Analysis of the determinants of market capitalisation: Innovation, climate change policies and business context

Abstract

This research seeks to provide decision-makers with valuable information that can guide policies aimed at mitigating climate change without damaging private investment. First, data envelopment analysis (DEA) is used to determine the efficiency of investments in research and development (R&D) made by the most innovative European companies. Second, a multilevel regression (MR) is run to analyse the impact that environmental policies, the business context and the efficiency of innovation exert on market capitalisation. The analysis focuses solely on European territory in 2019. The results reveal a pattern of behaviour by the countries and industries whose R&D spending has enabled them to optimise their output. In addition, the study identifies environmental measures that boost companies' share price, along with innovation, business confidence and the lifting of restrictions on foreign investment.

Keywords: Innovation, environmental policies; DEA; multilevel regression; business context

1. Introduction

In recent years, the nexus between corporate environmental, social, governance and financial performance has been attracting particular attention (Ooi et al., 2018; Chua, 2018; Husse and Pippo, 2021; Maiti, 2021). Since corporate responsibility to society goes beyond profit maximisation, companies must show environmental accountability. This reflects the growing need to curb global warming by reducing greenhouse gas (GHG) emissions, thereby ensuring the health of the environment and the well-being of the population. The scourge of global warming affects all countries, with extreme heat, fires and increasingly frequent floods being just some of its manifestations. The WMO (2020) has estimated that approximately 79% of disasters in the last half century are related to weather, water and climate.

Against this backdrop, society is demanding government policies that promote innovation in all productive sectors: the isolated action of a mere few will in no way solve the problems of air pollution (Asheim et al., 2020; Neofytou et al., 2020; Tödtling and Trippl, 2021). All the related research supports the need for drastic changes to be made to energy systems, where the transition to low-carbon models is an imperative (Carley and Konisky, 2020; Sovacool and Griffiths, 2020; Martí and Puertas, 2022). Industrial sectors should see this technological innovation as an opportunity to position themselves in a market that is increasingly aware of environmental problems. Government action is needed to help ensure the financial viability of all research and development (R&D) processes aimed at reducing GHG emissions. Rodriguez et al. (2021) demonstrate the willingness of business representatives to contribute to the energy transition in an international structure. However, the authors claim that collaboration with government is essential, as although the priority of facilitating bioenergy with carbon capture requires a combined effort, it must first be promoted by the relevant authorities.

There has been abundant scientific output on this issue, providing decision-makers with insights to guide their policies in the right direction. Afrifa et al. (2020) examine the relationship between innovation, governance and climate change (CC), demonstrating that investment in innovative technologies moderates environmental problems. Authors such as Lin and Zhun (2019) and Abdelzaher et al. (2020) suggest that innovation can mitigate CC by restricting energy consumption and emissions, thereby reducing countries' vulnerability to CC. Furthermore, Venturini (2021) analyses the climate risk factors that determine the dynamics of the stock market. Others such as Eren et al. (2019), Anton and Nucu (2020) and Wang et al. (2021) investigate the impact of financial development on renewable energy in India, the EU and China, respectively. Nevertheless, we still know little about the impact that innovation, CC policies, and the business environment can have on the market capitalisation of companies.

In this research, we propose a broader analysis, with a joint assessment of elements that have not yet been considered together in previous studies. The aim of this paper is to study the determinants of the market capitalisation of the most innovative companies in Europe. The research is conducted in two stages: in the first, we calculate the efficiency of the innovation carried out in 2019 using data envelopment analysis (DEA); in the second, we estimate a multilevel regression (MR), taking innovation efficiency, business context, and national-level environmental policies as independent variables, and companies' market capitalisation as the dependent variable. This will allow us to answer two research questions:

Q1. Which countries and/or industries stand out in terms of their innovation profile?

Q2. Which variables have the greatest impact on market capitalisation?

The results of the research help bridge the gap in the literature. Some previous studies, such us that by Ahmed and Jahanzeb (2020), have shown that financial development, market capitalisation and technological innovation reduce the intensity of emissions. The nexus between innovation and climate change has also been analysed (Danish and Ulucak, 2021; Crecente et al., 2021). To date, however, there have been no analyses that examine the effects of concepts such as innovation efficiency and climate change measures on market capitalisation. In order to answer the two questions raised in the present research, a quantitative assessment is conducted, the results of which will be of great help to companies. Specifically, the paper makes the following novel contributions: (1) it analyses a broad range of companies, industries and countries, thus revealing a pattern of behaviour that can guide improvements in the efficiency of R&D investments; (2) it produces evidence to support the formulation of public policies aimed at boosting the attractiveness of innovative companies; (3) it provides valuable information to the business sector, establishing the key considerations when choosing the most appropriate territory in which to locate; (4) the recency of the statistical information helps ensure that the conclusions drawn can be immediately acted on by decision-makers.

The rest of the paper is structured as follows. Section 2 reviews the literature on innovation, climate policies and business context as key features of companies. The methods and variables used are presented in section 3. The results of the research are analysed in section 4. Lastly, the conclusions, the contribution of the study and the limitations are summarised in section 5.

2. Innovation, climate policies and national business context

The transition to an increasingly sustainable socioeconomic system requires conducive conditions that drive innovation and ensure the introduction of environmentally-friendly practices. There is a nexus between innovation, climate policies, business confidence and the stock market (Acheampong et al., 2020; Zeqiraj et al., 2020; Dabbous and Tarhini, 2021), although this has not always been a point of agreement among the scientific community. The development of financial and capital markets facilitates technological progress, constituting an ideal channel for cutting carbon emissions. According to Leitão et al. (2022), the stock and debt markets together with technology facilitate the reduction of CO_2 emissions in high-growth economies, by providing the appropriate structure to foster the efficient allocation of resources. It has been shown that the companies that are most committed to curbing CC have greater access to finance (Fernandez-Cuesta et al., 2019) and at lower costs (Maaloul, 2018). This new viewpoint contradicts another line of thought which holds that there is a positive relationship between stock markets and gas emissions (Abbasi and Riaz, 2016; Katircioğlu and Taşpinar, 2017), or even that the two are independent of one another (Shahbaz, 2016). According to Shahbaz et al. (2021), financial development and energy use increase CO_2 emissions, whereas R&D spending reduces them. Méndez-Picazo et al. (2021) claim that entrepreneurship has a direct relationship with environmental problems, demonstrating its links to sustainable development.

There is an extensive literature in support of innovation as a way to drive the technological change that guarantees countries' ecological development (Li et al., 2020; Chen et al. 2020). Sometimes the increase in emissions brings about new forms of production that then enable a reduction (Su and Moaniba, 2017). Ali et al. (2021) suggest that innovation aimed at ensuring clean technology can simultaneously boost growth and improve environmental conditions. Lin et al. (2021) find a relationship between R&D investment and CO_2. In this setting, R&D is the cornerstone of innovation efficiency. According to Zhu et al. (2021), companies should rely on research and industry-university cooperation, complemented by appropriate environmental regulations and backed by public investment. Dabbous and Tarhini (2022) argue that the collaborative economy has positive impacts on sustainable development and energy efficiency. Technological progress can reduce pollution while improving the competitiveness of all business sectors, including tourism (Tiago et al., 2021; Martín Martín and Salinas Férnandez, 2022).

Traditionally, technology has been associated with economic development and this in turn with environmental pollution (Miao et al., 2017). Guaita Martinez et al. (2022) emphasise the importance of new technologies when it comes to solving the problems associated with extreme situations, such as those caused by COVID-19. It remains a reality that economic growth and material flows are the main drivers of GHG emissions (Leitão et al., 2022). Nevertheless, according to Blampied (2021), countries with major environmental constraints are associated with lower growth rates; this finding underscores the need for a transition to greener economies. He suggests a shift in strategy from "grow first, then clean up" to "clean up in order to grow". Nor can we overlook the impact of globalisation on all business sectors, affecting the adoption of new technologies (Skare and Riberio Soriano, 2021). Marinakis and White (2022) shows the consequences of a technological system designed to efficiently develop non-renewable resources.

GHG emissions can be considered social costs caused by companies, which are not ever internalised by shareholders or managers of those companies. This would suggest that they have no incentive to reduce these externalities (Azar et al., 2021). However, fund managers may be open to taking an interest in these costs and even letting them influence their portfolios, thus affecting corporate valuations (Brinkman et al., 2008). The risk of social stigmatisation caused by growing public concern about CC could trigger disruptions in market capitalisation. Therefore, reducing GHG emissions would be favourable to the investment climate. According to Krueger et al. (2020) institutional investors see climate risks as having a direct impact on their portfolios. The Big Three (BlackRock, Vanguard and State Street Global Advisor) are currently playing an active role in the environmental evolution of the companies in which they invest. Azar et al. (2021) show a direct relationship between the investment of these three large firms and the reduction in CO_2 emissions by the companies in which they buy shares. Lee and Suh (2022) discuss the impact of "greenwashing" in a process approach that can explain the link between environmental, social and governance (ESG) performance and financial performance. The Big Three are committed to investing where there is a demonstrated environmental priority; this is not an altruistic action as it increases the value of their portfolio. Barzuza et al. (2020) argue that The Big Three could put pressure on companies to reduce their carbon emissions in order to attract investors that are sensitive to environmental concerns. In this regard, the studies by Brandon and Krueger (2018) and Hoepner et al. (2021) provide evidence of the influence of climate risk on investment portfolio decisions.

Furthermore, authorities play an important role in this new scenario, where financial profitability and compliance with CC goals are closely related (Wang and Lei, 2020). There are relatively few studies focused on analysing the connection between climate policies and stock market reaction, and they report widely differing conclusions. Ramiah et al. (2013) document the risk and uncertainty caused by environmental policies. They argue that the evolution towards becoming a greener nation has a mixed effect on abnormal returns with apparent sector-by-sector differences. On the other hand, Guo (2020) concludes that it is only the announcement of these policies that has a negative impact on the performance of the stock markets of developing economies. However, this research attempts to show that in developed countries the consequences are very different.

3. Methods and materials

The empirical research has been conducted using a sample of the 1000 most innovative companies based in the European Union[1] (EU), whose R&D expenditure exceeded 229 billion euros in 2019. The European Commission annually publishes a report containing a list of these companies, together with others located in different territories (Grassano et al., 2020). Due to a lack of statistical information on all the variables needed for the analysis, the number of observations has been reduced to 650, which is considered a representative sample. In order to achieve the research objectives, DEA and MR have been used. Both these methods are supported by a notable literature in the field of innovation (Puertas et al., 2020; Bresciani et al., 2021; Zhu and Xu, 2021; Mavi and Mavi, 2021; de Castro-Pardo et al., 2022).

3.1. Stage 1: Innovation efficiency, data envelopment analysis

The DEA method yields a measure of the relative efficiency of decision-making units (DMUs) characterised by multiple inputs and outputs. It is a mathematical programming method that yields the weights that guarantee an optimal solution to the problem posed. On the basis of a production function, DEA identifies the DMUs that have been able to maximise outputs using the available resources (output orientation), or minimise inputs while maintaining the desired output level (input orientation). The DMUs are the observations of the sample (companies). As originally defined by Charnes et al. (1978) they are assumed to operate under constant returns to scale (CRS), that is, with proportional variations in inputs and outputs, such that the size of the DMUs does not affect the level of efficiency. Later, in order to relax this restriction and better reflect the reality of the problems under analysis, Banker et al. (1984) defined the model with variable returns to scale (VRS). Under this new scenario, an increase in inputs can produce smaller or larger increases in outputs, depending on the corresponding scale of operation of the DMU in question. Given the characteristics of this research, the use of an output-oriented DEA-VRS model is proposed. The efficiency level takes values equal to or greater than 1; the amount over 1 indicates how much the outputs need to increase by in order to achieve full efficiency. The production frontier is made up exclusively of efficient DMUs; in other words, only those that have registered a value equal to 1. On the

[1] The study specifically focuses on the EU-28, and only in 2019.

other hand, the efficiency score is calculated as the inverse of the level of efficiency, yielding a value between 0 and 1, with 1 being the maximum score.

When applied to the evaluation of efficiency, this method offers a number of key advantages: the weighting scheme obtained is objective, thus avoiding evaluation error due to subjective factors; it is not affected by the scale of the inputs and outputs used; and it is not necessary to establish a functional form for the relationship between these variables (Wang and Choi, 2019). Due to the flexibility of DEA and the various versions subsequently developed, it has proven popular in the scientific community and has been used to assess efficiency in a wide variety of fields, such as agricultural sustainability (Pan et al., 2021), technological innovation (Zameer et al., 2020), environmental measures (Wang and Feng, 2021) and even healthcare services (Cinaroglu, 2021), among others.

In order to calculate the efficiency, it is first necessary to determine the variables that define the production function to be maximised in order to determine the optimal weights of the variables of each DMU; that is, those that allow outputs to be maximised with the available inputs. The choice of inputs and outputs has been conditioned by the objective of the proposed research; namely, to determine the efficiency of the innovation policies adopted by European companies. Table 1 defines the variables used in this stage of the study, all of which are provided by the European Commission. The production function is defined with 3 inputs and 2 outputs, all of which are supported by an extensive literature about the calculation of efficiency in innovation processes

Table 1. DEA variables (2019)

Variable	Role	Unit	Definition	Literature
R&D	Input	Million euro	Cash investment funded by the companies themselves. It includes research contracted out to other companies or public research organisations.	Carrillo and Jorge (2018); Li et al. (2019); Shi et al. (2020)
Capex	Input	Million euro	Expenditure used by a company to acquire or upgrade physical assets such as equipment, property, industrial buildings.	Carrillo and Jorge (2018); Chen et al. (2018); Xu et al. (2020)
Employees	Input	Number	Total consolidated average employees or year-end employees if average not stated	Carrillo and Jorge (2018); Li et al. (2019); Wang et al. (2020)
Net sales	Output	Million euro	Amount invoiced by the companies for the provision of their services and /or sale of their goods. Excludes sales taxes and shares of sales of joint ventures & associates.	Carrillo and Jorge (2018); Li et al. (2019); Wang et al. (2020)
Profit	Output	Million euro	It is calculated as profit before taxation, plus net interest cost minus government grants, less gains arising from the sale of businesses or fixed assets.	Chen and Breedlove (2020); Mills et al. (2021)

The companies analysed in the study belong to different industries that together represent the bulk of the industrial sector. The ones that spent the most on innovation in 2019 were *Automobiles & Parts*, *Pharmaceuticals & Biotechnology*, *Technology Hardware & Equipment*, and *Software & Computer Services*. These four alone account for more than half of all investment in R&D, although they are not those that registered the highest amount in sales or profits in 2019. According to Taques et al (2021), R&D intensity may be determined by the specific features of these industries. Table 2 summarises the main statistics of these variables.

Table 2. Descriptive statistics for inputs and outputs (2012-2019).

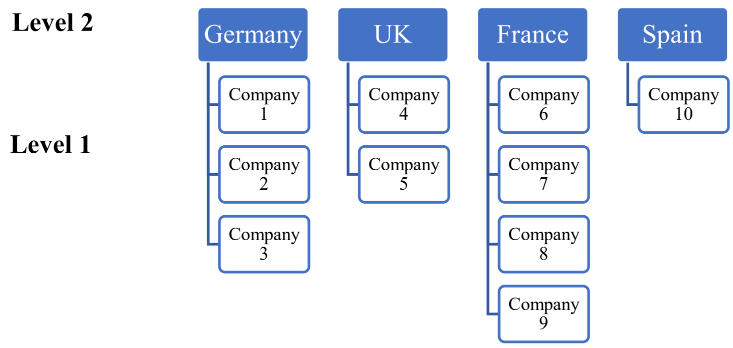
	R&D	Capex	Employees	Net sales	Profit
Mean	301.24	566.28	27,104.14	9,033.316	846.85
SD	994.23	1,789.06	59,639.50	24,521.496	2,290.74
Max	14,306.00	20,447.75	671,205.00	306,993.986	23,792.95
Min	9.16	0.01	13,00	0.01	-3,565.16

A high degree of dispersion can be seen in the sample: in all cases the standard deviation far exceeds the mean value of the variables. This reflects the fact that a wide variety of companies with very different characteristics and sizes are included in the analysis. For example, while one British company belonging to the *Pharmaceuticals & Biotechnology* industry has only 13 workers, there is a German company from the *Automobiles & Parts* industry which has 671,205 employees. The latter is the one that invests the most in R&D, while the maximum in Net sales, Profit and Capex corresponds to a British company belonging to the *Oil & Gas Producers* industry.

3.2. Stage 2: Market capitalisation, multilevel regression

The MR is used in research problems where there are independent variables that can readily be grouped into categories, making it possible to distinguish hierarchical levels of the predictor variables, separating the variation of analysed individuals from that corresponding to the groups to which they belong (Goldstein, 2011). Statistical analysis predicts that observations at the same level usually behave similarly. This means the requirement of independence for general linear models is not met, thus necessitating hierarchical structures that make it possible to account for the covariance among the data, since the residuals could be correlated. In the proposed research, market capitalisation is estimated by means of a two-level regression: one level corresponds to the company itself and the other to the country where it is located (Figure 1).

Figure 1. Hierarchical structure of the sample



In MR modelling, the following assumptions must be met: the dependent variable is quantitative and continuous; the independent variables are quantitative and/or categorical;

the latter have some variation in value (non-zero variance); there is no perfect multicollinearity between two or more predictors; and the predictors are uncorrelated with external variables (Field, 2013). The model is defined by the following expression:

$$Y_{ij} = \gamma_{00} + \gamma_{01} Z_j + \gamma_{10} X_{ij} + \gamma_{11} X_{ij} Z_j + (\mu_{0j} + \mu_{1j} X_{ij} + \varepsilon_{ij}) \qquad (1)$$

where Y_{ij} represents the market capitalisation of company i in country j, X_{ij} the innovation efficiency of company i in country j, and Z the characteristics of country j where the company is located. The variables have been log-transformed to provide stability and reduce the effect of outliers and units of measurement, thus limiting the range of variability. This model includes both fixed effects γ and random effects μ. Table 3 details the components of the estimated models.

Table 3. Description of the dependent variable and the independent variables corresponding to the second level

Variables	Definition	Source	Unit
Model 1: Business Context			
Business confidence index (BC index)	Provides information on future developments, based on opinion surveys on developments in production, orders and stocks of finished goods in the industrial sector.	OECD	Above 100 suggest an increased confidence in near future business performance, below 100 indicates pessimism
FDI regulatory restrictiveness index (FDI index)	Measures statutory restrictions on foreign direct investment across 22 economic sectors	OECD	Restrictions are evaluated on a 0 (open) to 1 (closed) scale.
Model 2: Environmental policies			
Energy savings rate (Energy savings)	Calculated from ODEX and reflects efficiency gains since 2000	ODYSSEE	%
Total CO_2 intensity (CO_2)	Relates the CO_2 emissions from fuel combustion of industry to the value added in constant prices at exchange rate	ODYSSEE	kCO2/EUR2010
Environmentally related tax revenue (Tax)	Government-imposed revenues related to the environment	OECD	% GDP
Dependent variable			
Market capitalisation (Market cap)	Refers to the total market value of a company's outstanding shares of stock.	European Commission	Million euro

As shown in Table 3, two models have been estimated to individually assess the independent variables that characterise the behaviour of the country, thus preventing a situation where one of them masks the importance of others. In the first level, the innovation efficiency of each company in the sample, calculated in stage 1, has been included as an independent variable. Table 4 summarises the main descriptive statistics for all of them.

Table 4. Descriptive statistics and correlation coefficient of the variables in the MR (2019).

		Mean	SD	Max	Min	1	2	3	4
Model 1: Business Context									
		Mean	**SD**	**Max**	**Min**	**1**	**2**	**3**	
1	Market cap	9,958.41	21,238.34	145,957.47	1.24	1			
2	BC index	100.33	0.74	102.07	99.14	0.045	1		
3	FDI index	0.03	0.03	0.11	0.004	-0.044	-0.007	1	
Model 2: Environmental Policies									
		Mean	**SD**	**Max**	**Min**	**1**	**2**	**3**	**4**
1	Market cap	9,958.41	21,238.34	145,957.47	1.24	1			
2	Energy savings	31.03	12.07	52.30	12.90	0.089	1		
3	CO_2	0.27	0.13	0.59	0.08	-0.022	-0.067	1	
4	Tax	2.41	0.67	3.63	1.39	0.002	0.208	0.146	1

As can be seen in Table 4, the variables of both models show a certain degree of homogeneity around the means; the standard deviation is not particularly high in either one, except for Market cap. The latter variable is strongly conditioned by the size of the company and the amount of profits recorded, characteristics that have a huge influence on the market value of this type of company. Regarding the correlations, in both models it can be seen that there is no multicollinearity among the independent variables.

4. Results

4.1. Stage 1: Innovation efficiency

The first stage of the research consisted in calculating the efficiency of the innovation carried out by 650 companies in 2019. DEA identifies the companies whose inputs maximise sales and profits; that is, the companies that comprise the production frontier. Table 5 shows the results ordered by country. Columns report the mean efficiency level (EFF level), mean score (EFF score), number of observations (Nº obs) and number of companies that have achieved maximum efficiency (Nº EFF). All calculations were done using the deaR statistical package implemented in Rstudio (Coll et al., 2018).

Table 5. Efficiency results ordered by country (2019)

Country	EFF level	EFF score	Nº obs	Nº EFF
Czech Republic	1.100	0.909	1	
Ireland	1.155	0.864	30	1
Portugal	1.157	0.865	2	
Luxembourg	1.158	0.866	8	
Spain	1.158	0.869	19	1
Sweden	1.168	0.862	53	3
Italy	1.169	0.861	32	2
Finland	1.175	0.857	27	1
France	1.179	0.855	96	6
UK	1.195	0.845	137	14
Germany	1.199	0.841	135	5
Austria	1.204	0.837	21	
Netherland	1.205	0.836	37	
Belgium	1.207	0.832	21	
Denmark	1.240	0.816	24	1
Slovenia	1.262	0.797	2	
Greece	1.278	0.783	2	
Poland	1.343	0.758	2	
Hungary	1.370	0.730	1	
Mean	**1.189**	**0.847**	**650**	**34**

The efficiency results show that only 34 companies—5.23% of those analysed—are fully efficient, almost half of which are located in the UK. On average, these European companies need to increase their outputs by 18.9% using the available resources. The margin for improvement ranges from 10% in the Czech Republic to 37% in Hungary. The average results for countries such as the UK and Germany, which have major R&D investment capacity, are not what a priori would be expected: both have inefficiencies that exceed 19%. That said, it should be noted that more than 41% of the companies analysed were located in these countries (Q1). Efficiency levels by industry are presented below, with the aim of identifying a pattern that can guide investors' policies (Table 6).

Table 6. Efficiency results ordered by industry (2019)

Industry	EFF level	Nº obs	NºEFF	Countries' EFF_level = 1
Oil & Gas Producers	1.045	8	3	UK (2), Finland (1)
Nonlife Insurance	1.057	4	3	France (1), Germany (1), UK (1)
Beverages	1.061	3		
Mining	1.073	3	1	UK (1)
Electricity	1.110	11	1	Italy (1)
Gas, Water & Multiutilities	1.118	9	2	UK (1), Germany (1)
Tobacco	1.120	2		
Industrial Metals & Mining	1.130	16	2	Germany (1), Spain (1)
Construction & Materials	1.136	22		
Support Services	1.137	13	1	UK (1)
Industrial Transportation	1.138	7		
General Retailers	1.140	8		
Media	1.152	8	1	France (1)
Mobile Telecommunications	1.156	5		
Forestry & Paper	1.157	3		
Banks	1.158	16		
Oil Equipment, Services & Distribution	1.164	3		
Financial Services	1.165	9		
Food Producers	1.166	13	1	UK (1)
Fixed Line Telecommunications	1.173	6		
Food & Drug Retailers	1.173	3		
Chemicals	1.176	27	1	Sweden (1)
Household Goods & Home Construction	1.178	14	1	UK (1)
Aerospace & Defence	1.180	17		
Travel & Leisure	1.182	7		
General Industrials	1.185	20	1	UK (1)
Personal Goods	1.187	14		
Automobiles & Parts	1.190	33		
Industrial Engineering	1.192	69	1	Germany (1)
Alternative Energy	1.204	4		
Pharmaceuticals & Biotechnology	1.215	107	11	UK (4), France (2), Germany (1), Denmark (1), Ireland (1), Sweden (1), Italy (1)
Health Care Equipment & Services	1.217	21		
Software & Computer Services	1.225	64	2	UK (1), France (1)
Technology Hardware & Equipment	1.235	30	1	France (1)
Electronic & Electrical Equipment	1.245	47	1	Sweden (1)
Leisure Goods	1.323	4		

The analysis by industry reveals that *Oil & Gas Producers* and *Nonlife Insurance* register the best performance. To be completely efficient, they only need to increase their outputs by 4.5% and 5.7%, respectively. The fully efficient companies represent 37.45% and 75% of the companies analysed in these industries, respectively (Q1). The first of these industries plays an essential and dynamic part in the global energy matrix (Kazamias and Zorpas, 2021). Recent international agreements have turned a spotlight on this industry due to its role in climate change (CC). There is a demand for safe facilities that cushion the risks perceived by the population; hence it needs to invest in R&D to introduce advances that foster the use of clean energy (Maghyereh and Abdoh, 2021). Furthermore, innovation in this type of industry is aimed at generating improvements in operating procedures, cutting costs, building up reserves and enhancing profitability (Ribeiro et al., 2017). The second of these industries is entirely different to the first, with very different R&D investment needs. In this case, it is the human and the structural capital that require greater attention (Nourani et al., 2018).

Also worth noting is *Pharmaceuticals & Biotechnology*, which accounts for 107 companies with great innovative capacity, although only 10% of them are fully efficient. It is categorised as a high-tech industry, along with ICT and the automotive industry, and it absorbs major investments in R&D as a key factor to ensure success (Matkowskaya et al., 2021).

The UK is remarkably well represented in all these industries, with maximum efficiency levels. It has been shown that the most productive British companies increase their R&D spending in line with foreign demand, meaning that globalisation and internationalisation are key to the investment profile of this country (Son, 2021). Onyekwere (2019) confirms that R&D has a positive impact on the productivity growth of British industries, hence the efforts made to achieve the maximum efficiency of these funds.

In short, the results of the empirical analysis make it possible to quantify countries' capacity for improvement in the management of their innovation resources, and point to certain notable similarities. Specifically, the results are strongly dependent on the level of industrialisation of the home country and the turnover of the sectors. The literature shows that the innovation process is a key determinant of productivity (Doran et al., 2019). This is an issue that should be taken into account due to its direct impact on market capitalisation.

3.2. Stage 2: Market capitalisation: Innovation, business context, environmental policies

In this second stage of the research, MR is used to assess the determinants of the market capitalisation of large companies with a highly innovative profile. Two models have been proposed to address not only the importance of the innovation carried out but also the possible effect of the country's business context (model 1) and the environmental policies adopted at the national level (model 2). The aim is to determine which actions have the greatest impact on the market capitalisation of these companies. Table 7 shows the results of the fixed effects estimation for both models. The coefficients have been standardised in order to be able to make comparisons between them and evaluate the relative impact of each of the variables. In addition, the country factor has been estimated, and turns out to be statistically significant. This means that as it is considered as a grouping variable and treated as a random effect, the hierarchical structure of the data has been respected when evaluating the fixed effects of the independent variables of level 1 and 2.

Table 7. Fixed effects estimation

	Model 1	**Model 2**
EFF level	-0.162***	-0.170***
BC index	0.084*	
FDI index	-0.081**	
Tax		0.091**
CO_2		-0.075**
Energy savings		0.111**

Dependent variable: Market cap.
*** p-value < 0.01, ** p-value < 0.05, *p-value < 0.1

In both models, innovation efficiency has a positive impact on the Market cap, and the impact is much greater than that of other variables. The estimation has been carried out in terms of the level of efficiency, such that the higher the EFF level the more inefficient the company is and, therefore, the lower the Market cap. Model 1 shows that the two variables analysed have the expected sign and are statistically significant, and both are of similar importance. The higher the level of business confidence in the country (BC index) and the lower the barriers to foreign investment (FDI index), the higher the Market cap (Q2).

According to Rahman and Shamsuddin (2019), if business confidence levels are high, investors pay a higher price per dollar of earning. In addition, business confidence increases stock market activity, as it is perceived as a sign of prosperity and economic growth (Zeqiraj et al. 2020). However, the liberalisation of restrictions on FDI encourages international linkages, attracting potential investors who then drive up the value of assets (Mistura and Roulet, 2019). In this respect, Amara (2020) finds that investors direct their assets towards countries that have fewer restrictions, helping to boost the value of companies. Foreign direct investment can be considered as a proxy for the impact of globalisation (Gil-Alana et al., 2020).

Model 2 estimates the effect of the country's environmental commitment on the value of the company. The results confirm that environmental taxes and energy efficiency have a positive impact, while the effect of CO_2 emissions is negative (Q2). Due to public awareness of the need to curb CC, environmental taxes have a positive effect on a country’s economic activity in all sectors. This reveals an alignment with one of the biggest problems facing humanity: the degree of public and private involvement has become a mark of distinction that positions a country on the international stage, granting it a relevant role at environmental summits. These results build on the study by Thampanya et al. (2021), who report a negative correlation between the market capitalisation of national companies and CO_2 emissions, improving the country's environmental quality. Ooi (2018) confirms that the most environmentally active companies achieve better financial performance. According to Nugyen et al. (2021), governments have the power to establish an institutional framework to influence stock markets and financial institutions, with the ultimate aim of reducing CO_2 emissions. In this respect, Shahzad (2020) confirms that environmental taxes play an effective role in the competitiveness of European markets and well-being in an economy.

The analysis therefore provides evidence that the efficiency of innovation is the factor that carries the greatest weight in the market value of companies, although other issues such as the business environment and national environmental policies should not be disregarded.

5. Conclusions

Innovation, environmental policies and a country's business context are elements that must be jointly analysed in order to position the industrial sector within the new international structure that strives to be one of the active powers when it comes to environmental quality. This research analyses the relative importance of these factors for companies' market value. To that end, the study was carried out on a representative sample, in terms of R&D spending, of companies from the European productive sector. DEA was used to determine the efficiency of business innovation, while MR was applied to assess whether the positioning of the country exerts any influence on the companies.

From the results, it can be concluded that innovation is not the only aspect that bolsters a company's market capitalisation, and companies' decision-makers should carefully assess their geographical location. It has been shown that the most environmentally active countries, with fewer restrictions on foreign investment and a better business climate, provide the perfect setting for large companies with a strong innovative profile, constituting a novel implication to the theory. Then, this research helps to fill the gap in the literature by jointly considering items that have so far been analysed in isolation. Other analyses have shown that financial development, market capitalisation and technological innovation reduce emissions (Ahmed and Jahanzeb, 2021). The results of the empirical analysis conducted here provide a pattern to be followed by investors seeking to maximise returns: first, they should assess the efficiency of the R&D investment made by the target company, and second, the positioning and constraints of the region in relation to CC and/or foreign capital inflows.

This research has focused on companies based in Europe. As a future line of research, the scope of analysis could be extended to other continents and a longer time horizon. This would make it possible to identify synergies or differentiating features that can guide public and private decision-makers in adopting the most appropriate measures to attract large companies, the drivers of economic growth.

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