Determinants of Energy Efficiency and Renewable Energy in European SMEs

AGUSTÍ SEGARRA-BLASCO AND ELISENDA JOVÉ-LLOPIS

UNIVERSITAT ROVIRA I VIRGILI (URV)

VI INTERNATIONAL ACADEMIC SYMPOSIUM:
Facing the Energy Transition: Markets and Networks
Barcelona 06/02/2018

UNIVERSITAT ROVIRA i VIRGILI

FLASH EUROBAROMETER SURVEY 426 (FLE426) on *"Small and Medium Enterprises, Resources Efficiency and Green Markets, wave 3*

Q1 What actions is your company undertaking to be more resource efficient?

Q2 Over the next two years, what are the additional resource efficiency actions that your company is planning to implement ?

Options,

- Saving water
- Saving energy
- Using predominantly renewable energy (including own solar panels, etc.)
- Saving materials
- Minimizing waste
- Selling your scrap material to another company
- Recycle, by reusing material or waste within the company
- Design products that are easier to maintain, repair or reuse

AIM OF THE STUDY

Research question:

The Drivers of EE and RE practices now and in the future?
Are EE and RE complementary or substitutive?
Is there any difference between EU-28 countries?

Originality of the paper:

- Most of studies have been worked with small samples and focused on large firms
  - ✓ Explore a large sample of **SMEs** as they are the economic backbone of the European Union (8,213 firms)

- Empirical studies are performed using a single country focus or a specific sector focus
  - ✓ Consider **28 European countries**, taking into account three clusters:
    - Core countries
    - Mediterranean countries
    - New EU countries

LITERATURE

Theoretical framework

Stakeholder theory considers (Carrillo-Hermosilla et al. 2010):

- ✓ Internal stakeholders (managers and employees)
- ✓ External stakeholders (customers, society, policy makers, and NGO (non-governmental organizations).

Evolutionary theory considers internal and external factors del Río (2009):

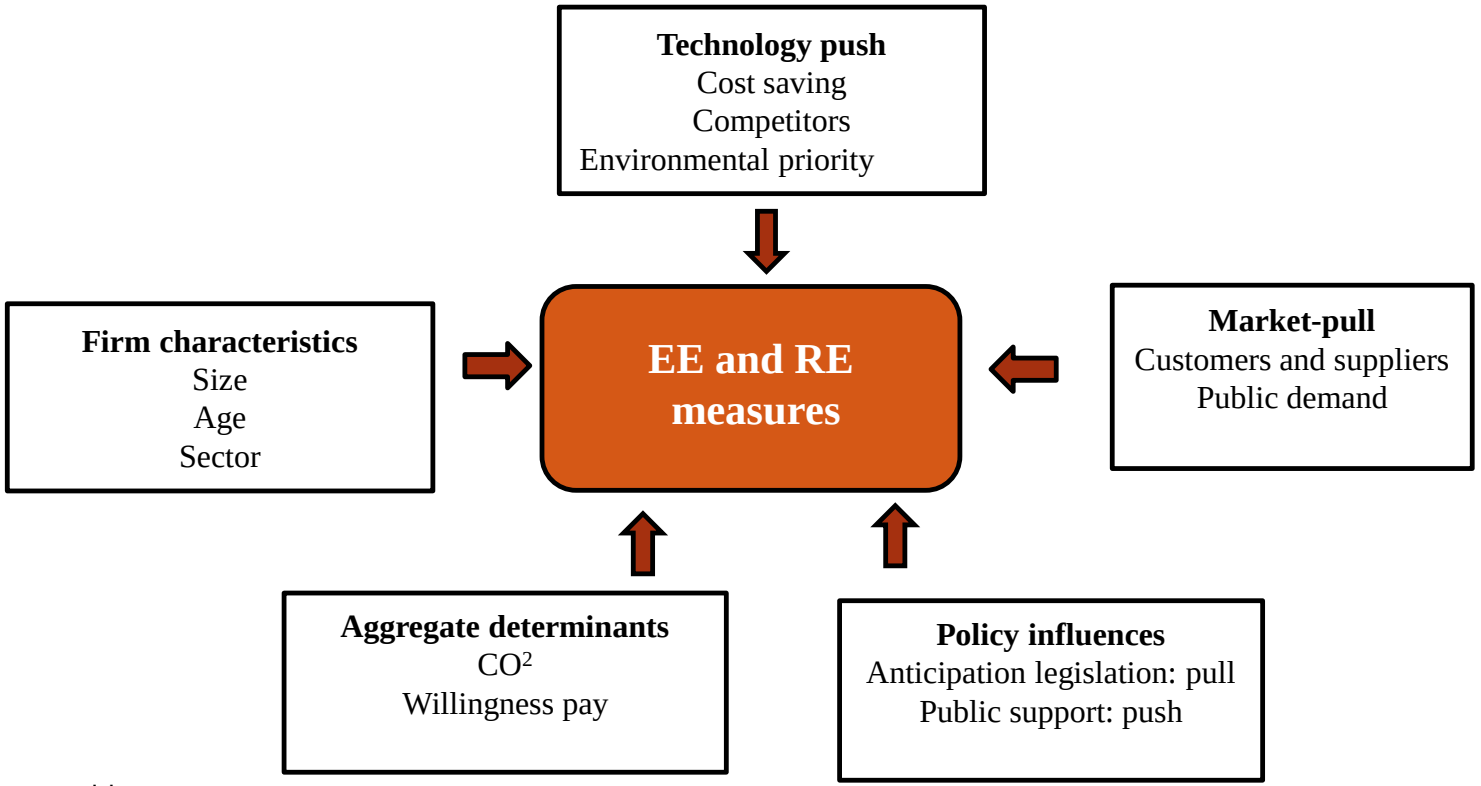
- ✓ Internal factors: technological capabilities, skills workers or financial resources.
- ✓ External factors: cooperation, networks and market relations with partners.

We adopt a **classification proposed by Jens Horbach** (2008) that considers 4 main drivers:

- ✓ Technology push factors
- ✓ Pull demand forces
- ✓ Public policy
- ✓ Firms' characteristics

LITERATURE

Main drivers influencing the EE and RE adoption



Source: own elaboration

DATA BASE

Flash Eurobarometer Survey 426 (FLE426) on *"Small and Medium Enterprises, Resources Efficiency and Green Markets, wave 3*

The database includes the 28 Members States of the European Union

Advantages: 1) provides an extremely rich set of information on firms' green behaviour in much greater detail than in other datasets, 2) allow cross-country comparison.

Drawback: cross sectional database

The final sample includes **8,213 firms**:

- ✓ Core countries
- ✓ Mediterranean countries
- ✓ the new EU members

Test for Complementarity between Sustainable Energy Strategies

We assume that a firm can perform two strategies: EE, and RE. A firm can adopt two binary decision in relation to each strategy; these being $A_i = 1$ when a firm performs the strategy and $A_i = 0$ otherwise. The function $\Pi(A_1, A_2)$ is supermodular and A_1 and A_2 are complementary only if,

$$\Pi(1,1) - \Pi(0,1) \geq \Pi(1,0) - \Pi(0,0)$$

	EE strategy		RE strategy	
	χ2 value	Probability	χ2 value	Probability
Whole database	26.72	0.000	17.96	0.000
Core countries	11.08	0.0009	7.26	0.0070
Mediterranean countries	0.08	0.7772	4.05	0.0442
New EU countries	20.23	0.0000	3.65	0.0562

ECONOMETRIC METHODOLOGY

To consider the possible complementarity between current EE and RE actions be more resource efficient and those planned them over the next two years, we apply a bivariate probit procedure

- simultaneous model where the present actions to be more EE and the future plans are interrelated

The general specification is the following:

$$EEnow_{i,t} = x_{i,t}\beta_{11} + \varepsilon_{1i,t} \quad (1)$$

$$EEfuture_{i,t+2} = z_{i,t}\beta_{21} + \varepsilon_{2i,t} \quad (2)$$

EE

RE

where $\begin{pmatrix}\varepsilon_1\\ \varepsilon_2\end{pmatrix} \sim N\left\{\begin{pmatrix}0\\0\end{pmatrix}, \begin{bmatrix}1 & \rho_{12}\\ \rho_{22} & 1\end{bmatrix}\right\}$

temporal and geographic perspective

RESULTS: BIVARIATE PROBIT: SAVING ENERGY

FUTURE	Core	Mediterranean	New EU
Saving energy (present)	1.616***	2.032***	1.792***
Renewable energy (future)	0.845***	0.529***	0.549***
Aggregate determinants			
CO^2	0.083*	-0.157**	-0.183
Willingness pay	0.092***	0.063***	-0.050*
PRESENT			
Other resource efficient practices			
Saving water	0.822***	0.897***	1.087***
Renewable energy	0.385***	0.208	0.174
Saving materials	0.266***	0.432***	0.552***
Minimizing waste	0.451***	0.356***	0.326***
Selling scrap	0.075	0.160	-0.029
Recycling	0.062	0.042	-0.103
Designing products	0.260***	0.113	0.172*
Policy influences			
Anticipation legislation	0.242**	0.341*	0.149
Public support	0.329***	0.225	0.294***
Market pull drivers			
Customers suppliers	0.090	0.277*	0.258***
Public demand	0.134*	-0.151	0.010
Technology push drivers			
Cost saving	0.586***	0.613***	0.623***
Competitors	0.107	0.0877	0.410***
Environment priority	0.447***	0.453***	0.349***
Firm characteristics			
Size	**0.078*** **	0.029	0.064***
Age	**0.070***	0.045	0.071
Aggregate determinants			
CO^2	0.001	-0.062	0.403**
Willingness pay	0.0002	0.007	0.055*
Observations	3,216	1,249	3,748

Future

- Engaging in EE actions during the previous years has a positive relationship with the probability of engaging in EE practices in the future – this persistence is present in all country clusters

- ✓ Complementarities between EE and RE – an increased use of RE leading to an increased use of EE

Present

- ✓ Public policies are strongly related to promoting EE actions
- ✓ Customers and providers is a significant driver
- ✓ Cost saving is a significant driver for all groups
- ✓ EE is closely related to firm characteristics and other eco-efficiency actions

RESULTS: BIVARIATE PROBIT: RENEWABLE ENERGY

FUTURE	**Core**	**Mediterranean**	**New EU**
Renewable energy (present)	**1.907*** **	0.327	**1.917*** **
Save energy (future)	**0.954*** **	**0.719*** **	**0.654*** **
Aggregate determinants			
CO2	**-0.127** **	**0.226*** **	-0.198
Willingness pay	-0.027	**-0.076*** **	-0.019
PRESENT	**Core**	**Mediterranean**	**New EU**
Saving water	**0.356*** **	0.109	**0.211** **
Saving energy	**0.445*** **	**0.415*** **	**0.230** **
Saving materials	-0.010	-0.059	0.044
Minimizing waste	0.116	**0.350** **	**0.199***
Selling scrap	-0.018	-0.109	0.003
Recycling	0.109	0.095	**0.237*** **
Designing products	**0.263*** **	-0.230	**0.410*** **
Policy influences			
Anticipation legislation	0.118	0.337*	0.140
Public support	**0.288*** **	**-0.281***	**0.308*** **
Market pull drivers			
Customers suppliers	0.034	-0.185	0.048
Public demand	0.081	0.074	0.113
Technology push drivers			
Cost saving	-0.062	0.190	0.094
Competitors	0.132	-0.297	0.115
Environment priority	**0.400*** **	**0.267***	0.069
Firm characteristics			
Size	-0.027	**0.074***	**0.057***
Age	0.023	0.116	-0.003
Aggregate determinants			
CO2	**-0.148*** **	0.072	0.021
Willingness pay	**-0.051*** **	-0.027	-0.014

Future

✓ Persistence in Core and New EU members

✓ Firms that are satisfied with the return on the investments made on resource efficiency practices, that invest a high amount of money in them, or that have a better environmental management and awareness are more likely to implement RE actions

Present

✓ Positive link between RE and public support: Core and New EU members

✓ Demand pull and technology push playing a moderate role

✓ In EE and RE strategies firm' internal characteristics play a moderate role

CONCLUSIONS

- ✓ Sustainable energies measures (EE and RE) are highly persistent at the firm level and across countries in the European Union
- ✓ High complementarities between EE and RE practices are found. Also, European SMEs firms undertaking such measures are more likely to continue applying them in the future
- ✓ EE strategies are influenced by cost saving and regulations, in contrast, RE are more linked to public support and environmental awareness
- ✓ The drivers of EE and RE, in addition to their persistence and the complementarities between them, highlight the need to deploy an energy policy that jointly pursues EE improvements and the promotion of RE
- ✓ The EU European Union need energy policy that jointly pursues EE improvements and the promotion of RE, and, especially to reduce financial barriers encountered by European SMEs.
- ✓ Diversity of drivers and barriers between members recommend to design specific Energy Polity according firm's characteristics and country context.

Determinants of Energy Efficiency and Renewable Energy in European SMEs

THANK YOU!!

AGUSTÍ SEGARRA-BLASCO AND ELISENDA JOVÉ-LLOPIS

UNIVERSITAT ROVIRA I VIRGILI (URV)

VI INTERNATIONAL ACADEMIC SYMPOSIUM:
Facing the Energy Transition: Markets and Networks

BARCELONA 06/02/2018

UNIVERSITAT ROVIRA i VIRGILI

VARIABLES

Dependent variable

- ✓ *EEnow* is a dummy variable equal to 1 if the firm reports having introduced an EE action. Our dependent variable is decomposed into two EE and RE strategies

.

Independent variables → drivers

- ✓ Policy influences: anticipation of future changes in legislation and public support in form of financial and fiscal incentives
- ✓ Market pull: the demand of customers or providers and the demand from the public sector
- ✓ Technology push: cost saving, catching-up with main competitors and firms attitude towards environmental
- ✓ Other efficiency practices

Dependent variable

- ✓ *EEfuture* is a dummy variable equal to 1 if the firm reports planning to implement additional resource efficiency actions, such as saving energy and predominantly using RE, respectively

.

Independent variables → drivers

- ✓ Lag dependent variable →persistence
- ✓ RE or EE (future) → complementarity
- ✓ Economic and environmental awareness: self-perceived profitability, intensity to be green and the personal attitude toward the environment

Control variables

- ✓ Firm characteristics: size, age (young),
- ✓ Sector and country dummies
- ✓ Aggregate determinants: CO2 emissions and willingness to buy environmental products