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# Analysis of the impact of the Paris Agreement on R&D expenditure on electricity sector



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1<sup>st</sup> July

# OUTLINE

- Motivation
- Related Literature
- Research Objectives of this Study
- Methodology and sample
- Results
- Main Conclusions

# MOTIVATION:

## The Paris Agreement

- In October 2014: in Paris, EU member countries signed an agreement regarding climate changes.
- **Three main objectives of the Agreement:**
  1. commitment to reducing greenhouse gas emissions, setting a reduction target of 40% relative to 1990 levels.
  2. a renewable energy target of at least 27% of energy consumption.
  3. and improved energy efficiency through possible amendments to the energy efficiency directive.

The electricity market is one of the last to have been standardized and organized in what concerns financial trading.

# Related Literature: R&D expenditure (1)

- R&D expenses could be transformed into energy savings and, as a consequence, facilitate the reduction of CO2 emissions, based on low-carbon technology (Gu & Wang, 2018).
- A way of reducing CO2 emissions is by increasing the use of renewable energies (Sim, 2018).
- The government's policy aims can influence the speed of development of new renewable energies (Kim, Lee, & Park, 2014)

# Related Literature:

## R&D expenditure(2)

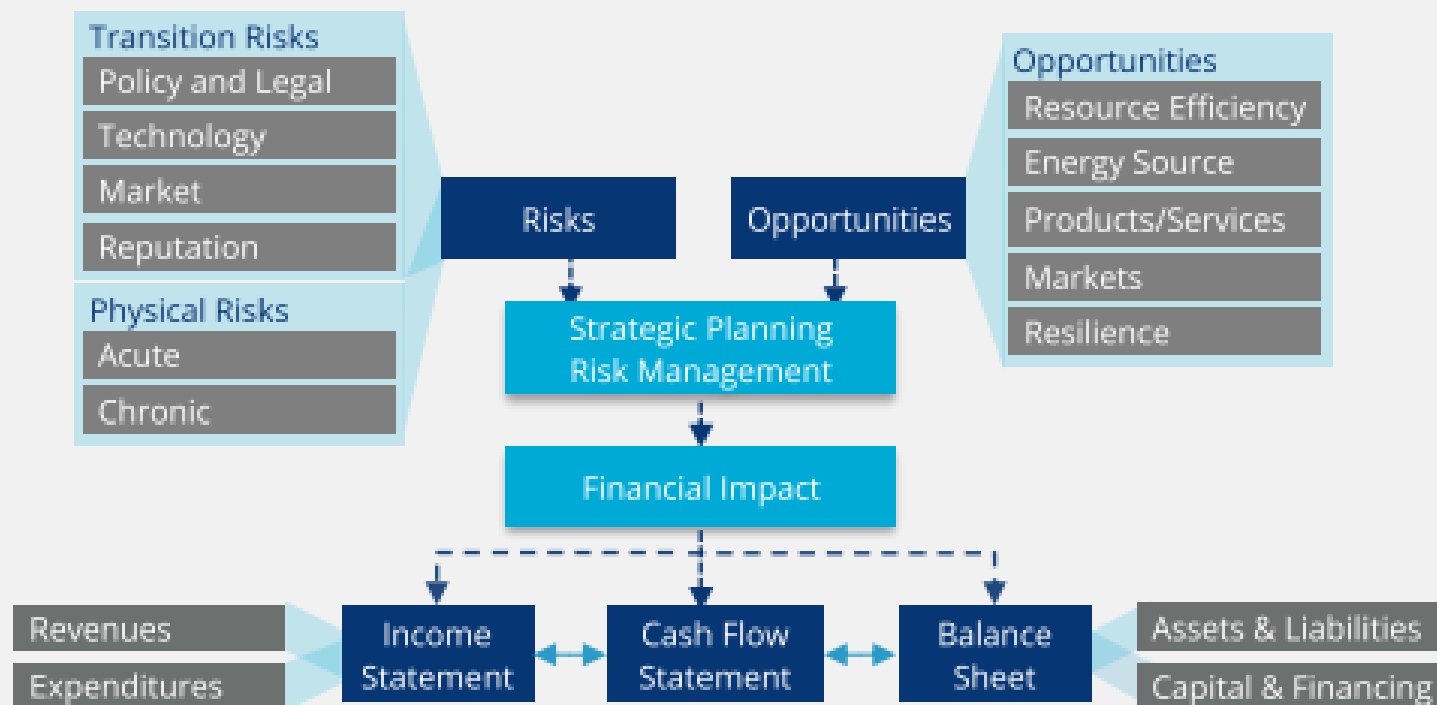
- There are several factors that can condition R&D expenditure in the companies such as (Heidenberger, Schillinger, & Stummer, 2003):
- the type of management (ownership vs control);
- the strategy of the company (obtain new knowledge vs explore existing knowledge);
- the incentives (age of managers and decrease profits);
- the financing (internal capital vs external);
- the budget (short-term vs long-term)
- Changing regulation

# Impact of Paris Agreement in companies

- The reduction in greenhouse gas emissions implies movement away from fossil fuel energy and related physical assets.
- A clear EU emissions reduction pathway gives companies across the EU predictability in terms of their investments in low-carbon technologies
- “Investment in research and innovation must be encouraged in order to develop innovative and breakthrough technology in terms of low carbon solutions” – Carlos Moedas - European commissioner

# Impact of Paris Agreement in companies

## Climate-Related Risks, Opportunities, and Financial Impact



Source: TCFD(2017) Final report, recommendations of the task force on climate –related financial disclosure, p.8

# Objectives of this Study

- Due to the existence of new legislation at the macro level in the countries of the European Union, would it have had an impact at the micro level (companies)?
- What was the reaction of companies in this sector to this impose?
- In order to do this, it is necessary to analyze whether, in comparison with other European countries, there were significant differences and taking into account different periods of time and check if changes the behavior of the companies from the point of view of R&D expenditures.



# Descriptive statistics

Data from 2008 -2017, Listed companies

| Variable                                   | Obs | Mean     | Std. Dev. | Min     | Max      |
|--|-----|----------|-----------|---------|----------|
| Research And Development                   | 429 | 1.71e+09 | 4.72e+09  | 1000    | 3.06e+10 |
| Net Income Incl Extra Before Distributions | 429 | 4.34e+10 | 1.49e+11  | 20000   | 1.36e+12 |
| Company Market Capitalization              | 409 | 4.71e+11 | 1.07e+12  | 4357183 | 4.44e+12 |
| after2014                                  | 429 | .2890443 | .4538478  | 0       | 1        |
| EU28                                       | 429 | .5337995 | .4994387  | 0       | 1        |
| after2014*EU28                             | 429 | .1561772 | .3634471  | 0       | 1        |

**Source:** Thompson Reuters

# Descriptive statistics

## Sample:

429 observations

22 European countries

13 countries EU28

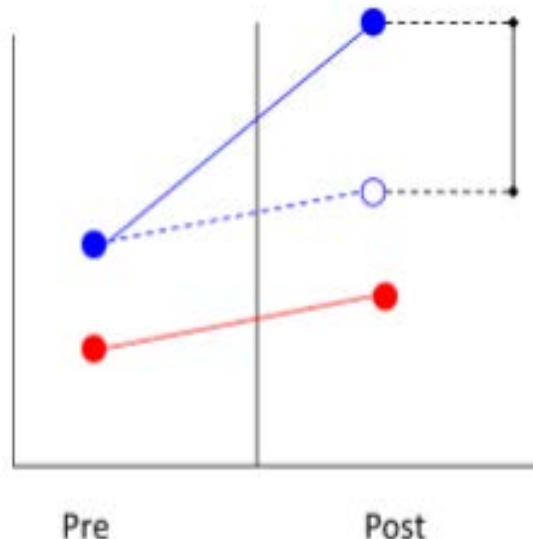
9 countries non EU28

| Country of Headquarters | Freq. | Percent | Cum.   |
|-------------------------|-------|---------|--------|
| Austria                 | 16    | 3.73    | 3.73   |
| Bosnia and Herzegovina  | 6     | 1.40    | 5.13   |
| Cyprus                  | 2     | 0.47    | 5.59   |
| Denmark                 | 8     | 1.86    | 7.46   |
| Faroe Islands           | 4     | 0.93    | 8.39   |
| Finland                 | 3     | 0.70    | 9.09   |
| France                  | 26    | 6.06    | 15.15  |
| Greece                  | 31    | 7.23    | 22.38  |
| Ireland; Republic of    | 1     | 0.23    | 22.61  |
| Italy                   | 6     | 1.40    | 24.01  |
| Netherlands             | 20    | 4.66    | 28.67  |
| Norway                  | 37    | 8.62    | 37.30  |
| Poland                  | 5     | 1.17    | 38.46  |
| Republic of Serbia      | 8     | 1.86    | 40.33  |
| Romania                 | 27    | 6.29    | 46.62  |
| Russia                  | 100   | 23.31   | 69.93  |
| Spain                   | 7     | 1.63    | 71.56  |
| Sweden                  | 10    | 2.33    | 73.89  |
| Switzerland             | 4     | 0.93    | 74.83  |
| Turkey                  | 37    | 8.62    | 83.45  |
| Ukraine                 | 4     | 0.93    | 84.38  |
| United Kingdom          | 67    | 15.62   | 100.00 |
| Total                   | 429   | 100.00  |        |

# Methodology and sample

- Difference in difference methodology

Treatment Variables =  
Countries EU28  
After 2014



Effect of program  
difference-in-difference  
(taking into account pre-  
existing differences  
between T & C and general  
time trend).

# Results: Difference in differences

Model propose

$$\text{LogR\&D} = \beta_0_i + \text{trend} + \beta_1 \log\text{NetIncomeInclExtraBeforeDis}_{i,t} + \beta_2 \log\text{CompanyMarketCap2}_{i,t} + \beta_3 \text{Time Dummies}_t + \beta_4 \text{Headquarters Dummies}_i + \beta_5 \text{Time Dummies} * \text{Headquarters Dummies}_{it} + \varepsilon_{i,t}$$

$$i = 1, \dots, N; t = 1, \dots, T$$

H0: The legislation have impact in the EU28 companies after the Agreement =0

H1: Otherwise

# Results: Difference in differences

Unbalanced data

| VARIABLES                        | (1)<br>OLS<br>logResearchAndDevelopment_M | (2)<br>FE<br>logResearchAndDevelopment_M | (3)<br>RE<br>logResearchAndDevelopment_M |
|----------------------------------|---|--|--|
| trend                            | 7.63e-05*<br>(4.14e-05)                   | 0.0246<br>(0.0352)                       | 0.000153*<br>(8.19e-05)                  |
| after2014                        | -0.285<br>(0.249)                         | -0.466*<br>(0.259)                       | -0.349**<br>(0.166)                      |
| EU28                             | 0.267<br>(0.222)                          |  | -0.0439<br>(0.397)                       |
| after2014EU28                    | -0.879**<br>(0.381)                       | -0.427<br>(0.317)                        | -0.466**<br>(0.234)                      |
| logNetIncomeInclExtraBeforeDis_M | 0.589***<br>(0.0506)                      | 0.185*<br>(0.110)                        | 0.299***<br>(0.0539)                     |
| logCompanyMarketCap2_M           | 0.277***<br>(0.0508)                      | 1.908<br>(3.734)                         | 0.512***<br>(0.0745)                     |
| Constant                         | -0.848<br>(0.696)                         | -143.6<br>(164.8)                        | -0.493<br>(1.394)                        |
| Observations                     | 429                                       | 429                                      | 429                                      |
| R-squared                        | 0.738                                     | 0.089                                    |  |
| Number of company_id             |   | 89                                       | 89                                       |

# Discussion of Main Results

- OLS, RE, and FE models point in same direction → Reduction of R&D expenditures
- FE model → Company Market Capitalization not statistically significant
- Positive relation between R&D and NetIncomeInclExtraBeforeDis\_M
- Positive relation between R&D and Company Market Capitalization

# Concluding Remarks

- Governments and companies should encourage and invest more R&D expenditures
- The objectives of the Paris Agreement will bring several challenges to companies of the electricity sector (rethinking their business)
- The implementation of the Paris Agreement will have a strong technological side, which will require investments

# Limitations and recommendations

## ■ Limitations:

- Missing data
- Can not be generalized to other sectors

## ■ Further research

- Analyze other sectors like oil or coal companies
- Analyze the tax impact in these companies
- Analyze just renewable electricity companies



# THANK YOU!

The authors gratefully acknowledge financial support from FCT- Fundação para a Ciência e Tecnologia (Portugal), national funding through research grant (UID/SOC/04521/2019).



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