Documents de travail

«European investment Bank loan appraisal, the EU climate bank?»

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Document de Travail n° 2022 – 10

Mars 2022

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European investment Bank loan appraisal, the EU climate bank ?

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Abstract

What are the determining factors in the allocation of European Investment Bank (EIB) green investments? Using data describing more than 17,000 EIB loans to European Union (EU) member states from 1960 to 2020, we first break down EIB loans into green, neutral and brown loans. We then provide evidence that EIB green investments tend to be allocated to the most advanced economies, specifically, that green investment is positively correlated with high GDP per capita and increases with national environmental expenditure. Our findings illustrate the dichotomy between economic development and environmental objectives faced by the EIB.

Keywords: `European investments Bank ; Green investment ; Climate policy`

`JEL Classification : E22, G24, Q56`

1. Introduction

Climate change is now a matter of consensus among scientists (Oreskes, 2004; IPCC, 2018; Cook et al., 2013). According to a study conducted by McKinsey[1], to achieve carbon neutrality by 2050, the EU would have to invest 28 trillion euros in new clean technologies and techniques over the next 30 years. Twenty-three of the 28 trillion would come from shifting investments from carbon-based to non-carbon activities, leaving a funding requirement of 5 trillion by 2050.

The EIB, the EU's financial arm, announced in November 2019 that it would become a "Climate Bank"[2]. The EIB was the first international financial institution (IFI) to issue a green bond (a climate awareness bond or CAB) in 2007. The EIB has since remained a leader in the field, with an estimated EUR 30.8 billion (compared with EUR 600 million in 2007) raised in the form of green bonds by 2020[3].

This study is at the intersection of several strands of the literature: contributions on the challenges and the role of the EIB in the EU's green transformation (Kavvadia, 2021; Fayolle, 2020; Griffith-Jones and Carreras, 2020), studies of the macroeconomic determinants of EIB investments in general (Clifton et al., 2018), and of the determinants of green investments (Eyraud and Clements, 2013; Yuan and Gallagher, 2018). However, none of these studies have looked at the EIB's past activity in green investments, how its investments are

[1] How the European Union could achieve net-zero emissions at net-zero cost, December 3, 2020 Report

[2] The EIB Group Climate Bank Roadmap 2021-2025, November 2020.

[3] 10th anniversary of "green bonds" celebrated in Luxembourg , 5/07/2017.

allocated in the EU, or what the main macroeconomic determinants of these investments are.

The present study of the key drivers of EIB green investments aims to fill this gap in the literature. We use the official EIB loan-level database of projects financed in the EU between 1960 and 2020. As the EIB database does not provide information on the environmental friendliness of the projects, the first contribution of this study is to break down EIB loans by type of investment, i.e. green , neutral and brown (*A la* Mielke and Gesine A, 2018; Garrett-Peltier, 2017). The aim of our empirical analysis is to identify the factors that determine how green investments are allocated in the EU.

Our contribution is twofold:

- We identify the EIB loans that should enable carbon neutrality to be achieved by 2050 and analyze their sectoral, spatial and temporal distributions (using a keyword approach).
- We study the macroeconomic determinants of EIB green loans (econometric analysis).

The results of this environmental breakdown show that the majority of the EIB's green investments are concentrated in the transport and energy sectors and overwhelmingly benefit the most developed countries in the EU such as France, Germany and Italy (2100 of the 4375 green investments over the period 1960-2020). Green investments have increased significantly as a portion of the EIB's lending portfolio since the 2000s, up to 25% of its portfolio in 2015. The corresponding econometric analysis suggests that EIB green investments are positively correlated with the GDP per capita and environmental expenditure of beneficiary states. A 1% increase in GDP per capita is associated with a 3.8% increase in EIB green investments and a 1% increase in national environmental expenditure is associated with a 0.5% increase in EIB green investment in the recipient country, suggesting that public investment in this area has a leverage effect.

The remainder of the paper is organized as follows: Section 2 reviews the literature on EIB loan activity and green investments. Section 3 is a qualitative analysis of EIB loans by type of investment (green, brown or neutral). Section 4 presents a quantitative analysis of the macroeconomic determinants of EIB lending. Section 5 concludes and discusses the economic and political implications of the results of sections 3 and 4.

2. Literature review

Our research question is related to two strands of the literature: (i) analyses of EIB loans and their determinants (Licari, 1969; Fayolle, 2018; Bussière, 2008; Clifton et al., 2014; Clifton et al., 2018; Griffith-Jones and Tyson, 2012; Yuan and Gallagher, 2018) and (ii) the definition and determinants of green investments (Eyraud and Clements, 2013; Yuan and Gallagher, 2018).

2.1. Overview of EIB activities

The EIB is the EU's financial institution. Its objective is to implement the EU's economic and social policies by issuing bonds on financial markets. These resources are then made available to "project promoters" in the form of loans and guarantees. Bank financing (through loans and guarantees) is granted to a wide range of economic actors: private companies, local authorities, associations, public/private partnerships. The EIB's shareholders are exclusively EU member states. The EIB's actions are immediately distinguishable from other forms of EU financing (CAP, ERDF, ESF) in that they come in the form of loans to be repaid rather than grants. According to its statues (TEU, Art.3) The EIB must finance relevant economic projects that fit with the EU's objectives and that cannot be financed by private banks or member states (TFEU 2008, Art.309). EIB loans are provided on a non-profit basis, the relatively advantageous interest rates only allowing the EIB "to meet its obligations, to cover its expenses and to constitute a reserve fund" (EEC Treaty, 1957). These characteristics – low interest rates, long-term lending, and project targeting – allow EIB financing to be studied as an EU fund in its own right (Robinson, 2009).

Studies of EIB activities can be classified into four groups. First, those written by the EIB itself (Kaser, 1984; Bussière, 2008), highlighting ts role in European integration. The role of the EIB in the integration of member states has since been studied by Clifton et al. (2018), who assess the EIB's lending policies in terms of three historical objectives: (i) development, (ii) integration and (iii) investment. They use GDP per capita as a proxy of countries' level of development, the interest rate differential as a proxy for access to capital, and intra-European trade as a proxy for market integration. They find that EIB lending is negatively correlated with GDP per capita, suggesting that the EIB acts as a development bank. Their results also suggest that the EIB plays a major role in the integration of new member states by investing more in new EU candidate states. The second group consists of studies of the EIB's activities in different sectors (Tuijnman, 2009; Pinder et al., 1995; Clintworth and Boulougouris, 2018; Griffith-Jones and Tyson, 2012). These articles assess the EIB's lending policies in terms of the EU's sectoral policy objectives, to understand whether EIB investments meet EU education, transport, maritime policy, and industrial objectives, respectively. The third field of investigation covers the EIB's activities outside the EU (12% of its total loan volume) and its role in stimulating economic growth in these countries (Langan, 2014; Griffith-Jones and Tyson, 2012; Yuan and Gallagher, 2018). Langan (2014) has studied the EIB's policies in the context of ACPâ€"EU development cooperation while Yuan and Gallagher (2018) focus on the EIB's lending in the energy sector of Central and South American countries. The last group of studies consider EIB loans as potential instruments to boost economic growth in Europe. Since the financial crisis of 2007/2008, the EIB has been used as a counter-cyclical financing instrument (Marzinotto, 2011; Griffith-Jones and Naqvi, 2020), and more recently, the EIB has emerged as a financing tool to tackle the environmental and climate crisis (Kavvadia, 2021 ; Fayolle, 2020; Griffith-Jones and Carreras, 2020).

Among the many case studies performed however, the EIB's environmental standards and the environmental impact of the projects it finances have rarely been considered. Wouters and Hachez (2011) have compared

the accountability principles applied by the EIB with the practices of other multilateral lending institutions, focusing on environmental, social and human rights issues. They find that for loan recipients within the EU, the EIB's standards are relatively high and aligned with those of other European institutions. In its external actions however, the standards and principles of the EIB are relatively unclear and non-transparent. A number of internal EIB studies have also looking into environmental issues. These are technical documents that describe how environmental costs are considered when selecting projects to fund (European Investment Bank, 2013b). In terms of carbon value, the EIB indicates that it estimates the damage as ranging from EUR 40/tonne to EUR 68/tonne. The EIB's climate action strategy has been described in other internal documents (European Investment Bank, 2013a; European Investment Bank, 2015a; European Investment Bank, 2015b; European Investment Bank, 2020), which highlight the economic and environmental benefits of investing massively in climate change adaptation and mitigation measures to create jobs and increase the resilience of economies to resource scarcity and climate shocks.

2.2. Green investments: various definitions

To identify green investments in the EIB's loan portfolio, we use the EIB's own green taxonomy (see table 1). This taxonomy is based on the principles of the International Development Finance Club, to which the EIB belongs. An economic activity is classified as global warming mitigating if "it promotes efforts to reduce or limit greenhouse gas (GHG) emissions or enhance GHG sequestration". There is no consensus on the definition of green investment (Eyraud and Clements, 2013). Investment is green (Marinoni et al., 2009) if it aims to protect the environment (Helen, 2019). However, green investment has also been described as "investment that allows economic activity to be directed towards low carbon alternatives" (Geddes et al., 2020). In that sense, green investment encompasses more than energy efficiency and renewable energies (Shen and Malik, 2021). If pollution is considered an inefficiency of the production process rather than a form of waste (Porter and Van der Linde, 1995), green investment can be defined as any investment that improves the overall production process. Thus, along with investments in energy efficiency and renewable energies, those directed towards recycling and waste management, water sanitation, limiting industrial pollution, protecting biodiversity, and finally those aimed at limiting and adapting to climate change all fall under the green investment umbrella (Shen and Malik, 2021).

Some authors have focused on particular types of green investments, such as photovoltaics for Escoffier et al. (2019), and renewable energies for Eyraud and Clements (2013). Others have focused on particular sectors of the economy. In their study of the urban infrastructure sector for example, Vandermeulen et al. (2011) model the utility of green investments in infrastructure through the positive effect they have on the quality of life of residents. Green investments in pollution reduction (Miao et al., 2018; Guolei, 2018) and financial innovations to facilitate the funding of low carbon projects have also been studied.

In the framework of the European Green Deal and in order to provide financial markets and policy makers with a single classification scheme, the EU called upon an independent group of experts to develop its own

Table 1: List of activities classified as eligible for climate mitigation finance, EIB, 2015

Category	Sub-Category
1.Renewable Energy	1.1 Electricity Generation 1.2 Heat Production or other renewable energy application 1.3 Measures to facilitate integration of renewable energy into grids
2.Lower-carbon and efficient energy generation	2.1 Transmission and distribution systems 2.2 Power Plants
3.Energy efficiency	3.1 Energy efficiency in industry in existing facilities 3.2 Energy efficiency improvements in existing buildings 3.3 Energy efficiency improvements in the utility and public services 3.4 Vehicle energy efficiency fleet retrofit 3.5 Energy efficiency in new buildings 3.6 Energy audits
4.Agriculture, forestry and land-use	4.1 Agriculture 4.2 Afforestation and reforestation, and biosphere conservation 4.3 Livestock 4.4 Bio fuels
5.Non-energy greenhouse gases reductions	5.1 Fugitive emissions 5.2 Carbon capture and storage 5.3 Air conditioning and refrigeration 5.4 Industrial processes
6.Waste and wastewater	6.1 Waste and wastewater
7.Transport	7.1 Urban transport modal change 7.2 Transport oriented urban development 7.3 Inter-urban transport
8. Low-carbon technologies	8.1 Products or equipment 8.2 R&D
9. Cross-cutting issues	9.1 Support to national, regional or local policy 9.2 Financing instruments
10. miscellaneous	10.1 Other activities with net greenhouse gas reduction

Source: European Investment Bank (2015a); Green investments tracking methodology.

taxonomy (EU Technical Expert Group on Sustainable Finance, 2020). This taxonomy aims to identify economic activities that contribute to the fight against global warming (mitigation) and economic activities that help societies live with global warming (adaptation), while also identifying those that are harmful to the environment and the climate, so called "brown activities". This taxonomy (2020) is more recent than the EIB's (2015), but both are structured around the same two criteria, namely whether an investment (1) contributes to climate change adaptation or (2) contributes to climate change mitigation.

2.3. Main determinants of green investments

Green investment allocation can be driven by economic, political and environmental factors.

Regarding the economic determinants of green investments, economic development is known to increase energy consumption and is therefore expected to accelerate investment in green energy (Eyraud and Clements, 2013). The environmental Kuznets curve suggests that environmental degradation and economic growth obey an inverted U-shaped relationship (Stern, 2004; Panayotou, 1993; Dai et al., 2016). Economic development

is usually proxied in the literature by GDP or GDP per capita (Guanglai et al., 2018; Gadenne et al., 2008). Interest rates are considered to be negatively related to levels of investment because the latter are generally financed by bank borrowing (Taylor, 1999; Eyraud and Clements, 2013). This variable is relevant to our analysis since EIB financing is based on loans with interest.

Political factors are important in the allocation of green investments because these are often conditioned by governments' environmental preferences. Gokul (2015) show that greener policies accelerate the deployment of low-carbon technologies because they make the cost of emissions higher. On the other hand, Baker and Ekundayo (2006) argue that the implementation of higher carbon tax rates reduces the amount of R&D spending by companies in low-carbon technologies because of short-term financial constraints. In this study, countries' level of environmental awareness will be proxied by national environmental protection expenditure. The objective of green investments is to reduce or mitigate environmental degradation and move towards a low carbon economy (Shahbaz et al., 2013). Countries with high levels of environmental degradation are therefore expected to engage in remediation measures. Green investments are also expected to depend on demographic factors such as population. Countries facing drastic increases in population have energy supply needs that are not necessarily reflected in GDP figures (Baldacci et al., 2008). Furthermore, the implementation of environmentally-friendly projects requires high levels of knowledge and technical skills in a country's population (Guerrieri et al., 2010).

3. EIB Lending (1960-2020): Environmental appraisal

This section provides a qualitative assessment of EIB lending. After a brief description of the database (section 3.1), we describe the methodology used to identify green EIB investments in section 3.2 before presenting the main results in section 3.3

3.1. EIB Database

The EIB loan-level database of projects financed by the EIB in the EU from 1960 to 2020 contains records of 17500 projects funded across the 27 EU member states. Various kinds of borrowers (i.e. private companies, local or regional authorities, consortia) are identified and the data on each financed project include its beneficiary, the date of financing, the amount lent, the sector of activity and a brief description of the project.

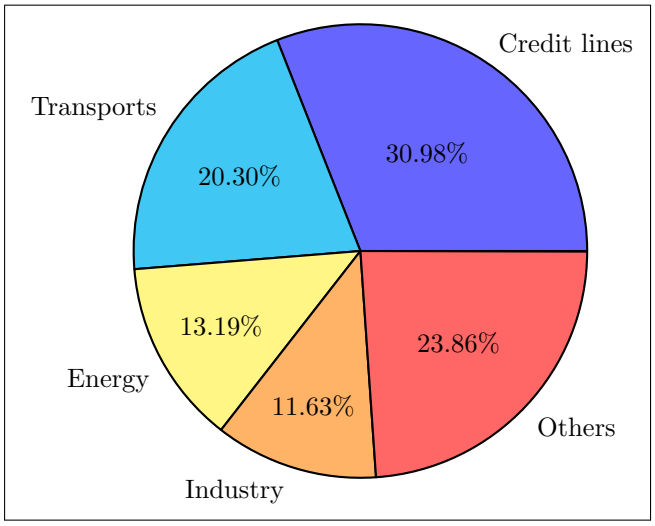
The classification by economic sector[4] in this loan-level database is original and does not correspond to any official classification such as the Statistical Classification of Economic Activities in the European Community (Rev.2,2008), the one used by many other European institutions.

[4]The loans granted by the EIB are classified into 13 sectors of the economy: Agriculture, fishing, forestry / Composite infrastructure / Education / Energy / Health / Industry / Lines of credit / Services / Solid waste / Telecommunications / Transportation / Urban Planning / Water, sanitation.

The preponderance of transport loans (20% of the total volume of loans granted), can be explained by the establishment of the trans-European transport network, a central element of European transport policy. Although this was already mentioned in the Treaty of Rome (1957), it has only been an area of competence in its own right since the Single Act (1986). The activity of the EIB in transportation has been studied by Pinder et al. (1995) using EU documents and information on more than 700 projects financed by the bank between 1986 and 1992. They show that the EIB's financing coincides poorly with the EU's transportation objectives. They explain this discrepancy as arising from the EIB's mandate and its relative independence from the EU Commission.

The second most funded sector by the EIB is energy (13.19% of the total volume of loans granted). Marty-Gauquie (2004) observed that between 2002 and 2004, renewable energy sources received on the order of 1 billion euros, or 14% of the total loans granted to the energy sector.

Figure1: Percentage of total loan amount granted by the EIB to member states between 1960 and 2020 by sector of activity



The EIB invests heavily in European industry (11.63% of the total volume of loans granted) to encourage development and stimulate research. This sector accounts for a quarter of European GDP and more than 30% of the GDP of Ireland, the Czech Republic and Slovakia. Overall therefore, nearly half (45%) of EIB loans are concentrated in three areas: industry, energy and transport, reflecting the weight of these sectors in the EU's economy.

The "lines of credit" sector, which by itself accounts for 30% of EIB investments since 1960 (see figure 1), is not an economic sector as such. It is rather an "authorization given by the EIB to the borrower to draw down funds up to a fixed ceiling for a given period". The multi-sectoral nature of these credit lines makes them difficult to interpret directly. In our loan-level approach, the loans in this "category" are treated just like any other, and are classified by investment type as in the other economic sectors. The following section covers how the green nature of investments was evaluated.

3.2. Identification of green EIB investments

EIB investments were evaluated using the eligibility criteria in Table 1 (European Investment Bank, 2020) to determine whether they were green, brown and neutral in terms of their environmental friendliness. These criteria were established by the EIB itself (2015) to identify projects to be counted as contributing towards its climate action indicator. The 10 categories can be separated into two groups: (i) climate change mitigation investments, which can be defined as efforts to limit the impact of human societies on the climate; and (ii) climate change adaptation investments, which can be defined as efforts to limit the impact of climate disruption on human societies.

To identify green investments, we created an algorithm to detect the keywords listed in table 1 in the project descriptions of EIB loans. Since there is no taxonomy for brown investments, these projects were identified as being "non-green". In the energy sector for instance, green investments are those in renewable energy, so all non-renewable energy projects were classified as brown and all remaining projects—those not identified by the algorithm as brown or green, or projects without an associated description—were classified as neutral. This approach has its limitations: the classification is based on ex-ante information, i.e. before the investment is made, and says nothing about the actual impact of the investment after it was made.

The results of this breakdown will be presented in terms of three major characteristics: (i) the economic sector of the investment as defined by the EIB, to clarify the EIB's sectoral strategy and identify which sectors have been prioritized in the allocation of green investments, (ii) time, to see if green investments have been trending upwards or downwards in the EIB portfolio, and (iii) geographic distribution, to determine whether green investments are allocated uniformly across the EU.

3.2.1. Sectoral breakdown

Using the above described approach, 4374 of the 17750 loans approved by the EIB in the study period (see table 2) were identified as green investments. This represents about 25% of all the projects financed by the EIB since 1960 (30% of the total loan amount) and corresponds to the institution's past commitments. A majority of these green investments were made in the transportation, energy and water management sectors.

The predominance of the transportation sector in the EIB's green investment portfolio is a reflection of the importance accorded to establishing a trans-European transport network in EU transport policy. The main focus of these green investments in the transportation sector has been on improving public transport networks in cities and improving railways (see Table 5 in the appendix for a representative selection of green projects). A small number of loans have also been granted to research and development on new electric car motors. A variety of projects in the energy sector can be labeled as green investments, including the construction of oil pipelines or the transportation of natural gas. For example, the EIB has financed R&D projects aiming to improve the energy efficiency of gas delivery networks. Regarding renewable energies, the EIB has provided loans for the construction of wind turbines and solar panels. Loans granted to companies to acquire carbon

Table 2: Breakdown of EIB loans by type of investment and by sector of the economy (1960-2020)

Type of investments			
Sector	**green**	**Neutral**	**Brown**
Agriculture, fishing, forestry	22	70	14
Composite infrastructure	49	135	49
Education	80	415	1
Energy	671	1220	193
Health	58	359	0
Industry	390	1780	417
Lines of credit	1068	3203	978
Services	118	636	31
Solid waste	245	38	3
Telecommunications	24	629	8
Transportation	877	571	1573
Urban planning	190	439	33
Water, sanitation	582	384	4
Total Projects	4374	9464	3712
Total Lending	290 billion euros	325 billion euros	341 billion euros

Reading note: Of the 106 projects in agriculture, fisheries and forestry financed by the EIB, 22 can be considered green according to the EIB taxonomy.

credits from the EU-ETS market as a means to strengthen the EU's climate action are also classified in the energy sector. Under the Kyoto Protocol, some EU member states—mostly those with transitional economies—have surplus carbon quota that can be "greened" and reinvested in mitigation projects. A few development banks are involved in this policy (Tuerk et al., 2010). The EIB's green investments in the public planning sector focus on the thermal renovation of public and private buildings, in keeping with the EIB's commitment to prioritize the most energy-consuming, high emission and polluting sectors.

Our methodology classifies 3712 EIB loans as brown investments. These are massively concentrated in the industry, transport and energy sector. They consist in investments in fossil fuel projects, in the improvement of road transport networks or in the expansion of airports[5]. In our approach indeed, a loan that promotes environmentally damaging behavior is classified as brown. By contributing to the improvement of national road networks, the EIB increases the attractiveness of cars over more environmentally friendly modes of transport such as trains and trams. These loans represent around 23% of all EIB intra-EU loans since 1960. Finally, loans classified as neutral with respect to the environment are massively concentrated in the education, health and service sectors.

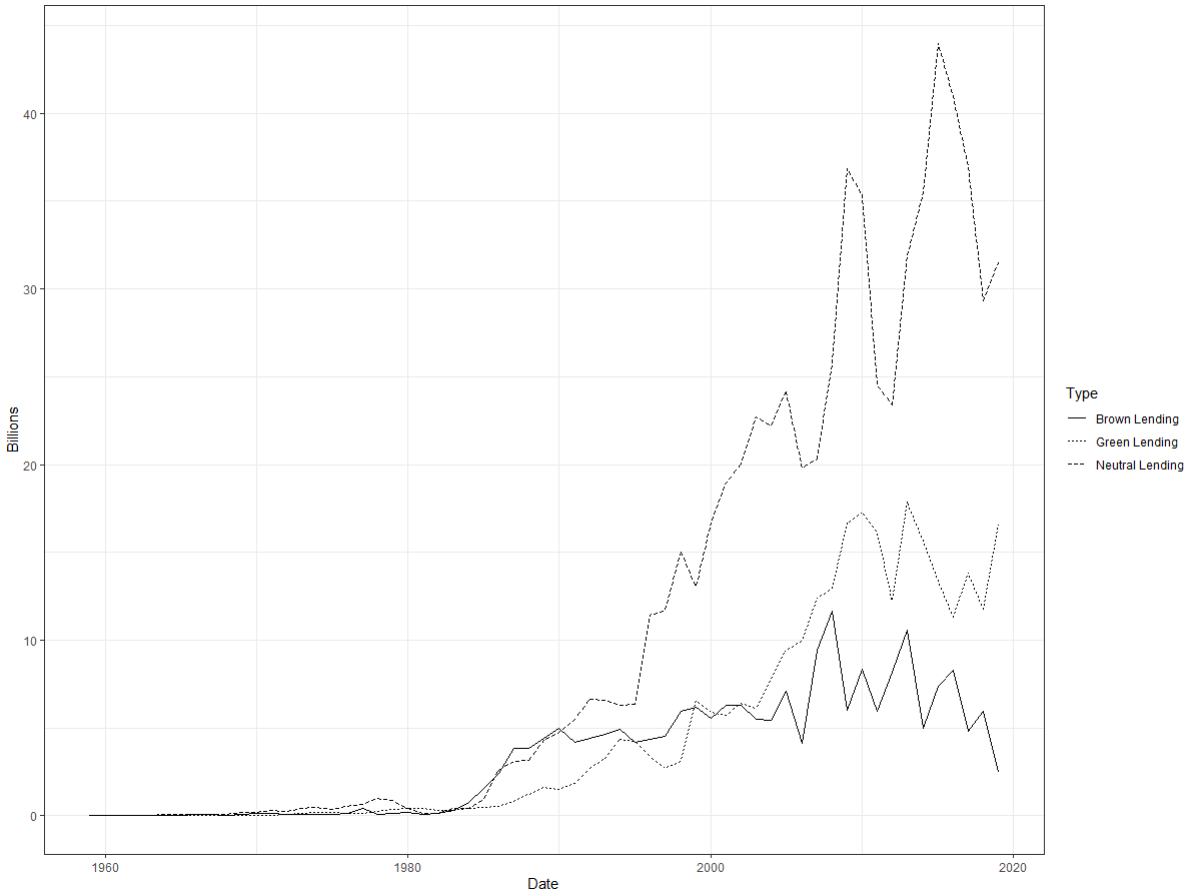
3.2.2. Temporal breakdown

Figure 2 shows that the EIB's yearly lending volume has increased significantly since its creation, with a first peak just after the start of the 2007-2008 financial crisis and a second one corresponding to the implementation of the Juncker Plan. Green investments have also been increasing, while investments classified as brown

[5]For example, the expansion of Leipzig and Dresden airports, 84 millions euros, Germany, 2002.

with our approach have tended to decrease. The curves corresponding to green and brown investments cross in the early 2000s. This corresponds to the period in which the EIB officially formalized its environmental strategy at the Goteborg European Council and ratified the EU's sustainable development strategy. Since then, the Bank and other EU bodies have been trying to coordinate their actions in this area. The final decrease in brown investments (2019) corresponds to the end of EIB financing of fossil fuels.

Figure 2: Evolution of EIB investments in the EU over the period 1970-2020, Author's calculations.

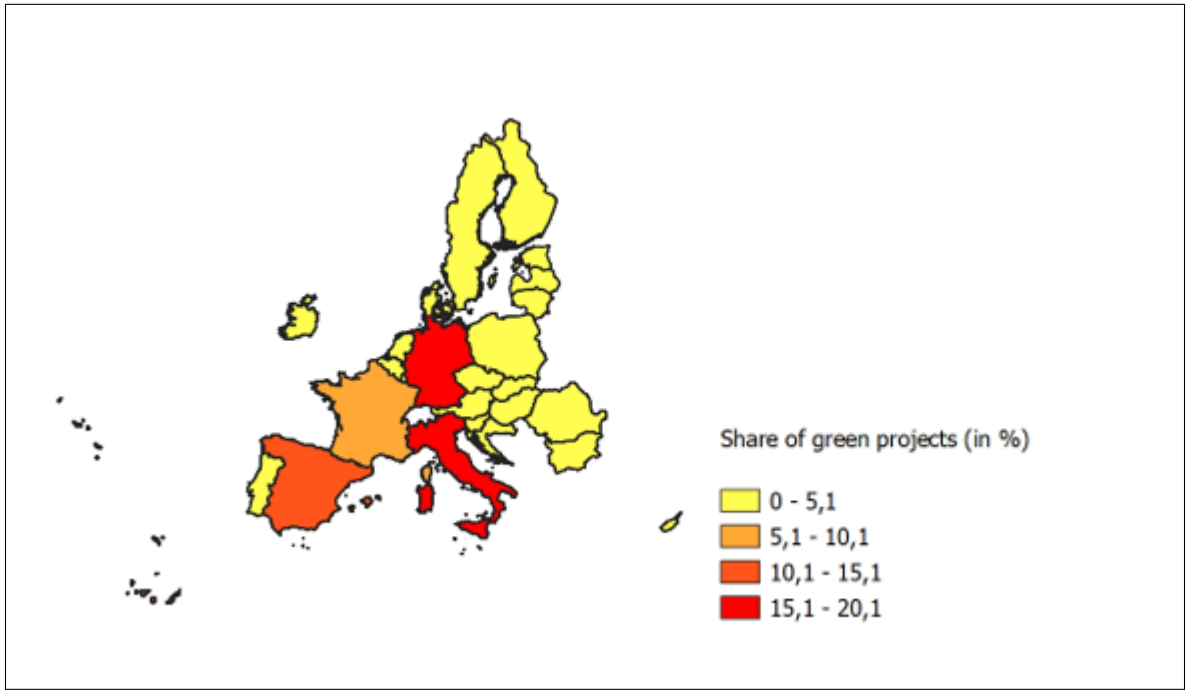


Source: EIB database and Author's calculations.

3.2.3. Geographic breakdown

The distribution by member state of EIB green investments (Figure 3) is very unequal, with France, Germany, Spain and Italy accounting for around 50% of all green investments (2100 projects out of 4375). This is an interesting result because these countries are not the ones that benefit the most from EIB credits in general. As indicated by (Clifton et al., 2018), the EIB's development objectives encourage it to prioritize investments in less developed economies, to promote economic convergence within the EU. This result can be explained by the increase in environmental awareness suggested by the environmental Kuznets curve above a certain level of economic development. Moreover, the economies that benefit the least from the EIB's green

Figure 3: Share of green investments in total EIB loans in EU member states, 1960-2020.



Source: EIB database and Author's calculations.

investments are also those (e.g. Poland) that are the furthest behind on energy transition. These are the countries that have little incentive to transition to a greener economy, particularly considering the loss of jobs that would result (Brauers and Pao-Yu, 2020).

4. Main determinants of EIB green investments: an empirical investigation

4.1. Data and Methodology

The econometric study covers the investments in the EIB database identified as green in the previous section and is based on previous studies of the determinants of development bank investments (Neumayer, 2003; Yuan and Gallagher, 2018; Clifton et al., 2018) and of the determinants of environmentally-friendly investments (Eyraud and Clements, 2013 ; Escoffier et al., 2019). In model (1), we use a panel approach to identify what factors drive the allocation of EIB green investments. The dependent variable of model (1) is the annual amount of green investments by country in billions of euros. The corresponding econometric specification is:

$$GI_{it} = \beta_0 + \beta_1 GDP_{it-1} + \beta_2 r_{it-1} + \beta_3 P_{it-1} + \alpha_1 X_{it-1} + \vartheta_t + \mu_i + \epsilon_{it} \quad (1)$$

where GI_{it} denotes the annual amount of green investments in country i at time t, β_0 is a constant, GDP_{it} is the annual GDP per capita of country i at time t, r_{it} is the interest rate for country i at time t, P_{it} is the national environmental protection expenditure[6] of country i at time t, X_{it} is a set of control variables consisting of the usual drivers of development bank allocation and green investment, and ϵ_{it} is the estimation error. Year and country fixed effects are included in the regression models. We also incorporate a binary variable (ETS) representing the effect of the the EU Emissions Trading System[7]. This variable is equal to 1 after 2005 for participating countries and equal to 0 otherwise. To control for the effect of newcomers, we use a dummy variable that is equal to 1 in the first five years of a country's eligibility for EIB lending (*New_d)*, and equal to 0 otherwise. The panel is unbalanced because the EU has grown in the period considered from the six founding countries in 1960 to 27 countries in 2020. Table 4 (see Appendix) provides descriptive statistics for the variables of interest.

4.2. Empirical results and interpretation

The estimated determinants of EIB green investments are presented in Table 4, where the different columns summarize the results obtained with alternatives specifications as a robustness check.

The main macroeconomic determinant of green EIB loans is GDP per capita. The results obtained with the "counterfactual" specification (first column in Table 4), in which the dependent variable is the log of the total amount granted by the EIB to country i at time t irrespective of the green, brown or neutral nature of the loans, confirm those of Clifton et al. (2018) that the EIB acts as a development bank, the amounts granted to countries being negatively correlated with their GDP per capita. The EIB acts to promote the economic convergence of European regions in keeping with the EU's cohesion policy.

Considering green investments separately however (columns 2 to 4), the amounts allocated to countries are positively correlated with GDP per capita, indicating that the most developed countries (the EU 15 more or less) obtain a greater share of green investments. A 1% increase in GDP per capita is associated with a 3.84% increase in EIB green investments. France, Germany, Belgium and the Netherlands and are indeed among the largest investors in environmental R&D (Eurostat,2018). This result is also consistent, from a theoretical point of view, with the environmental Kuznets curve (Panayotou, 1993), which suggests that once a certain stage of economic development has been reached, environmental considerations influence households' choices. This result is in agreement with previous research (Guolei, 2018 ; Eyraud and Clements, 2013 ; Shuai et al., 2018) showing that GDP and GDP per capita are associated with the amounts invested by states in low carbon sectors.

Our econometric study also suggests that interest rate increases lead to a decrease in green investments. This

[6]state expenditures listed as environmental protection expenditures by Eurostat.

[7]The EU Emissions Trading System was established in 2005 and is the world's first emissions trading system.

Table 3: Determinants of EIB green investments

Model	Counterfactual	(1)	(2)	(3)	(4)
Dependent variable	Level Log(I)	Level Log(GI)	Ratio Log(GI/GDP)	Level Log (GI)	Level Number of GI projects
Log(GDP per capita)	-2.945***	3.842***		2.84***	3.7132***
	(1.09)	(2.51)		(2.49)	(1.96)
Debt(% GDP)	-0.01*	0.56	0.45	0.24	-0.24
	(0.02)	(1.19)	(2.5)	(2.98)	(2.4)
Interest rate	0.48	-0.95**	-0.56	-0.09	-0.49**
	(0.02)	(1.56)	(1.97)	(1.64)	(1.18)
Environmental expenditure		0.5**	0.9**	0.09*	0.49**
		(2.57)	(1.59)	(1.49)	(2.73)
Greenhouse gases		0.007	0.08	0.48	-0.15*
		(0.10)	(0.15)	(0.2)	(0.8)
Population	2.78*	0.05*	0.07**	0.08*	0.09*
	(1.89)	(2.6)	(1.9)	(1.8)	(2.42)
New_d		-5.9*	-4.5*		
			(0.1)		
ETS		0.09**			
		(2.25)			
R-sqr	0.53	0.46	0.38	0.40	0.49
Country FE	Yes	Yes	Yes	No	Yes
Year FE	Yes	No	Yes	No	Yes
Observations	316	316	316	316	316

Notes: ***, ** and * denote significance at the 1%, 5% and 10% levels respectively. Robust standard errors are reported in parentheses.

result makes sense in that higher interest rates make access to capital more expensive (Eyraud and Clements, 2013). We find furthermore that a 1% increase in government environmental expenditure is associated with a 0.5% increase in EIB green investments in the recipient country. This suggests that public investment in this area has a leverage effect. The EIB never funds projects in their entirety, describing its support rather as "a guarantee of a rigorous appraisal process that sends a positive signal to other investors". On average, the EIB finances about 33% of the total project cost. This support then acts as quality assurance to attract other public and private investors. This mechanism explain the positive correlation between public expenditure and EIB loans and confirms the role of public policies already highlighted by (Gokul et al., 2015) or (Gokul, 2015). These associations are consistent with underlying economic theories and are significant in all the specifications considered (millions of euros, number of projects)

5. Conclusion

We have explored the unequal allocation of green investments within the EU using a database of EIB loans. We first broke down the loans into green, neutral and brown investments by searching for keywords in the

project descriptions. Of the 17,750 loans granted to member states between 1960 and 2020, about a quarter were identified as having a favorable environmental impact and were classified as green investments. These loans mainly benefited the transport, energy and solid waste sectors and were awarded more frequently to the most advanced economies in the EU. The corresponding econometric analysis suggests that EIB green investments are positively correlated with GDP per capita and the environmental expenditure of the EU member states. Specifically, a 1% increase in GDP per capita is associated with a 3.8% increase in EIB green investments, while a 1% increase in national environmental expenditure is associated with a 0.5% increase in EIB green investments in the recipient country, suggesting that public investment in this area has a leverage effect. Although our approach allowed us to identify green investments in the EIB's portfolio, this study does not indicate whether EIB financing increases the environmental performance (better carbon capture, lower GHG emissions, improved energy efficiency) of member states. The keyword approach used here suggests that EIB green investments are positively associated with various environmental indicators but does not provide any information on the actual impact of the investments.

Our work has implications regarding how the low-carbon transition is financed by the EU via the Green Deal (European Commission, 2019). The demand for green investment seems to be lower in the less developed economies, the very ones with the greatest investment needs. To avoid a two-speed low-carbon transition, a mechanism should be created to encourage Eastern economies to invest massively in the relevant areas. To this end, the European Commission is considering implementing a so-called "just transition mechanism", to ensure that the transition to a low-carbon economy proceeds in an equitable manner across the EU. This scheme will focus on the most carbon-dependent regions and those where the fossil fuel sector is a major provider of employment. In view of the above mentioned limitations of this work, further research should be conducted on the EIB. In particular, it would be interesting to determine whether EIB green investments are associated with an increase in the environmental performance of beneficiary member states.

References

Baker, E. and Ekundayo, S. (2006). Profit-maximizing R&D in response to a random carbon tax. *Resource and Energy Economics*, 28(2):160–180.

Baldacci, E., Clements, B., Gupta, S., and Cui, Q. (2008). Social spending, human capital, and growth in developing countries. *World Development*, 36(8):1317–1341.

Brauers, H. and Pao-Yu, O. (2020). The political economy of coal in poland: Drivers and barriers for a shift away from fossil fuels. Energy Policy, 144:111621.

Bussière, E. (2008). The Bank of the European Union. *Luxembourg : European Investment Bank*.

Clifton, J., Diaz-Fuentes, D., and Lara Gomez, A. (2018). The European Investment Bank : Development, Integration, Investment? *Journal of Common Market Studies*, 56,4:733–750.

Clifton, J., Diaz-Fuentes, D., and Revuelta, J. (2014). Financing utilities : How the role of the European Investment Bank shifted from regional development to making markets. *Utilities Policy*, 29:63–71.

Clintworth, M. and Boulougouris, E. (2018). Combining multicriteria decision analysis and cost–benefit analysis in the assessment of maritime projects financed by the European Investment Bank. *Maritime Economics Logistics*, 20(1):29–47.

Cook, J., Nuccitelli, D., Green, S., Richardson, M., Winkler, B., Painting, R., Way, R., Jacobs, P., and Skuce, A. (2013). Quantifying the consensus on anthropogenic global warming in the scientific literature. *Environmental Research Letters*, 8(2):024024.

Dai, H., Xie, X., Xie, Y., Liu, J., and Masui, T. (2016). Green growth: The economic impacts of large-scale renewable energy development in china. *Applied Energy*, 162:435–449.

Escoffier, M., Hache, E., Mignon, V., and Parise, A. (2019). Determinants of investments in solar photovoltaic: Do oil prices really matter? *EconomiX Working Paper*, 28.

EU Technical Expert Group on Sustainable Finance (2020). Taxonomy : Final report of the technical expert group on sustainable finance. *Secretariat provided by the European Comission*.

European Commission (2019). Communication from the commission, the european green deal.

European Investment Bank (2013a). Energy lending criteria. *Luxembourg : European Investment Bank*.

European Investment Bank (2013b). The economic appraisal of investment projects at the EIB. *Luxembourg : European Investment Bank*.

European Investment Bank (2015a). Climate action list of eligible sectors and eligibility criteria. *Luxembourg : European Investment Bank*.

European Investment Bank (2015b). Stratégie de la BEI en matière d'action pour le climat. *Luxembourg : European Investment Bank*.

European Investment Bank (2020). Common principles for climate mitigation finance tracking. *Luxembourg : European Investment Bank*.

Eyraud, L. and Clements, B. (2013). Green investment: Trends and determinants. *Energy Policy*, 60:852–865.

Fayolle, A. (2018). La relance par l'investissement en Europe : l'expérience de la Banque Européenne d'Investissement. *Annales des Mines : Réalités industrielle*s, 1:71–74.

Fayolle, A. (2020). Covid-19, La BEI accélère sa transformation en Banque Européenne du Climat. *Revue d'économie financière*, 3:229–234.

Gadenne, D., Kennedy, J., and McKeiver, C. (2008). An empirical study of environmental awareness and practices in SMEs. *Journal of Business Ethics*, 84:45–63.

Garrett-Peltier, H. (2017). Green versus brown: Comparing the employment impacts of energy efficiency, renewable energy, and fossil fuels using an input-output model. *Economic Modelling*, 61:439–447.

Geddes, A., Schmid, N., and Schmidt, T. (2020). The politics of climate finance: Consensus and partisanship in designing green state investment banks in the United Kingdom and Australia. *Energy Research Social Science*, 69:101583.

Gokul, C. (2015). Long-term payoffs of near-term low-carbon deployment policies. *Energy Policy*, 86:493–505.

Gokul, C., Iyer, Leon E, C., James A, E., Nathan E, H., and Haewon C, M. (2015). Long-term payoffs of near-term low-carbon deployment policies. *Energy Policy*, 86:493–505.

Griffith-Jones, S. and Carreras, M. (2020). The role of the eib in the green transformation. Policy Study, The Foundation for European Progressive Studies (FEPS) and the Initiative for Policy Dialogue (IPD), Columbia University.

Griffith-Jones, S. and Naqvi, N. (2020). Industrial policy and risk sharing in public development banks: Lessons for the post-COVID response from the EIB and EFSI. Global Economic Governance Programme, University of Oxford.

Griffith-Jones, S. and Tyson, J. (2012). The EIB and its role in regional development and integration. M,A Macedo Cintra da Rocha Gomes (eds) The transformations of the International Financial System, Chapter 10.

Guanglai, Z., Ning, Z., and Wenmei, l. (2018). How do population and land urbanization affect CO2 emissions under gravity center change? A spatial econometric analysis. *Journal of Cleaner Production*, 202:510–523.

Guerrieri, P., Luciani, M., and Meliciani, V. (2010). The determinants of investment in information and communication technologies. *Economics of Innovation and New Technology*, 20(4):387–403.

Guolei, C. (2018). Characteristics and influencing factors of spatial differentiation of urban black and odorous waters in China. *Sustainability*, 10(12):4747.

Helen, S. (2019). The influencing mechanism of multi-factors on green investments: A hybrid analysis. *Journal of Cleaner Production*, 239.

IPCC (2018). Summary for policymakers, in: Global warming of 1,5°c, an ipcc special report on the impacts of global warming of 1,5°c above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development,and efforts to eradicate povert. In press.

Kaser, J. (1984). European Institutions, The European Investment Bank : Its role and place within the european community system. *Yearbook of European Law*, 4(1):303–325.

Kavvadia, H. (2021). The european investment bank's 'quantum leap' to become the world's first international climate bank. *Politics and Governance*, 9(2):185–195.

Langan, M. (2014). A moral economy approach to Africa-EU ties : The case of the European Investment Bank. *Review of the International Studies*, 40(3):465–485.

Licari, J. (1969). The EIB. *Journal Of Common Market Studies*, 8(3):192–215.

Marinoni, O., Higgins, A., Hajkowicz, S., and Collins, K. (2009). The multiple criteria analysis tool (MCAT): A new software tool to support environmental investment decision making. *Environmental Modelling Software*, 24(2):153–164.

Marty-Gauquie, H. (2004). The EIB and the financing of renewable energy sources; La BEI et le financement des energies renouvelables. *Revue de l'Energie*, 560.

Marzinotto, B. (2011). A European fund for economic revival in crisis countries. *Bruegel Policy Contribution*, 01.

Miao, C., Fang, D., Sun, L., Luo, Q., and Yu, Q. (2018). Driving effect of technology innovation on energy utilization efficiency in strategic emerging industries. *Journal of Cleaner Production*, 170:1177–1184.

Mielke, J. and Gesine A, S. (2018). Green investment and coordination failure: An investors' perspective. *Ecological Economics*, 150:88–95.

Neumayer, E. (2003). The determinants of aid allocation by regional multilateral development banks and united nations agencies. *International Studies Quarterly*, 47(1):101–122.

Oreskes, N. (2004). The scientific consensus on climate change. *Science*, 306:1686.

Panayotou, T. (1993). Empirical tests and policy analysis of environmental degradation at different stages of economic development. *International Labour Office Geneva*.

Pinder, D., Edwards, J., and Wise (1995). The european investment bank, transport investment and european union objectives: an exploratory analysis. *Journal of Transport Geography*, 3(3):167–178.

Porter, M. and Van der Linde, C. (1995). Toward a new conception of the environment competitiveness relationship,. *Journal of Economic Perspective*, 9(4):97–118.

Robinson, N. (2009). The EIB : The EU's neglected institution. *Journal of Common Market Studies*, 47,3:651–673.

Shahbaz, M., Solarin, S., Mahmood, H., and Arouri, M. (2013). Does financial development reduce co2 emissions in malaysian economy? a time series analysis. Economic Modelling, 35:145–152.

Shen, Y. and Malik, M. (2021). Does green investment, financial development and natural resources rent limit carbon emissions? A provincial panel analysis of China. *Science of the Total Environment*, 755.

Shuai, G., Chen, X., Wu, Y., Tan, Y., Zhang, Y., and Shen, L. (2018). Identifying the key impact factors of carbon emission in China: Results from a largely expanded pool of potential impact factors. *Journal of Cleaner Production*, 175:612–623.

Stern, D. (2004). The rise and fall of the Environmental Kuznets Curve. *World Development*, 32(8):1419–1439.

Taylor, M. (1999). Real interest rates and macroeconomic activity. *Oxford Review of Economic Policy*, 15(2):95–113.

Tuerk, A., Frieden, D., Sharmina, M., Schreiber, H., and Vorsatz, D. (2010). Green investment schemes: first experiences and lessons learned,. *Joanneum Research Center*.

Tuijnman, A. (2009). The education lending policy of the European Investment Bank. *European Journal of Education*, 44(1):111–125.

Vandermeulen, V., Verspecht, A., Vermeire, B., Van Huylenbroeck, G., and Xavier Gellynck, X. (2011). The use of economic valuation to create public support for green infrastructure investments in urban areas. Landscape and Urban Planning, 103(2):198–206.

Wouters, J. and Hachez, N. (2011). A responsible lender? The European Investment Bank's environmental, social and human rights accountability. *Leuven Center for Global Gouvernance Studies, Working Paper*, 72.

Yuan, F. and Gallagher, K. (2018). Greening development lending in the Americas: Trends and determinants. Ecological Economics, 154:189–200.

6. Appendix

List of Tables

Table 4: Descriptive statistics for key variables

Variable	Obs	Mean	Std.Dev	Min	Max	Source
GDP per capita	623	22104	16104	804.5	115761	Eurostat
Interest rates	623	5.849	2.122	-0.250	24.1	Eurostat
Ln (total EIB Lending)	623	46553	69214.62	0	382057	EIB
EIB GI projects	4375	162	234	2	880	EIB
Population	623	25361544	23570511	406	82534	Eurostat
Government debt	423	62.97	30.99671	4.60	178.90	Eurostat
Environmental protection expenditure	423	756.4	926.1472	1.3	6163	Eurostat
Greenhouse gases	623	330.47	245.6592	1.96	1387.92	Shift project Data portal
Energy Intensity	623	0.00015	0.000	0.00005	0.00071	Shift project Data portal
Carbon Intensity	623	0.43	0.50	0.08	2.84	Shift project Data portal
Human Capital	539	2.956	0.3137255	1.551	3.688	World Bank

Table 5: Selected green projects

Year	Sector	Country	Project	Amount (millions euros)
2016	Energy	Romania	Energy efficiency investments in Bucharest	22
2016	Energy	Sweden	Co-investment in an onshore wind farm	5
2016	Energy	Belgium	Finance investments targeting energy efficiency measures	7
2016	Industry	Italy	investments fund targeting energy efficiency projects	12
2016	Industry	Germany	investments in the energy-efficient of housing	57
2016	Services	Finland	Financing a portfolio of new near zero energy buildings	75
2016	Transport	Poland	Construction of tramway lines and rolling stock	191

Source: EIB database.

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