested in more than 145 ideas across nine sectors in 35 countries around the world.

In the same way, the recent Sustainable Europe Investment Plan has just mobilised public and private investment of one billion euros over 10 years. The aim of this financing plan is to reach net-zero emissions by 2050, developing a clean energy transition of coal-dependent regions.

Currently, the existence of policy plans oriented to entrepreneurial opportunities for adapting to climate change is common. The European Entrepreneurial Region Project (EER) identifies and rewards European regions and cities which promote sustainable enterprises according to their natural, geographical, and agricultural resources (blue, green and orange) driving forward the 2030 Agenda for Sustainable Development.

Policy makers are contributing to sustainable global entrepreneurship by concrete policies aimed to a sustainable economy. The new business models demanded by the circular economy, focused on reducing the negative impacts on society, the environment and the efficient use of goods and services, give rise to entrepreneurship and intrapreneurship projects within the so-called green economy (Schaper, 2016). New initiatives are needed in the industrial sector, since more than 50% of the costs in these companies are associated with the consumption of raw materials, which includes extraction, importation and transportation (Nava Chacin et al., 2015). It means that the value chain of green economy would need to be rethought because some raw materials are inexpensive and are not incorporated in the final price. Likewise, it must be sensitised towards innovative productive models that encourage the use of non-polluting energies, the increase of the useful life of products or the shared consumption of them, in other words, the philosophy of zero waste: reject, reduce, reuse, recycle and compost.

Another perspective of sustainable economy, apart to the traditional innovative productive models, has been defined through concepts as Socio-Economics (local economic impact and job creation) (Swart et al.,

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2003), Eco-Efficiency (product stewardship) (DeSimone and Popoff, 2000), Socio-Environment (global climate change, regulations on health and safety) (Pelling and High, 2005) and Equity-Economy (against gender discrimination) (Robert et al., 2005). Authors as Gladwin et al. (1995) and McDonough et al. (2002) argue that sustainable entrepreneurship is a kind of spin-off from sustainable development and that sustainable entrepreneurs are who create social and economic value in a sustainable way (Edgeman and Eskildsen, 2014).

In this sense, social entrepreneurship -known too as 'Third Sector'- is another perspective of sustainable economy. Co-operative models of economy focused on sustainable growth and inclusive society have increased a lot as result from more than two decades of management-driven public sector policies. Social innovation is achieved when transformations proposed to add value to society and the environment, helping to public decision-makers and defining the society as a whole (Avelino et al., 2019).

Given this context, we propose to start answering two main questions: what is the relationship between climate change policy and entrepreneurial opportunities? and, what is the relationship between climate change policy and their impact on GDP?

The paper proceeds as follows: first, we discuss earlier work on change climate policies, entrepreneurial opportunities and the circular economy; second, data and methodology is set out; next, we present and discuss our results; and finally, we draw some conclusions and explain the limitations of our research.

2. Climate change policy, the circular economy and entrepreneurial opportunities

2.1. Climate change policy

The Sustainable Development Goals (SDGs) are specified across three dimensions: society, environment and economy. The SDGs (2012) are a set of seventeen goals on poverty, environment, social equality and prosperity and 169 goals that the member states of the United Nations (UN) have committed to achieve by 2030. These seventeen goals are the continuators of the Millennium Development Goals (MDGs) that were created in 2000 with the aim of alleviating the social problems of underdeveloped countries. In the late 1980s, The Brundtland Commission linked sustainable to systematic or long-term use of natural resources available for future generations.

Governments and private and public institutions have begun to invest in this sustainable awareness, developing opportunities for new entrepreneurship. Awards, investing labs or public funds are some of the tools used by countries in order to transform older and unsustainable growth economies into newer and sustainable economies (Helm, 2008).

Although the common framework for understanding climate change identifies two different behaviours (mitigation and adaptation), we use adaptation as crucial in our approach. That means that mitigation is used in order to avoid future climate change, but adaptation is depicted as a phenomenon which we can plan for now, but which will happen in the future (Tompkins and Adger, 2005; Youssef et al., 2018; Barker, 2001). In this way, adaptation policies have developed new concepts, such as the circular economy, which has opened new windows for entrepreneurship, sustainable in this case. The benefits of these policies are being studied around the world in order to improve our planet through sustainable business projects.

2.2. The circular economy

The European Environment Agency (EEA) (EEA 2016: 9) applies the circular economy concept to "all kinds of natural resources, including biotic and abiotic materials, water and land. Eco-design, repair, reuse, refurbishment, remanufacture, product sharing, waste prevention and waste recycling are all important in the circular economy." That represents a spectrum of different sustainable economies (blue-water, land-green, orange-culture).

D'Amato et al. (2017) have provided a complete synthesis of concepts related to green economy. For example, they consider that the circular economy, green economy and bioeconomy (CE, GE and BE) (Murray et al., 2017) represent the same idea: adaptation towards a sustainable economy (D'Amato et al., 2017:1). But green, blue and orange economy have only recently appeared in the academic literature with differences between them.

Green and blue infrastructures develop ecosystem services focusing on, at least, four principles: temperature regulation, air quality improvement, water regulation and noise reduction. Both concepts have developed new opportunities for entrepreneurship associating business creation to cultivation of land, healthy fishing, organic food, sustainable energy, etc. In this sense, the circular economy is the umbrella under which different ecosystem services created by green and blue economy can promote new eco-entrepreneurs.

Orange economy is the last academic contribution to the circular economy framework (Elia et al., 2020). In this sense, creativity is understood as a practical result of the global economy which make possible to generate wealth in the impoverished countries promoting cultural industries (Buitrago and Duque, 2013). These orange ecosystems are built on digital platforms like e-commerce marketplace (Avgerou and Li, 2013; Leong et al., 2016) and crowdfunding platforms (Burtch et al., 2013; Zheng et al., 2014). Li et al. (2017) and Du et al. (2018) introduced the idea of digital entrepreneurship ecosystem as a collective and collaborative effort among "digital species", which allows overcoming the resource limitation of a single firm and accelerate the creation of digital startups. Buitrago and Duque (2013) provided this approach according to the knowledge creation process obtained through intellectual property. Firstly, they apply it to the cultural heritage of the Latin American and Caribbean region, but it can be used in relation to every country or city.

This paper focuses on green economy and the land opportunities that entrepreneurs can identify and exploit around the world. This approach of climate change adaptation and entrepreneurial opportunities is the main idea of our research.

2.3. Entrepreneurial opportunities

Dubin (1978) provided the eight phases model for theory building which has been used in several theoretical approaches. Ardichvili et al. (2003:106) applied Durbin's first five phases for identifying and recognizing entrepreneurial opportunities: (1) entrepreneurial alertness; (2) information asymmetry and prior knowledge; (3) social networks; (4) personality traits, including optimism, self-efficacy, and creativity; and (5) type of opportunity.

The first author who used the term ''alertness'' to define entrepreneurial opportunities was Israel Kirzner (Kirzner, 1979). But previous works of Schumpeter (1934) described entrepreneurship related to environmental opportunities and the entrepreneur as innovation and value creation agent.

So, entrepreneurial alertness applied to our approach would explain how climate change and public policies are creating new opportunities for sustainable entrepreneurship. In this sense, entrepreneurship is associated with sustainable growth, social development and innovation and its positive impact is beyond doubt. But entrepreneurship's origins associated with sustainability are currently being researched (Almodóvar-González et al., 2020; Ardichvili et al., 2003; Willis et al., 2020; George et al., 2020; Chowdhury et al., 2019; Rawhouser et al., 2019).

The Sustainable Development Goals (SDGs) are the inspiration for many types of entrepreneurship that combine value creation with conservation and social protection. In 2009, Hekkert and Negro argued that in 2030, these SDGs would mark the path to new ventures, and they were right (Hekkert and Negro, 2009).

Authors such as Schaper (2016), who defines the concept of

eco-entrepreneur, and Belz and Binder (2017), who define sustainable entrepreneurship as a model of economic and social behavior, open the doors to a sustainable entrepreneurship framework to explore (Ploum et al., 2018; Muñoz and Cohen, 2018; Espina, et al., 2018) (see Fig. 1).

So, if climate change has triggered new opportunities for sustainable entrepreneurship, the circular economy is identified as a crucial agent in the entrepreneurial process (Schroeder et al., 2019).

Following this literature revision, this paper proposes the following questions in our research: Has the economic and political commitment of countries to mitigate climate change been increased? Does the economic policy of European countries contribute positively to promoting the circular economy, both in terms of employment and wealth? Is there a relationship between sustainable entrepreneurship and policies to mitigate change policy? Does the primary sector facilitate this type of entrepreneurship for reasons of opportunity?

3. Methodology

3.1. Sample

In order to answer the last questions, we propose the following methodology. We obtained a sample frame from the Eurostat Database (2014–2017) using variables related to climate change adaptation (https://ec.europa.eu/info/energy-climate-change-environment_en). Likewise, the reports of the Global Entrepreneurship Monitor (GEM) have been used in the same period to extract data related to the entrepreneurial activity of the regions (https://www.gemconsortium.org/report). This study identifies the period 2014–2017 to consider the first years of exit of the last global economic crisis. The Paris agreement (2015) adopted during the Climate Conference (COP21) stablished the global framework to climate change adaptation. In that agreement, countries were encouraged to collaborate jointly to achieve certain goals of economic contribution to mitigate climate change in addition to proposing the reduction of emissions. In 2014, harmonized indicators about the economic contribution of the countries to mitigate climate change start to appear. For that reason, the period 2014–2017 is considered in the sample (The year 2017 is the last available).

3.2. Variables

Some researchers relate government policies to favor entrepreneurship as an instrument to solve global problems such as climate change, using variables from the institutional environment (Michaelova and Michaelova, 2017; Mintrom and Luetjens, 2017; Reimer and Saerbeck, 2017). There are a few quantitative academic references about climate change and entrepreneurial opportunities and there are included in the paper. Some of them relate circular economy to sustainable entrepreneurships (Barker, 2001; Dhahri and Omri, 2018) and use macroeconomic variables and regression techniques to observe the impact of sustainable entrepreneurship on the economic growth. The contribution of this paper to the literature is that climate change policy is related to total entrepreneurship activity of European countries and this approximation is not so common. Using GEM database, Moya et al. (2019) is an example of this framework of sustainable entrepreneurship.

The study includes six variables associated with the circular economy and entrepreneurship and they are analysed in the period 2014–2017.

1 *Contribution to the international 100bn USD commitment on climate related expending (Contrib):* Following the Eurostat database, this indicator measures the total amount spent from the annual budget of the EU Member States as well as of the European Commission and the European Investment Bank, in order to contribute to the international 100bn USD commitment for climate finance under the United Nations Framework Convention on Climate Change (UNFCCC) (EUROSTAT: DG CLIMA, EIONET).
2 *Total Entrepreneurial Activity (TEA)*: This rate includes the total number of entrepreneurial initiatives of the adult population (between 18 and 64 years old) involving entrepreneurial activities in the initial phase (less than 42 months of activity). In this case, we have used the percentage of TEA generated by the perception of an opportunity in the environment. The percentage of TEA that has been generated in the agricultural and extractive sectors is also available.
3 *Eco-Innovation Ratio (Eco_Inn)*: This indicator is based on 16 sub-indicators from eight contributors in five thematic areas: eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency outcomes and socioeconomic outcomes. The overall score of an EU Member State is calculated by the unweighted mean of the 16 sub-indicators. It shows how well individual Member States perform in eco-innovation compared to the EU average, which is equated with 100 (index EU=100). The index complements other measurement approaches of innovativeness of EU countries and aims to promote a holistic view on economic, environmental and social performance.
4 The relevant target in the Roadmap to a Resource Efficient Europe is for an increase in the funding for research that contributes to the environmental knowledge base. Such increases will tend to improve a Member State's positioning according to the index. This indicator is published by the Eco-Innovation Observatory.
5 *Value added at factor cost – percentage of gross domestic product (GDP)*
6 *Persons employed – percentage of total employment (Empl)* in the following three sectors: the recycling sector, repair and reuse sector and rental and leasing sector.

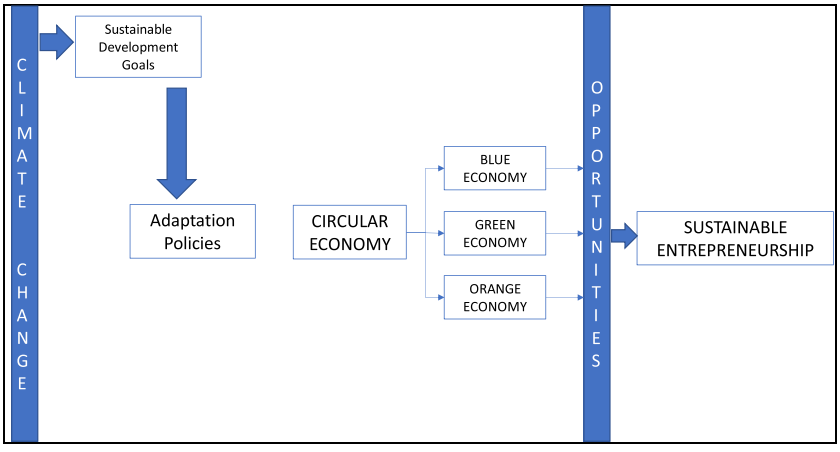

Fig. 1. Climate Change and Sustainable Entrepreneurship as proposed thinking Source: authors' own.

7 *Ecological Agriculture Percentage (Agr):* This indicator is defined as the share of total utilised agricultural area (UAA) occupied by organic farming (existing organically farmed areas and areas in process of conversion). Organic farming is a method of production which puts the highest emphasis on environmental protection and animal welfare considerations, in the case of livestock production. It avoids or greatly reduces the use of synthetic chemical inputs such as fertilisers, pesticides, additives and medical products.

8 Farming is only considered to be organic at the EU level if it complies with Council Regulation (EC) No 834/2007, which has set up a comprehensive framework for the organic production of crops and livestock and for the labeling, processing and marketing of organic products, while also governing imports of organic products into the EU. The detailed rules for the implementation of this Regulation are laid down in Commission Regulation (EC) No 889/2008.

3.3. Statistical model

First, the different variables and their evolution over time, as well as the main measures of coordination and dispersion, are analysed descriptively. The statistical process and its important steps are explained as follows:

- The different partial correlations between the variables and their statistical significance are presented below. According to these possible correlations, we will study the relationship between variables.
- After that, regional convergence–divergence studies are proposed in order to identify different behavioural patterns of each country. In this sense, we are going to determine the contribution to climate change and the variables which explains the so-called circular economy.
- A relativisation of the variables has been used according to each European average value. For example, in the case of the behavior of the evolution of the contribution by citizens to climate change policies, the relativised variable would have the following expression:

$$\text{Relative } Variation\ Contrib._{country_{2014-2017}} = \frac{\Delta Contribution_{country_{2014-2017}}}{\Delta Contribution_{mean\_select\_countries}}$$

- Specifically, two convergence matrices are proposed. The first matrix relates the evolution of the countries with respect to the contributions per citizen to climate change with respect to the starting situation of the study (2014). The second matrix analyses, for the final moment of the study, the relationship between the weight of the activities of the circular economy on the country's GDP and the position reached in the eco-innovation ratios. From the application of the contribution measures it is expected to see the impacts on the rest of the variables.
- Finally, the variables related to entrepreneurial activity are incorporated. At first, all the variables associated with sustainable entrepreneurship are combined, that is, the combination of TEA variables, percentage of TEA in agricultural and extractive sectors, and percentage of entrepreneurship motivated by opportunities. So, the interaction of all these variables gives rise to a new variable that indicates the number of entrepreneurs dedicated to sectors related to sustainable entrepreneurship. With the results of this new variable, the countries have been divided into two groups, depending on their degree of involvement with this variable. The average values reached by the evolution of the analysed variables are presented.

$$TEA\_Sustainable = TEA\ x\ TEA\_S\ x\ TEA\_Opp$$

- On the other hand, a Logit model is proposed, both at the beginning and at the end of the period, for analysing other sectors affected by climate change. As all the countries do not have values at some intermediate moments, we do not work with panel data, but instead carry out two analyzes (beginning and end of period) in order to know their temporal evolution.
- In this way, the independent variable is the TEA motivated by any opportunity and relativised with respect to the average of the set of countries analysed.

$$TEA\_Opp._{country_{,\ 201x}} = \frac{TEA\_Opp\ _{country_{201x}}}{TEA\_Opp_{mean_{select_{countries,201x}}}}$$

- As independent variables, those related to the contribution to climate change and its impact through the activities of the circular economy are used.

$$TEA\_Opp_{,201x} = \alpha + \beta_1 \cdot Cont_{,201x} + \beta_2 \cdot GPD\_EC_{201x} + \beta_3 \cdot Emp\_Ec_{201x} + \mu_{201x}$$

3.4. Results

This paper presents the main descriptive statistics of the variables related to each country's contribution to climate change, aspects of the circular economy as well as the rate of entrepreneurial activity.

Table 1 presents variable indicators for 22 European countries for which records are available. Regarding the contribution per inhabitant that countries have made to the fight against climate change, Germany stands out with an average contribution in the 2014–17 period of 85 euros per citizen, followed by France with 50 euros and Sweden with an average contribution of 42 euros.

This contribution has been consolidated and increased by their governments in France and Sweden. On the opposite side, Greece, Poland, Cyprus and Romania present a contribution per citizen that exceeds the common budget to fight against climate change.

It seems clear that the generation of the circular economy is a consequence of state climate change adaptation policies, especially in the sectors associated with recycling and energy. In terms of the contribution to the total of the GDP of each country, the activities of the circular economy alone do not exceed 1% of total GDP. Bulgaria and the United Kingdom present a higher contribution and Belgium and Slovakia present a lower percentage. Unlike the previous variable, there is greater homogeneity between countries. Regarding the employment generated, it barely exceeds 2% of the total employment generated, except in countries such as Croatia, Italy and Slovenia with a greater generation of jobs.

Another consequence of climate change adaptation polices should be the rational use of agricultural areas, dedicating a percentage of land to sustainable crops or creating protected agricultural spaces to ensure the generation of nutrients that increase land productivity. Thus, considering the percentage of organic agriculture with respect to the total agricultural area of the regions, there is a general increase in all European countries, from 6.78% to 8.30%. Austria, Italy, Latvia and Sweden stand out for a greater commitment to organic farming.

Eco-innovation activities are identified as key elements to achieve a sustainable economy and to generate efficiency in the use of scarce natural, energy and industrial resources. Thus, Germany, Finland, Sweden and Denmark, present greater balance between economic, environmental and social performance. Denmark is the only one of this sustainable group that has worsened its situation over time. We have also recognised the cases of Bulgaria, Cyprus and Romania, which are far from the European average.

Finally, the indicator associated with the total rate of entrepreneurial activity of European countries is presented. After that, we try to identify if there is a relationship between the new entrepreneurship and the

Table 1
Variable Indicators. Concentration descriptions (2014–17). Source: authors' own.

Variables	Contrib_ Clima		%GDP_Ec_Cir		Empl_Ec		%Sp_Agr		Ratio_Eco_Innov		T_Entrep_Act		TEA_Opp	
Country / Year	2014	2017	2014	2017	2014	2017	2014	2017	2014	2017	2014	2017	2014	2017
Belgium	12.77	9.24	0.67	0.68	1.12	1.10	5	6.28	90	83	5.4	6.2	63.2	63.2
Bulgaria	0.01	0.01	1.14	1.22	1.75	1.72	0.96	2.72	31	38	3.5	3.7	66.6	73.1
Denmark	39.46	31.61	0.83	0.82	1.37	1.36	6.25	8.6	131	120	5.47	5.47	91.1	91.1
Germany	63.52	81.55	0.97	0.99	1.47	1.49	6.18	6.82	135	139	5.27	5.3	75.8	79
Greece	0.00	0.43	0.35	0.36	1.66	1.52	6.72	7.96	65	77	7.85	4.8	61.5	79.8
Spain	10.72	11.37	1.03	1.06	1.94	2.04	7.26	8.73	111	112	5.47	6.2	66.1	68.5
France	44.15	65.52	1.00	0.98	1.78	1.64	3.87	5.99	112	99	5.34	3.9	82	77.6
Croatia	0.01	0.01	1.21	1.27	2.27	2.21	4.03	6.46	91	75	7.97	8.9	51.3	63.2
Italy	2.36	10.44	1.08	1.07	2.08	2.06	10.91	14.86	100	113	4.42	4.3	78.4	75.2
Cyprus	0.00	0.00	0.81	0.99	1.91	1.99	3.63	4.61	44	45	12	7.3	70.4	70.4
Latvia	0.21	0.01	1.02	1.09	2.84	2.82	10.86	13.92	65	73	14.1	14.2	80.5	72
Hungary	0.27	1.43	0.83	0.98	1.74	1.88	2.34	3.73	74	63	7.9	7.9	64.7	64.7
Netherlands	20.20	23.74	0.80	0.84	1.16	1.19	2.67	3.14	98	88	9.46	9.9	80.4	83.8
Austria	16.60	18.71	1.04	1.12	1.51	1.51	19.35	23.37	103	113	8.71	8.71	81.7	81.7
Poland	0.11	0.11	1.13	1.11	2.13	2.20	4.56	3.41	53	59	9.21	8.9	59.1	90.2
Portugal	0.91	0.21	0.73	0.79	1.79	1.84	5.74	7.04	92	105	9.97	9.97	71.3	71.3
Romania	0.00	0.04	0.68	0.79	1.52	1.54	2.09	1.93	68	65	11.35	10.8	70.1	70.1
Slovenia	1.14	1.82	1.31	1.30	2.17	2.06	8.55	9.6	93	117	6.33	6.9	71.4	74
Slovakia	0.23	0.67	0.66	0.79	1.74	1.78	9.37	9.9	61	74	10.9	11.8	64.2	61.4
Finland	24.26	21.69	0.94	0.88	1.74	1.58	9.29	11.41	129	141	5.63	6.7	81.1	86.3
Sweden	39.89	51.53	0.93	0.88	1.56	1.58	16.53	19.16	121	144	6.71	7.3	84.2	76.8
U. Kingdom	24.11	15.46	1.18	1.19	1.47	1.59	3.02	2.85	104	105	10.66	8.4	83.6	82.2
Mean	13.68	15.71	0.92	0.96	1.76	1.76	6.78	8.30	89.59	93.09	7.89	7.62	72.6	75.3
Mediam	1.75	5.53	0.96	0.99	1.74	1.68	5.96	6.93	92.50	93.50	7.88	7.30	71.4	74.6
Sta. Desv.	18.46	23.01	0.22	0.22	0.39	0.39	4.61	5.51	28.83	30.43	2.80	2.68	9.72	8.32

opportunities generated by the circular economy. On average, the rate of entrepreneurial activity in European countries is around seven business ventures per hundred active people, with a decreasing trend, due to the recovery–economic stability phase analysed.

The results also present the percentage of TEA – which has been produced through climate change opportunities (compared to entrepreneurship for reasons of need or otherwise) – as well as the percentage of TEA that corresponds to activities in the agricultural sector and in the extractive sector (energy, water and recycling).

According to the results of the Table 2, there is a positive and significant relationship between the unit contribution and the eco-innovation index of the countries, both at the beginning and at the end of the period. It also highlights a positive relationship with the percentage of TEA that is motivated by opportunities, although this relationship is only statistically significant at the beginning of the period.

In this sense, a greater contribution to mitigate the climate change makes a lower employment due to the circular economy, which may be affected by the expansion of sustainable investments to the entire real economic circuit and not only to the sectors most directly influenced by the circular economy, such as recycling. When considering the relations of the circular economy with the rest of the variables, it seems logical that the greater contribution of the circular economy to the GDP of a country is due to the employment generated in these activities.

This relationship is more intense as time progresses and the activities of the sustainable economy are consolidated. On the other hand, during 2007, the positive relationship is also significant between the weight of the circular economy and the enterprises within the agricultural and extractive sector. These sectors are more conducive to implement these sustainable activities.

This same relationship occurs between the total employment generated by the circular economy and the percentage of enterprises in the agricultural–extractive sectors. Regarding the variable that indicates the total agricultural area devoted to organic farming, the positive relationship existing with the eco-innovation ratio of the countries is consistent during 2017.

And finally, Table 2 shows that a negative and significant relationship between eco-innovation ratio and TEA and a positive and significant relationship with the percentage of entrepreneurship motivated by reasons of opportunity (in 2014). This relationship seems to indicate that most of the innovations in social and environmental fields are carried out within existing companies in a country or through intra-

Table 2
Variables Correlation 2014–2017. Source: authors' own.

Var.	Year	Contr	GDP_EC	Empl_EC	Sup_Ag	Eco_Inn	TEA	TEA_S	TEA_Op
Cont.	2014	1	0.082	**−0.462***	0.163	**0.779****	−0.395	−0.191	**0.618***
	2017	1	−0.039	−0.404	0.185	**0.638****	−0.396	−0.152	0.363
GDP_EC	2014		1	**0.442***	0.097	0.155	−0.215	0.053	0.115
	2017		1	**0.521***	0.052	−0.019	0.036	**0.547****	−0.022
Empl_EC	2014			1	0.131	−0.329	0.284	0.256	−0.246
	2017			1	0.116	−0.272	0.381	**0.439***	−0.247
Sup_Ag	2014				1	0.354	−0.12	−0.155	0.375
	2017				1	**0.548****	0.063	0.059	0.104
Eco_Inn	2014					1	**−0.424***	−0.123	**0.578***
	2017					1	−0.231	−0.15	0.382
TEA	2014						1	0.28	−0.047
	2017						1	0.168	−0.228
TEA_S	2014							1	−0.076
	2017							1	−0.143

* Signific. < 0.05; ** Signific. < 0.01.

entrepreneurship of large companies and institutions, being a clear strategic opportunity for those entrepreneurs who want to initiate business activity.

Due to the high correlation existing between the contribution to climate change and the degree of development of eco-innovation in the countries, both at the beginning and at the end of the period, its distribution is analyzed. We have appreciated a polynomial relationship (grade three) between the contribution that countries make to climate change and the degree of eco-innovation. In this way, if the contribution per citizen is greater, the economic, social and environmental performance of the regions is better. It is important to outline that there is a saturation when the contribution per citizen is 50 euros. There are diminishing returns of scale, except for exceptional cases, when the value approaches that amount (see Figs. 2a and 2b).

It is possible to establish four behavior patterns according to the evolution of the contributions that countries have made through climate change policies. For that reason, the value of the relative contribution of the year 2014 has been considered with respect to the average of the countries set analysed, as well as the relative evolution of the contribution having been considered with respect to the average variation in the period proposed. This group of countries allows us to see if there has been a convergence or a divergence between the countries in their commitment to the fight against climate change (Figs. 2a and 2b).

Thus, the only country that has increased its contributions more than proportionally and started from a prominent situation is France in 2014. At the extreme end, countries such as Spain, Poland, Portugal, Latvia and Bulgaria made less of a contribution to climate change and less than the European average.

Among the countries that have converged in the analysed period, we can highlight Greece, Romania, Italy and Hungary. They contributed less at the beginning of the period, but they contributed more during the period. Germany, the United Kingdom, Finland, Denmark and Sweden started with a greater contribution per citizen at the beginning of the period, but the evolution of their contributions has been lower than the average of all countries.

If we analyze the TEA, it is worth highlighting the case of France with a reduction of its TEA. Among the countries least committed to climate change there is no clear pattern regarding entrepreneurship and its typology.

Figs. 3a and 3b present the process of regional convergence occurring between the evolution of eco-innovation ratio and the weight of the circular economy with respect to GDP. Thus, Spain, France, the United

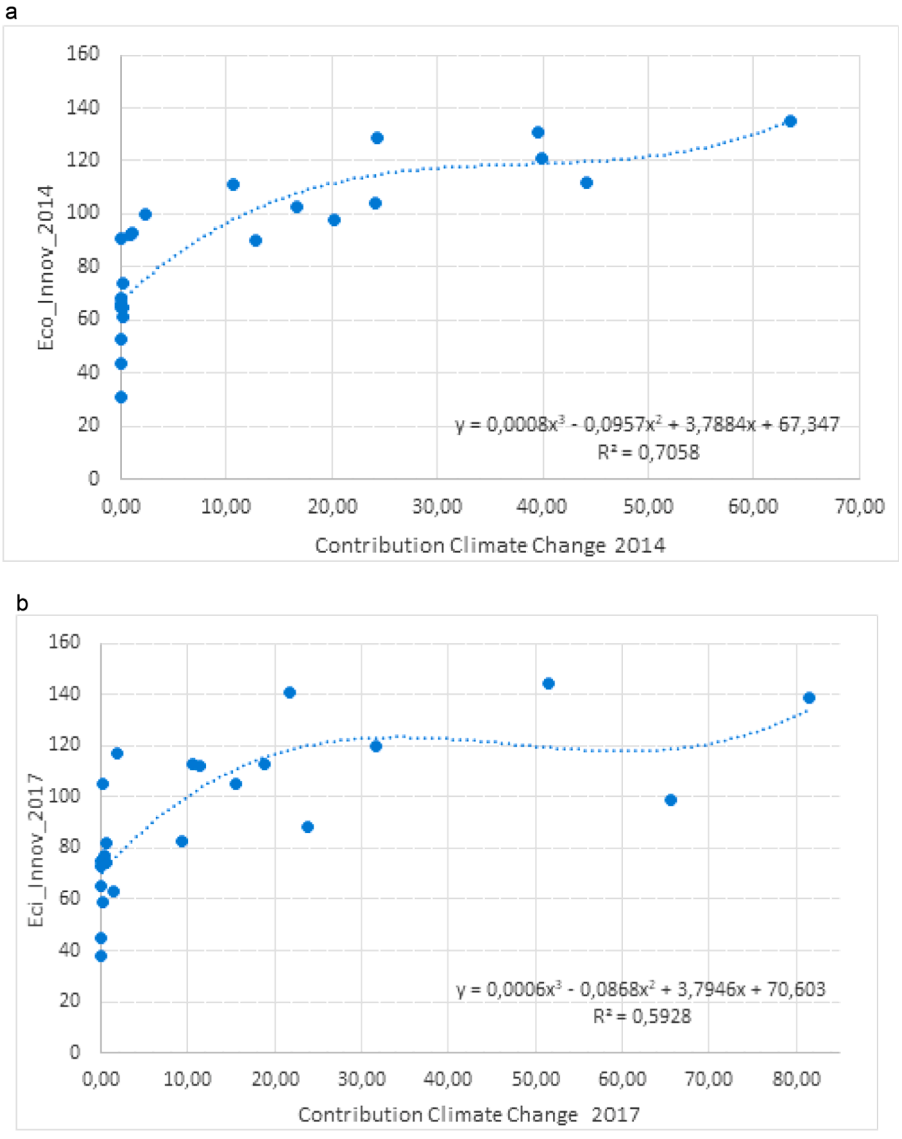

Fig. 2a. (a) Relationship between contribution to climate change and Eco-Innovation (2014). Source: authors' own. (b) Relationship between contribution to climate change and Eco-Innovation (2017). Source: authors' own.

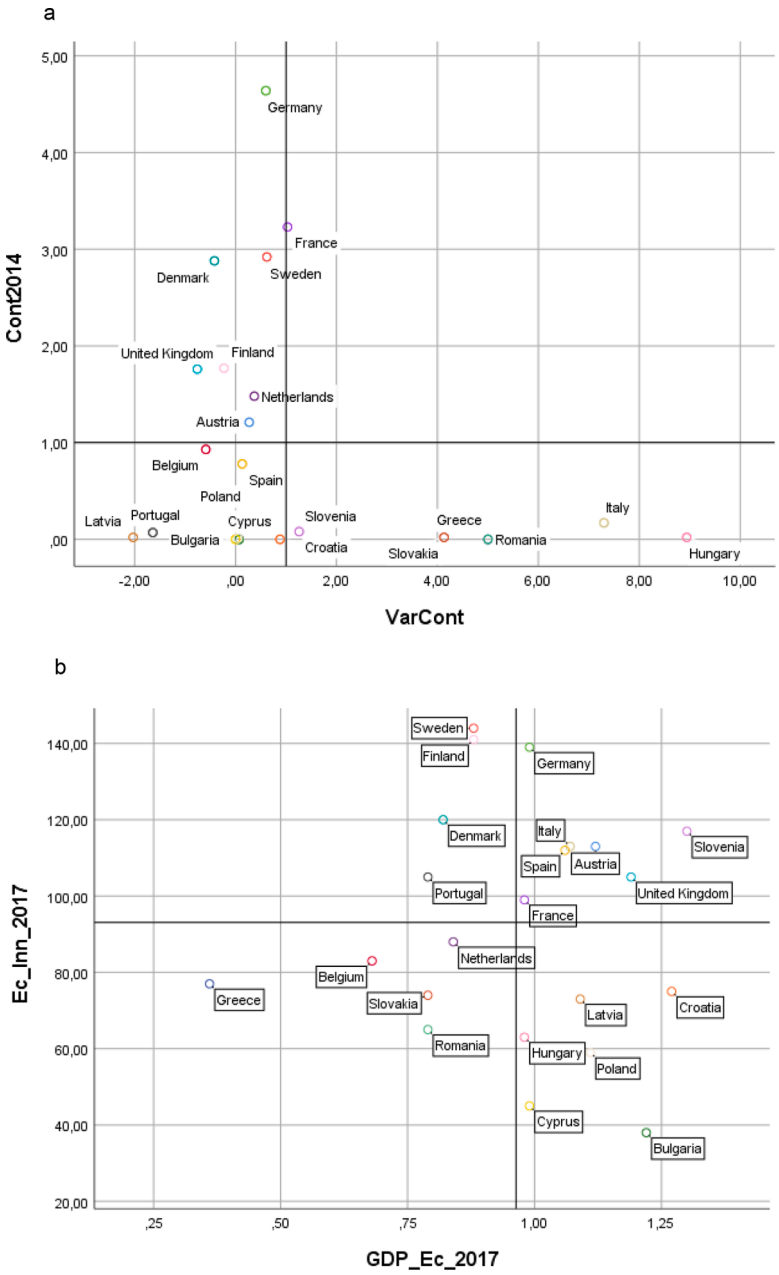

Fig. 3a. (a) Process of regional convergence occurring between the evolution of eco-innovation ratio and the weight of the circular economy with respect to GDP (2014–2017). Source: authors' own. (b) Process of regional convergence occurring between the evolution of eco-innovation ratio and the weight of the circular economy with respect to GDP (2014–2017). Source: authors' own.

Kingdom, Germany, Italy, Austria and Slovenia present the greatest growth in the circular economy and the highest eco-innovation ratio.

These countries have best adapted their economic system to the principles of responsible management, both in their companies and in their institutions. This means that their economies are based on innovation.

On the other hand, there are the countries with high contribution of the circular economy to GDP but not through eco-innovation. Countries such as Hungary, Cyprus, Poland and Croatia are examples. On the other hand, the countries with the lowest contribution of the circular economy to GDP and the lowest eco-innovation rate are Greece, Slovenia and Romania. These countries, despite improving their contributions to climate change, were still below the European average. Sweden, Finland, Denmark and Portugal have an eco-innovation ratio above the European average despite not having a direct relationship with the circular economy.

Finally, a new variable related to sustainable entrepreneurship has been included in order to incorporate the phenomenon associated with entrepreneurship. Specifically, an intersection has been made between TEA with the percentage of entrepreneurship in agricultural and extractive sectors which occurred by opportunity. In this way, a variable that explains the entrepreneurship by climate change opportunities is identified. Countries have been classified according to the result obtained, generating two groups: countries with at least 1% of the active population in sustainable sectors by detecting specific opportunities, and countries that do not exceed the 1% threshold of their population involved in these sectors.

Table 3 presents the average values of the evolution of the different variables analysed for each group. Thus, countries with more entrepreneurs for every hundred inhabitants of active population involved in

Table 3
Average values of the evolution of variables. Source: authors' own.

	Countries with less than 1% of Sustainable TEA BE, BG, DE, GR, IT, SP; FR, CY, DK, PT, SI, SE, FI.	Countries with more than 1% of Sustainable TEA AT, HR, UK, LV, RO, HU, NL, PL, SK	Total	Sig.
Var_Cont	6,04	17,49	15,08	0,628
Var_GDP_EC	1,49	6,86	2,88	**0,065***
Var_Emp_EC	−0,96	2,29	0,64	**0,043***
Var_S_Ag	18,58	14,96	17,83	0,107
Var_Eco_Inn	9,3	0,96	6,13	0,237
Var_TEA_Op	3,03	7,03	4,67	0,526

sustainable activities stand out for having increased their unit contribution to climate change by more than 17.5% in the period considered. The consequence of this is a greater weight of the activities of the circular economy within its GDP as in the generation of jobs (with significant differences existing in these variables).

There is an increase of 15% of organic crops in agricultural areas, but less than in the case of countries with less sustainable entrepreneurs. Similarly, the variation in the eco-innovation ratio has hardly improved in these countries, compared to the other group of countries. Finally, it is appreciated that the perception of opportunities is a remarkable variable over time, growing above 7% in the countries most involved with sustainable entrepreneurship, compared to 3% of the countries that are less so.

3.4.1. Logit model

Once the relationship between climate change and the circular economy is analysed, a new variable related to entrepreneurship is incorporated. A logit model is proposed to determine whether climate change is a disruptive element in which entrepreneurs can find an opportunity. Thus, the independent variable is the TEA – determined for reasons of opportunity – and relativized with respect to the average of the group of countries analysed (value 1 if the country has a TEA for an opportunity above the average and 0 if the country has a TEA for an opportunity below the average).

The explanatory variables are the contribution of countries to climate change, the weight of the circular economy within GDP and the percentage of employment in the circular economy over total employment. The eco-innovation ratio and the unit contributions to climate change are not incorporated into the model to avoid correlation. The percentage of agricultural areas used for ecological farms are not included in order to identify different sectors and not only one.

Two cross-sections are proposed according to the disposition of the available information (2014 and 2017). In this sense, Table 4 shows the results obtained for both periods.

The contribution per citizen to the countries' climate change is the only variable statistically significant in the whole period. There is a positive relationship with TEA based on reasons of opportunity and the contribution made to mitigate climate change. However, over time this probability, although still positive, has been reduced. The Odds Ratio confirms this situation. Thus, in 2014, coinciding with the beginning of the exit of the economic crisis, there are 1.54 times more possibilities to undertake through opportunities originated by climate change. In 2017, in full economic recovery, the chances of entrepreneurship by opportunity are reduced by 1.33 times. This situation can be easily understood thanks to the relationship between the circular economy and entrepreneurial activity. The rest of the variables considered on the weight of the circular economy are not statistically significant due to different economic policies being implemented in European countries.

There is not a clear relationship between improvements in eco-innovation, contribution to climate change and the weight these activities can generate to GDP through the circular economy. This means that the effects of these policies occur in the long term. Companies must lead this process of change with new business models and sustainable production systems. The externalities generated by climate change become an opportunity for entrepreneurship.

Finally, there is a positive relationship between entrepreneurship and the degree of eco-innovation but not between entrepreneurship in agricultural and extractive sectors and the increase of organic crops. This situation indicates that the large agri-food companies support this new form of responsible crops, due to their greater capacity to carry out the investments involved in adapting to more innovative and efficient systems in environmental terms.

4. CONCLUSIONS and limitations

This study provides a fresh beginning in the study of climate change policy and entrepreneurial opportunities. There is a clear relationship between European countries 'contribution to climate change and improvements in the countries' eco-innovation ratio. A greater commitment on the part of the regions and, especially, of their companies, with responsible management policies in the social, economic and environmental fields, translates into more efficient productive sectors, both in the generation of production and in management and use of their waste.

European Union needs to stablish a single climate change voice between partners to promote new and different sustainable entrepreneurship. Green Architecture of Common Agricultural Policy (2021–2027) is one of the success examples in which eco-innovations and climate pillars are combined to develop entrepreneurial opportunities as responsible crops. This is the essence of the 2030 Horizon's philosophy for taking care and protecting of people and environment to obtain social and economic revenues.

There is still a great dispersion among citizens' contributions made by countries. Only France has continued to maintain a high and growing contribution over the years. In this sense, the greater predisposition and awareness of the different European governments towards climate change can determine the volume of contributions made. The European Union should establish more tax reward mechanisms for those European countries that contribute to sustainable economy.

About the limitations of the study, it is worth highlighting the lack of complete set of data for all European countries. That limits the scope of the conclusions, in order to propose recommendations for European institutions. The sequence of data for all years is also uncompleted of all the variables, especially those associated with entrepreneurship, which limits the study in two cross-sections instead of applying a data panel. Another consequence of unavailable data set is not be able to study the

Table 4
Impact of climate change and circular economy on enterpreneurship. Source: authors' own.

	Year 2014				Year 2017			
Variable	Coef.	Std. Err.	*P*>(Z)	Odds Ratio	Coef.	Std. Err.	*P*>(Z)	Odds Ratio
Contribution	0.4321065	0.1904768	0.023	1.540499	0.2861781	0.1307796	0.029	1.331329
GDP_EC	−1.112759	5.734559	0.846	0.3286509	−4.295543	3.965694	0.279	0.0136292
Empl_EC	5.602637	3.517899	0.111	271.1406	2.015337	1.948506	0.301	7.503253
Constant	−13.07127	7.074421	0.065	0.0000	−1.889335	3.081649	0.540	0.1511722
Prob > chi2= 0.0001; Pseudo R2 = 0.6968; Log likelihood = −4,6113					Prob > chi2= 0.1423; Pseudo R2 = 0.5142; Log likelihood = −7,4082			

relationship between entrepreneurial type and sustainable economies.

Finally, this study concludes that the link between climate change and entrepreneurial opportunities provides a value' framework for researchers. Climate change policies contributes to develop transformations on value chain, e-commerce or raw material that they could be interesting to practitioners (Omri, 2018; Pelling, 2011).

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