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The effects of publicly supported environmental innovations on firm growth in the European Union

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Abstract

Enabling innovations with environmental benefits is considered crucial to align economic and environmental objectives. We estimate the economic effects of publicly supported environmental innovations for the business economy of 13 Member States of the European Union. Using an instrumental variable approach to address the inherent endogeneity problem, we find that the average publicly supported environmental innovation increases firm employment by 9%, turnover by 12% and market share by 12% over a two-year period. Notwithstanding country and sector heterogeneity, essentially all countries and sectors show positive effects. Moreover, the results are not driven by highly innovative firms but are based on small and medium-sized enterprises with limited innovation activity. Thus, this paper provides robust evidence that public financial support for environmental innovations can align economic and environmental objectives for a broad set of firms, sectors and countries. Public policy supporting environmental innovations might therefore facilitate the recovery and transition to a more sustainable economy.

Keywords: eco-innovation; environmental innovation; competitiveness; firm growth; European Union

JEL classification: C26, O31, O44, Q32, Q56

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1. Introduction

Aligning economic and environmental objectives forms an integral part of the Sustainable Development Goals (SDGs), the Paris Climate Agreement, and the European Green Deal. This alignment reflects debates among scholars and policymakers about whether economic and environmental objectives are substitutes or complements and which role public policy can play in steering the transition towards sustainable development (Arrow et al. 1995; Porter and Linde 1995; Jaffe et al. 1996). This discussion is also pertinent in the context of the COVID-19 crisis and in particular in relation to the recovery strategies of the European Union (EU) and its Member States. In July 2020, the EU agreed to establish the *Recovery and Resilience Facility* (RRF) with EUR 672.5 billion (of which EUR 312.5 billion in grants) that aims to support the EU's medium term recovery and resilience while delivering the objectives of the European Green Deal, thereby trying to combine economic and environmental objectives (European Commission 2020a; European Commission 2020b; European Council 2020).

Against this backdrop, innovations are considered enablers to achieve economic and environmental goals (Giovannini et al. 2015). A more specific type of innovations that explicitly combines economic and environmental aspects are environmental innovations or eco-innovations (Kemp et al. 2019). As such, they are subject to a *double externality* constraint, comprising the positive economic spill-over effects of conventional innovations and reduced negative environmental externalities. Provided that these two market failures are present, public intervention could theoretically achieve more efficient outcomes (Rennings 2000).

Researching the economic and to a lesser extent the environmental implications of environmental innovations have been subject of an increasing body of literature (Ekins 2010; Costantini and Mazzanti 2012; Horbach et al. 2012; Horbach and Rennings 2013; Triguero et al. 2013; Del Rio et al. 2016; Horbach and Rammer 2019). Nevertheless, two main shortcomings can be identified in the literature. First, it often does not address the issue of endogeneity that arises since environmental innovations may support firm growth, while growing firms may simultaneously determine their innovative activities (Calantone et al. 2002; Decker et al. 2016). This can lead to inconsistent and biased estimates (Angrist and Pischke 2009). Second, the literature frequently does not provide evidence on the economic outcomes of public financial support for environmental innovations (Ghisetti and Pontoni 2015; Ghisetti 2017; Flachenecker and Kornejew 2019; Cainelli et al. 2020).

This paper aims to address both limitations by applying an instrumental variable approach and investigating the economic implications of publicly supported environmental innovations on firm growth. Since the share of growing firms is found to be an engine of macroeconomic employment growth (Brown et al. 2017; Ferrando et al. 2019; Hallak and Harasztosi 2019; Flachenecker et al. 2020), productivity increases (Decker et al. 2016), and innovative activities (Brown et al. 2017; Vértesy et al. 2017; Ferrando et al. 2019), this paper evaluates to which extent public financial support for environmental innovations can combine both economic (firm growth) and environmental objectives (reduced environmental pressures). At the same time, public financial support for environmental innovations is shown to be a robust and arguably valid instrument for environmental innovations, thereby mitigating endogeneity concerns.

The analysis is based on firm level data of over 60,000 firms across the business economy of 13 EU Member States. This paper finds that publicly supported environmental innovations increase the employment of firms by 9% and turnover as well as market share by 12% over a two-year period. While there is country and sector heterogeneity, these positive effects are visible across essentially all countries and sectors. Additionally, these effects stem from average firms, such as small and medium-sized enterprises (SMEs) and firms with limited innovation activity. The results suggest that public financial support can align economic with environmental objectives, overcome the *double* *externality* constraint and incentivise innovation activities for firms with previously limited exposure, thereby potentially enabling beneficial longer-term effects on the innovation activities of firms.

From a policy perspective, these findings suggest that public financial support for environmental innovations for SMEs and low innovators is most promising in aligning firm growth and improved environmental outcomes. To this end, providing public financial support for environmental innovations through grants, subsidies or other financial incentives is consistent with the results of this paper. The findings can therefore support the design of policies aiming to support the scaling-up of SMEs, while positively contributing to greater environmental sustainability. These insights could further underpin implementing the objectives of the European Green Deal, the EU SME Strategy and enabling a more sustainable recovery from the COVID-19 crisis, including through the RRF.

The remainder of the paper is structured as follows. Section 2 reviews the literature on environmental innovations and firm growth. Section 3 describes the modelling approach, Section 4 provides information on the data used for the empirical analyses and Section 5 outlines the results. Section 6 embeds the findings within the broader policy context and Section 7 concludes.

2. Literature review

2.1 The economics of environmental innovations

The concept of environmental innovations has been the subject of an increasing body of literature over the last years. An environmental innovation is a new or significantly improved product, service, process, marketing approach or organisational structure, which results in lower environmental pressures, irrespectively of whether or not this was an explicit goal (OECD/Eurostat 2018; Kemp et al. 2019). Four types of push and pull factors have been identified as driving environmental innovations: the underlying regulatory framework and public policy, market pull factors, firm specific factors and technology push factors (Rennings 2000; Horbach et al. 2012). The focus of this paper is on public support measures.

Public support measures as one of the factors driving environmental innovations is in line with the discussion in the seminal papers of Porter (1990) and Porter and Linde (1995). The Porter hypothesis asserts that well-designed environmental regulation can encourage efficiency-based innovation (*weak version*) and even enhance business performance through increased competitiveness (*strong version*). The rationale behind the hypothesis is linked to a series of market failures such as the aforementioned *double externality* constraint, but also to asymmetric information and technological spill-over effects that public intervention might be able to address (Ambec and Barla 2002; Ambec and Barla 2007). Additionally, behavioural motives related to the inability to foresee long-term investments (*myopia*) and rent-seeking actions can also play a role (Ambec et al. 2013).

The different versions of the Porter hypothesis have been extensively investigated (Jaffe and Palmer 1997). While the positive stimulus to innovation has been well established (Lanoie et al. 2011; Rubashkina et al. 2015), it is the *strong* version of the theory that has generated more debate among researchers. For example, Lanoie et al. (2011) suggests negative direct returns of environmental regulation on business performance, which are only partly compensated by positive indirect effects induced by investments in research, development and innovation (R&D&I).[1]

There are two sets of considerations at play when simultaneously investigating (i) the economic outcomes of environmental innovations, and (ii) public financial measures supporting the environmental innovation in the first place. Regarding the former, on the one hand, R&D&I expenditures, physical implementation costs and the overall structure (technological, managerial,

[1] For an extended review of the Porter hypothesis, see Ambec et al. (2013) and Diederich (2016).

labour, etc.) of the firm may require a costly adaptation process due to an environmental innovation (e.g., hiring new staff, setting up new organisational or productive structures). Opportunity costs as well as financing costs related to environmental innovations may also be relevant since environmental innovations are often perceived as riskier and thus subject to price premiums (Soltmann et al. 2014). On the other hand, the firm's economic performance can be directly and indirectly enhanced by the increased competitiveness associated with an environmental innovation. Launching an environmental innovative product, for example, can help the firm supplying new markets to satisfy demand for more environmentally sustainable products. It may also support complying with existing or anticipated stricter government regulation and standards. Environmental innovations aimed at reducing material use relative to output can increase the competitiveness of firms and decrease their greenhouse gas (GHG) emissions (Flachenecker and Kornejew 2019). Moreover, corporate environmental responsibility could lead to price-premium gains (Orlitzky et al. 2003).

Regarding public support for environmental innovations, the key issue is whether the *double externality* problem prevents an efficient number of environmental innovations to occur, which may or may not justify public intervention. The second consideration relates to the exact policy instruments applied to achieve overcoming potential externalities (e.g., by internalising them through pricing or subsidising their costs for the firm) since their success critically depend on the details of the environmental innovation and are specific context (Veugelers 2012). Cainelli et al. (2020) suggest that environmental policy and demand-side factors are both significant in driving the adoption of innovations that promote recycling, reduce waste and decrease the use of materials. Cecere et al. (2020) claim that, even accounting for demand-pull effects and regulatory intervention, access to public funds and fiscal incentives improve the ability to environmentally innovate among SMEs in the EU, not crowding out other external financial investors. Similar positive incentives are identified by Olmos et al. (2012), in particular for public loans, equity investments, prizes and tax credits.

This paper therefore aims to contribute to this body of literature by investigating whether publicly supported environmental innovations are able to overcome the various market failures, offset the initial investment costs and potentially contribute to firm growth while generating environmental benefits (Flachenecker et al. 2017). To this end, the *strong version* of the Porter hypothesis provides a conceptual basis for the analysis in this paper.

2.2 Environmental innovations, firm growth and public financial support

The economic effects of environmental innovations have been investigated for different business performance measures, including findings for positive effects on turnover per employee (Doran and Ryan 2012) and productivity (Antonioli et al. 2016). Costantini and Mazzanti (2012) find that specific types of environmental innovations, namely eco-patents in technologically-intense sectors, positively affect export flows dynamics (see also Antonietti and Marzucchi (2014)). Ghisetti (2018) does not find any statistical significance link to value added, while Soltmann et al. (2014) suggest that the relationship between the intensity of green innovation and value added follows a U-shape at sector level. According to the authors, only firms with an existing stock of green innovations actually benefit from the investment due to increasing returns to scale, complementing similar findings by Li (2014) and Andries and Stephan (2019).

Moreover, different types of environmental innovations can lead to different conclusions. Rennings and Rammer (2011) analyse the effects of environmental innovations motivated by specific regulation. Higher profit margins are observed when regulation targets recycling, waste management and resource efficiency. Rexhäuser and Rammer (2014) claim that only innovations improving resource efficiency provide positive returns and profitability, the effects being larger for regulation driven environmental innovations. Similar conclusions are drawn by Ghisetti and

Rennings (2014) for competitiveness. Van Leeuwen and Mohnen (2017) find comparable results for total factor productivity, for which process-integrated environmental innovations rather than end-of-pipe ones play a positive and significant role. Marin (2014) suggests a substantially lower return on productivity growth compared to innovations without environmental benefits, potentially stemming from a short-term crowding out effect of green innovative investments (Marin and Lotti 2017). Controlling for the same potential opportunity costs, Rubashkina et al. (2015) and Arvanitis et al. (2016) find no evidence for positive productivity and competitiveness effects.

The literature investigating the relationship between environmental innovations and firm growth focuses predominantly on two different types of firm growth – employment and revenues (Table 1). Regarding employment, while product and service innovation seems to have a general positive effect on employment growth at firm level (Harabi 2000; Rennings et al. 2004; Horbach 2010), the effect of environmental innovative processes may differs. Pfeiffer and Rennings (2001) first observed that cleaner production is more likely to increase employment than end-of-pipe innovations, but only for specific sectors and high-skilled labour force. Similar results are found in Rennings et al. (2004), where end-of-pipe process innovations, contrarily to product and service ones, are expected to decrease employment. Horbach and Rennings (2013) suggest that only process innovations linked to cleaner technologies have significantly positive effects on employment growth. However, Rennings and Zwick (2001) find no evidence supporting positive effects on employment growth. Considering longer-term results, empirical findings reveal stronger positive effects of green innovations on job-creation at macroeconomic level (Leoncini et al. 2019), even though these effects do not apply to fast-growing firms. Finally, Kunapatarawong and Martínez-Ros (2016) observe positive employment effects, especially in less environmentally friendly industries and for self-induced innovations.

Table 1: Channels through which environmental innovations could affect firm growth.

Types of environmental innovation / types of firm growth	**Direct effects**		**Indirect effects**	
	Product innovation	**Process innovation**	**Product innovation**	**Process innovation**
Employment	New product cycle requires additional staff (+)	End-of-pipe measures requiring additional workers (+)	New demand (+)	Increased productivity and lower cost of capital (-)
	Innovation substituting labour or fewer resources available for staff (-)		Macro-level effects, such as complementary industries or changes in market power (+/-)	Increased competitiveness and output (+)
Revenue	New demand (+)	Re-organising cost (-)	Corporate social responsibility gains (+)	Increased productivity, competitiveness and output (+)
	Direct innovation costs and opportunity costs (-)		Cost of capital and opportunity cost of not investing in other types of innovation (-)	

Concerning revenues, the transmission channels through which environmental innovations can affect firm turnover growth do not differ from the ones affecting its general performance. On the one hand, Mazzanti et al. (2007) suggests a negative link between environmentally oriented innovations and turnover growth in the short term. On the other hand, Jove-Llopis and Segarra-Blasco (2018) find that high investments in eco-strategies improve sales growth, particularly for SMEs located in countries that recently joined the EU. Hojnik and Ruzzier (2016) studying environmentally innovative firms in Slovenia observe that process environmental innovation provide positive economic results, including increased turnover growth. Colombelli et al. (2015) provide evidence on positive sales resulting from environmental innovations compared to innovations with no environmental benefits by matching firm financial data with patent information. Ar (2012) also detects similar positive results for product environmental innovations, which is dependent on managerial environmental concern (i.e., the higher the concern, the stronger the positive relationship is). Considering circular economy innovations, Horbach and Rammer (2019) find positive and significant effects on turnover (and employment) growth for Germany.

While the evidence base on the effects of environmental innovations, firm growth and public financial support is increasing, what becomes apparent are two issues that do not seem to have received sufficient attention so far.

First, the problem of endogeneity is currently not sufficiently addressed in the literature. The research on the topic employs different methodologies ranging from literature reviews (Horváthová 2010; Lanoie et al. 2011; Ghisetti 2017), case studies (Pfeiffer and Rennings 2001; Fh-ISI et al. 2005), ad-hoc built models (Horbach and Rennings 2013; Kunapatarawong and Martínez-Ros 2016) to using lagged variables to identify the relationship between environmental innovations and growth variables (van Leeuwen and Mohnen 2017; Horbach and Rammer 2019). However, the problem of endogeneity is likely to persist since environmental innovations may support firm growth, while growing firms may simultaneously or serially correlated determine their innovative activities (Calantone et al. 2002; Decker et al. 2016). This in turn can lead to inconsistent and biased estimates (Angrist and Pischke 2009).

Second, the economic effects of public financial support measures for environmental innovations are not sufficiently investigated. While the effect of public financial support on the adoption of environmental innovation has been acknowledged in different ways (Olmos et al. 2012; Costantini et al. 2015; Arranz et al. 2019; Cainelli et al. 2020; Cecere et al. 2020), there is lack of studies assessing whether this support has lead not only to environmental innovations, but also to reaching economic goals, including firm growth. Essentially, the key issue is whether public financial support measures have been effective both from an environmental (innovation with environmental benefits) and economic (firm growth) perspective.

3. Data

The analysis is based on data from the Community Innovation Survey of the European Commission for the years 2012-2014.[2] The Community Innovation Survey 2012-2014 is a harmonised and representative survey of over 60,000 firms across the business economy of 13 Member States of the EU.[3] The 60,000 firms are stratified and weighted to represent the entire universe of firms with at least 10 employees in the business registries of their respective countries. The 13 Member States account for roughly half of all active enterprises with more than 10 employees in the EU in 2014. The Community Innovation Survey has been widely used in academic research (Lööf and Johansson 2009; Czarnitzki and Wastyn 2010; Harris and Moffat 2011; Hashi and Stojčić 2013; Horbach 2014; Horbach and Rammer 2019). Table 2 shows descriptive statistics of the main variables of interest for the analysis.

[2] The harmonised survey questionnaire can be accessed at https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey (last accessed in May 2021).

[3] The countries are Bulgaria (BG), Cyprus (CY), Czechia (CZ), Germany (DE), Estonia (EE), Greece (EL), Croatia (HR), Hungary (HU), Lithuania (LT), Latvia (LV), Portugal (PT), Romania (RO) and Slovakia (SK). The sectors are Mining and Quarrying (B), Manufacturing (C), Electricity, Gas, Steam and Air Conditioning Supply (D), Water Supply; Sewerage, Waste Management and Remediation Activities (E), Construction (F), Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles (G), Transportation and Storage (H), Accommodation and Food Service Activities (I), Information and Communication (J), Financial and Insurance Activities (K), Real Estate Activities (L), Professional, Scientific and Technical Activities (M), and Administrative and Support Service Activities (N).

Table 2: Descriptive statistics.

Variable	N	mean	median	SD	min	max
environmental innovation	61,683	0.245	0	0.430	0	1
public financial support for environmental innovation	61,683	0.182	0	0.586	0	3
relevant public financial support for environmental innovation	61,683	0.021	0	0.142	0	1
employment growth	61,683	0.113	0	0.675	-0.90	19.90
employment growth (in log)	61,683	0.048	0	0.296	-2.30	3.04
turnover growth	61,683	0.184	0	0.956	-1.00	19.90
turnover growth (in log)	61,589	0.063	0	0.410	-2.30	3.04
market share	61,589	0.074	0.005	0.773	0	100
market share growth (in log)	61,515	-0.009	-0.038	0.418	-3.48	3.14
number of innovations	61,074	1.410	0	2.216	0	12
SMEs	61,683	0.953	1	0.213	0	1

Notes: Weighted statistics.

3.1 Environmental innovations and public financial support

Table 2 shows that one quarter of firms had an environmental innovation between 2012 and 2014.[4] 18% of firms reported that they had an environmental innovation due to public financial support, and 2% of firms mentioned that public financial support constituted a high degree of importance for realising the environmental innovation (defined as *relevant public financial support*). Table 3 and Table 4 display country and sector heterogeneity, ranging from Germany with 34% of firms environmentally innovating to Romania with 3%, and manufacturing with 31% of firms having realised an environmental innovation to real estate with 9%. Interestingly, the distribution for relevant public financial support does not correlate strongly with the realisation of environmental innovations, which could suggest that the prevalence of environmental innovations may also be explained by other factors, including market demand, technological advancement and firm specific characteristics (Ghisetti and Pontoni 2015).

The focus of the subsequent analysis is on relevant public financial support for the following two reasons. First, while the results remain robust, *relevant* public financial support is a better predictor for realising environmental innovations from a statistical perspective compared to *general* public financial support. Second, isolating the effect of relevant public financial support for environmental innovations as much as possible from other factors driving firms to be environmentally innovative can mitigate biases from confounding effects. Indeed, relevant in comparison to any degree of public financial support is significantly lower correlated with other drivers of environmental innovations, including expected market demand, firm specific characteristics, or existing/expected regulations.

[4] We removed 881 firms that inconsistently reported not having had any innovations (i.e., product, process, organisational or marketing), but responded to have had an environmental innovation. Including these firms does not significantly alter the results. Additionally, we assume that firms that responded to the entire Community Innovation Survey questionnaire but not to questions on environmental innovations in countries that included this section of the questionnaire as not being environmentally innovative. The results remain robust to loosening this assumption.

Table 3: Environmental innovations and relevant public financial support by country.

country	environmental innovation	relevant PFS
BG	0.052	0.007
CY	0.153	0.022
CZ	0.192	0.000
DE	0.341	0.027
EE	0.110	0.027
EL	0.269	0.036
HR	0.169	0.027
HU	0.097	0.008
LT	0.202	0.022
LV	0.103	0.024
PT	0.331	0.030
RO	0.029	0.005
SK	0.110	0.011
Total	0.245	0.021

Notes: Weighted mean. PFS stands for public financial support.

Table 4: Environmental innovations and relevant public financial support by NACE sector.

NACE	environmental innovation	relevant PFS
B	0.211	0.006
C	0.306	0.027
D	0.250	0.046
E	0.231	0.041
F	0.121	0.005
G	0.199	0.018
H	0.171	0.020
I	0.133	0.024
J	0.187	0.006
K	0.213	0.002
L	0.089	0.009
M	0.217	0.019
N	0.272	0.006
Total	0.245	0.021

Notes: Weighted mean. PFS stands for public financial support.

3.2 Firm growth

As shown in Table 2, the employment and turnover growth variables have a natural lower bound at negative 100% and an artificial upper bound set at positive 2,000%. We therefore removed 2,154 observations from the sample that reported higher or equal values to the artificial upper threshold.[5] Table 5 and Table 6 show large country and sector differences. The average firm grew by 11% in terms of employment between 2012 and 2014, especially in Latvia, Lithuania and Bulgaria as well as in real estate and accommodation. Turnover growth is highly correlated with growth in employment, which shows a similarly level of country and sector heterogeneity.

We consider firm growth in terms of employment, turnover and market share. Turnover growth might be an imprecise indicator for assessing the effects of publicly supported environmental innovations on firm growth since it does not provide any information on the relative performance of firms. Thus, we also test whether publicly supported environmental innovations accelerate turnover growth beyond sector growth as measured by changes in the sector sales market share:

$$marketshare_{t,i} = \frac{turnover_{t,i}}{\sum_{\forall j \in S} turnover_{t,j}} \tag{1}$$

where t indexes time, i the firm and S the set of all firms belonging to the economic sector of firm i. Conveniently, this measure allows for cross-sectional but also intertemporal comparisons. Following Flachenecker and Kornejew (2019), this measures proxies changes in firm-level competitiveness.

[5] Including these threshold firms increases the significance level of our results, leaving the point estimates unchanged. However, we consider these firms as statistical artefacts.

Table 5: Employment and turnover growth by country.

country	employment growth	turnover growth
BG	0.309	0.399
CY	0.025	-0.011
CZ	0.073	0.077
DE	0.050	0.112
EE	0.267	0.236
EL	0.116	0.122
HR	0.260	0.409
HU	0.104	0.209
LT	0.362	0.455
LV	0.383	0.385
PT	0.113	0.194
RO	0.166	0.301
SK	0.126	0.260
Total	0.113	0.184

Notes: Weighted mean.

Table 6: Employment and turnover growth by NACE sector.

NACE	employment growth	turnover growth
B	0.122	0.192
C	0.097	0.179
D	0.119	0.093
E	0.062	0.130
F	0.325	0.462
G	0.096	0.092
H	0.155	0.195
I	0.431	0.978
J	0.184	0.384
K	0.114	0.183
L	0.615	0.855
M	0.106	0.188
N	0.046	0.138
Total	0.113	0.184

Notes: Weighted mean.

4. Empirical strategy

We apply an instrumental variable approach to identify the effects of publicly supported environmental innovations on three sets of metrics of firm growth: employment, turnover and market share growth. The empirical strategy is grounded on the theoretical works of Porter (1990) and Porter and Linde (1995). Accordingly, well-designed environmental interventions by the public sector (in our case by providing targeted financial support for environmental innovations) can encourage efficiency-based innovation (*weak version*; here environmental innovations) and enhanced business performance through improved competitiveness (*strong version*; here firm growth). Our approach can also be linked to more recent contributions on mission-oriented innovations (Mazzucato 2016; Mazzucato and Semieniuk 2017; Hekkert et al. 2020), because the analysis essentially evaluates the effectiveness of public financial support measures in achieving a long-standing policy objective: aligning economic and environmental progress.

4.1 Endogeneity concerns

Endogeneity can arise due to omitted variables, measurement errors and simultaneity. For this analysis, omitted variables are likely to be of concern since there are numerous factors underlying firm growth that might not be observable in the Community Innovation Survey such as the country or sector specific policy environment and pre-sample growth paths.[6] Measurement errors might also be a problematic issue that needs to be addressed, in particular for surveys (Bertrand and Mullainathan 2001). However, we expect measurement errors to be of limited relevancy to the Community Innovation Survey since some information is pre-filled from firm registries, and it mainly comprises binary questions, thereby mitigating potential systematic measurement errors.

[6] Since the Community Innovation Survey is not constructed as a panel for all countries, no firm identification numbers are available and the yearly turnover figures are perturbed, we could not merge the 2012-2014 wave with other waves of the Community Innovation Survey or directly link it to other datasets. On-sight research in Eurostat's Safe Centre was not possible due to travel restriction in the context of the COVID-19 pandemic.

Simultaneity constitutes the largest concern for endogeneity in our analysis. As previously outlined, most of the existing literature suggests that environmental innovations positively contribute to firm growth. Nevertheless, a reverse effect might simultaneously be at work (Galdeano-Gómez 2008; Sakamoto and Managi 2017):

- **Overestimating the 'true' effect**: Growing firms might have a higher propensity to voluntary engage in environmental activities, including those resulting in environmental innovations (Videras and Alberini 2000). Additionally, growing firms may have higher capabilities, knowledge, and willingness to learn making them more prone to environmentally innovative activities (Calantone et al. 2002) or introduce environmental productivity enhancements more generally (Galdeano-Gómez 2008). Following these considerations would be consistent with simple regression analyses overstating the true effect of environmental innovations on firm growth.
- **Underestimating the 'true' effect:** Growing firms active in highly competitive markets, in which their growth potential and market shares *ceteris paribus* are under constant pressure, have a higher incentive to continuously adapt their activities and introduce (environmental) innovations to at least maintain their growth rates and market shares compared to less competitive markets (Aghion et al. 2005). Therefore, firm growth could correlate with the level of competition and growth potential of the firm within a given market. This in turn would be consistent with a downward bias on the OLS estimate since (environmental) innovations might be more prevalent in such competitive markets.

While it is an empirical question, which of these two possibilities prevail, it becomes apparent that correlation analyses are likely to suffer from endogeneity concerns. This issue has been insufficiently addressed in the literature so far. Therefore, aiming to address all three sources of endogeneity, we apply a two stage least square (2SLS) instrumental variable approach (Angrist and Krueger 2001). We suggest that our approach is the most adequate at aiming to address endogeneity since alternative methods, including using lagged endogenous variables, co-integration tests, or estimating dynamic panels, are either not feasible due to data constraints or may infringe the exclusion restriction (Kraay 2012; Panizza and Presbitero 2014; Reed 2015; Wagner and Hong 2016).

4.2 Identification strategy

Applying an instrumental variable approach requires a valid instrument that complies with two conditions: the instrument needs to be relevant in explaining the endogenous variable, and it needs to be exogenous vis-à-vis the independent variable (*exclusion restriction*). Satisfying the first condition requires using a variable that strongly correlates with the introduction of an environmental innovation. The Community Innovation Survey comprises information on the relevancy of factors in driving the decision of firms to introduce environmental innovations. The questionnaire provides the degree of importance (high, medium, low, or not relevant) for nine factors determining environmental innovations.[7] All factors are highly and significantly correlated with the introduction of an environmental innovation, whereas public financial support in the form of government grants, subsidies or other financial incentives for environmental innovations show the highest positive correlation.

According to the second condition, the instrument needs to be exogenous, i.e., it must not correlate with any variable absorbed in the structural error. This means that the instrument cannot correlate

[7] The factors are existing environmental regulations; existing environmental taxes, charges or fees; environmental regulation or taxes expected in the future; government grants, subsidies or other financial incentives for eco-innovations; current or expected market demand for eco-innovations; improving the firm's reputation; voluntary actions or initiatives for environmental good practice within the firm's sector; high costs of energy, water or materials; and the need to meet requirements for public procurement contracts.

with any unobservable variable directly affecting firm growth. For instance, the Community Innovation Survey does not observe the ability and willingness of firms to address changes in the business or regulatory environment. Firms having previously managed changes and transformations might possess knowledge and capabilities to better cope with future challenges (Malerba 1992; Caloghirou et al. 2004). This type of absorptive capacity correlates with firm growth and simultaneously with all the factors underlying the introduction of environmental innovations, except with public financial support for environmental innovations.

There are four reasons why public financial support for environmental innovations is independent from firm growth (other than through environmental innovations) and therefore the most suitable instrument available in the Community Innovation Survey:

1) **Legal considerations:** Within the EU, firms are guaranteed by law to have equal access to public financial support, irrespectively of firm characteristics, including their previous experiences in dealing with changes and their current growth rates. However, for certain public funding programmes, specific types of firms, in particular SMEs, or sectors are given preferred access (Busom 2000; Blanes and Busom 2004). Controlling for sector-specific effects and restricting our sample to SMEs does not alter our results and thus provides confidence that specifically targeted programmes do not invalidate our approach. Importantly, the principle of non-discrimination in the EU applies regardless of the level at which the public financial support is being provided (EU, national or local levels) since public funds cannot discriminate against any firm within the EU, regardless of which jurisdiction it is located in (EU 2012).
2) **Funding considerations:** Public financial support for environmental innovations are targeted to recover parts or all costs directly related to the introduction of environmental innovations (European Commission 2018). This direct link between the amount provided through public funds and the R&D&I costs associated with an environmental innovation is independent from the type of funding, including grants, subsidies and co-financing. As such, the public financial support does not directly affect firm growth, but only indirectly through the effects of environmental innovations.
3) **Previous application:** Public financial support has been used previously used in the literature as an instrument. For instance, Czarnitzki and Wastyn (2010) investigate the effects of R&D&I on export activity, arguing that export activity is unrelated to receiving R&D&I subsidies. Flachenecker and Kornejew (2019) have used public financial support measures to identify the economic implications of circular economy innovations, a subset of environmental innovations.
4) **Equal opportunity:** Another potential confounding effect between firm growth and public financial support could be the results of a self-selection bias, whereby the best performing firms manage to access public funds for environmental innovations. First, this is an issue known by public entities that therefore developed numerous support measures for firms to ensure equal opportunity for all firms to receive public funding.[8] Second, we provide ample empirical evidence in Table 13, Table 14 and Table 15 in the Annex that there are no systematic biases detectable across different metrics of firm ability, including trademarks, patents, export activity, mergers and acquisitions, networks and governmental contracts. This provides reassurance that there is no systematic self-selection bias that could invalidate our results.

[8] See for example the EU initiatives and training programmes for firms, in particular SMEs, to access finance and compete in public funding opportunities (https://ec.europa.eu/growth/access-to-finance_en; https://ec.europa.eu/growth/access-to-finance/cosme-financial-instruments_en; last accessed on April 2021). There are comparable initiatives across national chambers of commerce and development banks.

4.3 Estimation model

For our main model, we follow Flachenecker and Kornejew (2019) to estimate the effects of environmental innovations on firm growth by exploiting dynamic effects at the firm level. The model can be described as follows:

$$\ln(y_{i,t}) = \gamma ECO_{i,t} + \delta_i + \zeta_s t + \pi_c t + \boldsymbol{X_{i,t}\kappa} + e_i \tag{2}$$

where $\ln(y_{i,t})$ represents the firm employment, turnover, or market share in time t expressed in natural logarithm. δ_i are time-invariant firm-level fixed effects, $\pi_c t$ and $\zeta_s t$ country and sector specific trends, and $\boldsymbol{X_{i,t}}$ is the control variables matrix. Country and sector specific time trends ($\pi_c t$ and $\zeta_s t$) are included in the level equation to control for confounding effects ranging from different policies environments at the national level and changing innovation ecosystems.

The Community Innovation Survey allows us to observe the firms at two points in time (2012 and 2014). Therefore, we are able to take the first difference of the data, thereby remove all time-invariant fixed effects, including several elements related to corporate knowledge (e.g., human capital, business contracts, innovations management), absorptive capacity (e.g., firms' internal structure, information management, retail structure), and their time-invariant willingness to embrace change (e.g., know-how of past changes, branding, market power) (Angrist and Pischke 2009; Acemoglu and Johnson 2007; Dinkelman 2011). Equation (2) transforms into:

$$\Delta\ln(y_{i,t}) = \gamma\Delta ECO_{i,t} + \zeta_s + \pi_c + \Delta\boldsymbol{X_{i,t}\beta} + \varepsilon_i \tag{3}$$

where $\Delta\ln(y_{i,t})$ represents firm growth expressed in natural logarithm and $\Delta ECO_{i,t}$ their introduction of an environmental innovation between 2012 and 2014. π_c and ζ_s country and sector specific effects, $\Delta\boldsymbol{X}_{i,t}$ are changes in the firm-level control variables matrix.

In line with applying a 2SLS approach, the first stage of our model estimates the effect of relevant public financial support on the introduction of an environmental innovation.

$$\Delta ECO_{i,t} = \alpha PFS_{i,t-1} + \mu_s + \nu_c + \epsilon_i \tag{4}$$

where $PFS_{i,t-1}$ represents relevant public financial support, $\Delta ECO_{i,t}$ the introduction of an environmental innovation, and μ_s and ν_c are sector and country specific effects. Equations (3) and (4) are estimated using 2SLS with errors robust against heteroscedasticity.

4.4 LATE theorem

The relationship that an instrumental variable approach identifies depends on the variation in the endogenous variable triggered by the instrument. In our analysis, the endogenous variable *environmental innovation* is a binary variable, whereas the treatment effects are likely to be heterogeneous across firms, sectors and countries. Therefore, our results are limited by the fact that we can identify a local average treatment effect (LATE) in accordance with the LATE theorem (Imbens and Angrist 1994; Angrist et al. 1996). The LATE theorem has been applied in the literature also to binary instruments (Lachenmaier and Wößmann 2006). The estimate γ in Equation (3) relies on the variation in firm growth caused by environmental innovations that were triggered by relevant public financial support and would not have been implemented without such financial support. Thus, essentially, we are evaluating whether publicly supported environmental innovations have resulted in firm growth.

Following Imbens and Angrist (1994) and Angrist et al. (1996), monotonicity is also required to identify our model. This means that the direction of the effect of public financial support on the likelihood of introducing an environmental innovation should be the same across all firms. This assumption appears to be reasonable in our sample, because public financial funding is only provided to firms for the purposes of introducing an environmental innovation, while it is very unlikely that public financial support prevents firms from introducing an environmental innovation (which might then not be granted in the first place).

5. Results

We are interested in the estimate of γ from Equation (3), across different dependent variables $y_{i,t} \in \{emyploment_{i,t}, turnover_{i,t}, marketshare_{i,t}\}$. To check whether the 2SLS estimates based on the public support instrument will be reliable, Table 7 presents estimates from the first stage model of Equation (4). For all three samples (minor differences are due to different coverages of the second stage dependent variable) the instrument is quantitatively and statistically strong as indicated by the F and LM statistics. Accordingly, the share of environmental innovations is 49.2 percentage points higher in the subsample of firms to which relevant public financial support was available, after controlling for country and sector-level fixed effects.

Table 7: First stage results for growth in employment, turnover and market share.

	(1) Employment growth	(2) Turnover growth	(3) Market share growth
Relevant public financial support	0.492^{***}	0.492^{***}	0.492^{***}
	(0.061)	(0.061)	(0.061)
Country FE	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes
R^2	0.123	0.123	0.123
Kleinbergen-Paap F	65.920	65.866	65.605
Kleinbergen-Paap LM	104.847	104.731	104.439
N	61,683	61,592	61,518

Dependent variable: Environmental innovation (binary). Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Based on fitted values from the first stage, we obtain the second stage estimates as shown in Table 8. We estimate the local average treatment effect of environmental innovations induced by public financial support to significantly improve firm performance across all three growth categories. Over two years, environmental innovations cause firm employment to grow by +8.7%, turnover by +11.6% and market shares by +11.7%. All these estimates are statistically significant at the 5% level. All regressions are weighted using sampling weights to account for the survey design of the data and obtain representativeness.

For comparison, we also show standard OLS estimates of γ next to 2SLS results to assess the endogeneity bias. Consistently across the three growth indicators, we find the endogeneity bias to be *negative*. This supports the hypothesis that most (environmental) innovation activity takes place in dynamic markets, where highly competitive firms mutually limit each other's business growth. This hypothesis suggests pro-active sector-wide financial support for environmental innovation activity to yield aggregate economic benefits smaller than our firm-level estimates imply. Our estimates are based on variation across firms within the same country-sector group, of which only some qualify for innovation subsidies. This allows those firms to grow faster than their peers and, following the hypothesis, probably at the expense of their competitor's market share. On the other hand, sector-wide technology updates can yield aggregate productivity gains and macroeconomic synergy effects, which our estimation design cannot capture.

We estimate the effect of the *average* environmental innovation among those induced by public support. While corresponding standard errors signal decent statistical precision, we cannot say anything about environmental innovations in general, i.e., effects of low and high-quality environmental innovations or the population of innovations not targeted by public support. They may be close to the average effect we estimate, but wide heterogeneity seems plausible as well. We provide empirical evidence for the encouraging view that public policy makers seem to have been successful on average to target economically beneficial environmental innovation.

Table 8: Second stage and OLS for growth in employment, turnover and market share.

	Employment growth		Turnover growth		Market share growth	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	2SLS	OLS	2SLS	OLS	2SLS
Environmental innovation	0.032^{***}	0.089^{**}	0.021^{*}	0.116^{**}	0.021^{*}	0.117^{**}
	(0.007)	(0.036)	(0.012)	(0.047)	(0.012)	(0.047)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.023	0.017	0.024	0.015	0.040	0.031
N	61,683	61,683	61,592	61,592	61,518	61,518

Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

To benchmark this effect quantitatively, we show country and sector fixed effects in Table 9, illustrating the variation of average employment, turnover and market share growth by country and sector. The marginal effect of the average publicly supported environmental innovation ranges from +9% to +12%, depending on the outcome measure. The dispersion of country fixed effects on the other hand explains 21% to 30% while sector fixed effects explain a baseline variation of 33% to 44%. Thus, the size of the effect of publicly supported environmental innovation is comparable in order of magnitude to the baseline variation across countries and sectors, especially for market share growth. Roughly speaking, any firm could make up for given structural differences prevailing in our EU sample with a few environmental innovations of average quality. This highlights an important observation when it comes to increasing territorial cohesion across EU Member States.

To test the validation of our main findings, we employed a series of robustness checks (see Annex). The results presented in Table 10, Table 11 and Table 12 in the Annex show that our estimates remain stable across different specifications and various control variables. In particular, the main estimate remains stable and significant when the size of business (measured in 2012 turnover), different degrees of internationalisation (whether the main market served is local, national, EU or rest of the world) and the share of employees with a tertiary degree are introduced.

In addition, our main estimates of firm growth (employment, turnover and market share) remain robust against different subsamples of firms, thereby confirming that the results are not driven by the most advanced and innovative firms. Specifically, as displayed in Table 13, Table 14 and Table 15 in the Annex, the main estimates overall remains significant and stable when restricting the sample to firms that show lower degree of innovativeness (trademarks, patents, export activity, mergers and acquisitions, networks and governmental contracts). Excluding firms that in the period of the analysis had registered a trademark or filed a patent or had exporting activities does not undermine the estimates. Moreover, also not considering firms that have undertaken a merger or acquisition, had joint innovation partnerships with other enterprises and organisations or had access to public contracts to provide goods and services does not change the robustness of the results. This not only confirms our instrumentation strategy (as mentioned in Section 4.2), but also provides insights suggesting that publicly supported environmental innovations are performed by average firms. Also, by replicating the analyses throughout the specific firm subsample, such as SMEs and firms operating only in the manufacturing sector, the result estimates confirm the robustness of our results (Table 16, Table 17 and Table 18 in the Annex).

Table 9: Country and sector heterogeneity in employment, turnover and market share.

	(1) Employment growth	(2) Turnover growth	(3) Market share growth
Environmental innovation	0.089**	0.116**	0.117**
Intercept	0.098***	0.115***	0.178***
Country FE (base = BG)			
CY	-0.166***	-0.307***	-0.204***
CZ	-0.096***	-0.157***	-0.115***
DE	-0.113***	-0.130***	-0.142***
EE	-0.003	-0.034**	-0.059***
EL	-0.101***	-0.136***	-0.062***
HR	-0.032***	-0.049***	0.030**
HU	-0.063***	-0.058***	-0.093***
LT	0.037**	0.042**	-0.007
LV	0.052**	-0.015	0.001
PT	-0.087***	-0.080***	-0.048***
RO	-0.075***	-0.044***	-0.132***
SK	-0.079***	-0.081***	-0.050***
Sector FE (base = B)			
C	-0.003	0.011	-0.091***
D	-0.007	-0.084***	-0.058**
E	-0.037*	-0.044*	-0.097***
F	0.034	0.053	-0.121***
G	0.009	-0.033	-0.122***
H	0.037*	0.027	-0.075***
I	0.163***	0.362***	0.132*
J	0.060***	0.093**	-0.027
K	0.010	-0.022	-0.188***
L	0.163**	0.127	0.132
M	0.034*	0.054**	-0.225***
N	0.015	0.078**	-0.216***
Q	0.102**	0.091	-0.158**
R	0.215	0.277	-0.058
U	-0.111	0.279	-0.079
R^2	0.017	0.015	0.031
N	61,683	61,592	61,518

2SLS estimates. Confidence levels based on robust standard errors: *** p<0.01, ** p<0.05, * p<0.10

6. Policy insights

Our empirical results provide evidence that firm-level environmental innovations can reconcile environmental with economic objectives. These benefits show up consistently across different performance indicators, including employment growth, turnover growth and market share growth and emerge as quantitatively considerable. Interpreting the result estimates in the spirit of local average treatment effects (i.e., induced by variation caused by the instrumental variable) we observe that past funding schemes at local, national and EU-level, potentially including funds managed by the Eco-innovation Action Plan,[9] have been successful in targeting innovations with

[9] At EU level, the Eco-innovation Action Plan was the main EU-level funding facility designed to directly support and focus on environmental innovations during our sample period 2012-2014, coordinating most of the EU policy actions directly targeted at the promotion of environmental innovations (European Commission 2011). Launched in 2011 within the Europe 2020 flagship initiative 'Innovation Union', it supports environmental innovations in technologies, business processes and organisational changes to address resource scarcity and environmental pollution, while promoting sustainable growth and labour force expansion. It is organised in seven broader policy actions spanning from policy and regulation to standard setting, funding and SME support. It includes measures such as the Eco-innovation Scoreboard, the

both environmental and economic payoffs. However, the lack of granularity of the data obstructed a more refined analysis on the sophistication of the environmental innovations beyond the average supported innovation (e.g., incremental or radical innovations).

Moreover, our estimates suggest that targeted public financial support for environmental innovations may also meaningfully contribute to regional development objectives. We demonstrated that economic side-effects of environmental innovations are quantitatively equivalent to structural country or sector-specific conditions affecting firm-level performance on average. As such, corresponding policy programmes may even achieve a *triple* dividend in terms of environmental sustainability, economic growth and territorial cohesion in helping to reduce regional disparities across EU Member States.

The design and selection criteria for public funding dedicated to environmental innovations are crucial to best achieve the abovementioned double or triple dividend. A more specific targeting of public environmental subsidies provides another way to achieve additional inclusiveness objectives, as our estimates are not driven by particularly able or innovative firms. A targeted approach to the provision of these funds could aim at focusing on SMEs and firms with little innovation experience rather than large firms and innovation frontrunners.[10] Focusing public support on those firms that would need to catch up to frontrunners would be consistent with the findings of this paper. This in turn might lead firms not only to grow in the short term, but also to continue innovating in the future based on overcoming a first innovation threshold (Szücs 2020).

It should also be mentioned that there are policy instruments available to support environmental innovations other than subsidies. These include regulation, environmental standard settings, green public procurement, taxes and technical support activities (Kemp et al. 2019; Llorente-González and Vence 2020). Subsidies might be effective in leveraging firms' pro-active eco-innovative behaviour – similar to what Leitner et al. (2010) define as 'smart' regulation – and internalising positive economic externalities. However, tax credits, as well as subsidies and grants, may entail specific negative side effects, such as public fund dependence and the crowding out of private investments that might become more important over time (Bloom et al. 2002). As such they seem to be effective for early market introduction phases of products and technologies.

In the recent EU context and based on the results of this paper, environmental innovation therefore might represent a key instrument to align environmental objectives and economic growth. In 2020, not only did the European Union set up a new Circular Economy Action Plan as part of the recently proposed European Green Deal, but also 'greened' the Horizon Europe research budget[11]. Additionally, the *Recovery and Resilience Facility* adopted environmental objectives as part of the overall strategy to recover and build resilience to address the COVID-19 crisis. For instance, more

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Network for Eco-innovation Investments (INNEON), the Eco-innovation Observatory, European Innovation Partnerships and the Environmental Technology Verification (ETV) scheme. However, the exact amount of public funding for environmental innovation is 'hidden' among several different EU funds (see Figure 1 in the Annex). Moreover, often, the monetary figures budgeted for such projects are included in broader funds concerning more generally environmental objectives or innovations, thereby making it challenging to identify the exact amounts dedicated to environmental innovations.

[10] While size thresholds and a focus on SMEs are already in place for some EU funds aiming to support environment innovations (for more details, see COSME eligibility requirements, Horizon's EIC Accelerator and the instruments under the Structural and Investment Funds), funds supporting firms conditional on their previous innovation experience are uncommon. Conversely, part of the EU funds for environmental innovations mainly (or exclusively) support highly innovative companies. This is the case of the EIC Accelerator (as of March 2020, EU SMEs are entitled to apply for funding for innovations related to the European Green Deal), which supports top-class radical innovator SMEs. This is also the case for the Innovation Fund (financed by the EU Emissions Trading System), which will focus on highly innovative and impactful technologies from sufficiently 'mature' projects for 2020-2030.

[11] The funds mobilised to promote environmental innovation encompass Horizon Europe, but also other EU-level research and innovation funds. For a synthesis of the funding opportunities related to environmental innovations, see Figure 1 in the Annex.

than one-third (37%) of the total allocation of each Recovery and Resilience Plan must support climate objectives. This incentivises the support to environmental innovation, as these are considered to contribute substantially to reaching the climate target of each Recovery and Resilience Plan according to Annex VI of the Regulation establishing the Recovery and Resilience Facility.

7. Conclusions

This paper provides evidence that publicly supported environmental innovations achieve both environmental benefits and foster firm growth. Economic benefits consistently show up across performance measures including growth in employment, turnover and market share, while being statistically significant and quantitatively considerable. Concretely, we find that the average publicly supported environmental innovation increases firm employment by 9%, turnover by 12% and market share by 12% over a two-year period. We address the inherent endogeneity bias by applying an instrumental variable estimation. Interpreting our results in the spirit of the LATE theorem suggests that public financial support (e.g., grants, subsidies, tax credits) have delivered both a reduction in environmental pressures as well as increased firm growth. This has important policy implications, showing that the public support has been effective in achieving both environmental and economic ambitions.

Importantly, our results are not driven by the most innovative firms, but by SMEs and those firms with limited innovative activities. This not only supports our identification strategy, but also raises important design questions about how to make public support for environmental innovations most efficient. This also relates to the current funding framework of the EU, which covers multiple programmes and designs in supporting environmental innovations, often focusing support to innovation frontrunners.

Public support for environmental innovations appears to provide a positive contribution to the environment, employment and growth. These policy objectives are more relevant than ever in the context of the COVID-19 crisis, and thus could provide further evidence for policymakers that environmental innovations can support achieving an environmentally sustainable recovery as well as transition more generally.

Bibliography

Acemoglu D, Johnson S (2007) Disease and development: The effect of life expectancy on economic growth. J Polit Econ 115:925–985. doi: 10.1086/529000

Aghion P, Bloom N, Blundell R, et al. (2005) Competition and Innovation: An Inverted-U Relationship. Q J Econ 120:701–728.

Ambec S, Barla P (2002) A theoretical foundation of the Porter hypothesis. Econ Lett 75:355–360. doi: 10.1016/S0165-1765(02)00005-8

Ambec S, Barla P (2007) Survol des fondements théoriques de l'hypothèse de Porter. Actual. Econ. 83:

Ambec S, Cohen MA, Elgie S, Lanoie P (2013) The porter hypothesis at 20: Can environmental regulation enhance innovation and competitiveness? Rev Environ Econ Policy 7:2–22. doi: 10.1093/reep/res016

Andries P, Stephan U (2019) Environmental innovation and firm performance: How firm size and motives matter. Sustain 11:1–17. doi: 10.3390/su11133585

Angrist JD, Imbens GW, Rubin DB (1996) Identification of Causal Effects Using Instrumental. J Am Stat Assoc 91:444–455.

Angrist JD, Krueger AB (2001) Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments. J Econ Perspect 15:69–85. doi: 10.1257/jep.15.4.69

Angrist JD, Pischke J-S (2009) Mostly Harmless Econometrics: An Empiricist' s Companion. Princeton University Press, Princeton, USA

Antonietti R, Marzucchi A (2014) Environmental investments and firm's productivity: a closer look. Seeds Work Pap Ser. doi: 10.1017/CBO9781107415324.004

Antonioli D, Borghesi S, Mazzanti M (2016) Are regional systems greening the economy? Local spillovers, green innovations and firms' economic performances. Econ Innov New Technol 25:692–713. doi: 10.1080/10438599.2015.1127557

Ar IM (2012) The Impact of Green Product Innovation on Firm Performance and Competitive Capability: The Moderating Role of Managerial Environmental Concern. Procedia - Soc Behav Sci 62:854–864. doi: 10.1016/j.sbspro.2012.09.144

Arranz N, Arroyabe MF, Molina-García A, Fernandez de Arroyabe JC (2019) Incentives and inhibiting factors of eco-innovation in the Spanish firms. J Clean Prod 220:167–176. doi: 10.1016/j.jclepro.2019.02.126

Arrow K, Bolin B, Costanza R, et al. (1995) Economic growth, carrying capacity, and the environment. Ecol Econ 15:91–95. doi: 10.1016/0921-8009(95)00059-3

Arvanitis S, Peneder M, Rammer C, et al. (2016) Competitiveness and ecological impacts of green energy technologies : Firm-level evidence for the DACH region *. KOF Work. Pap.

Bertrand M, Mullainathan S (2001) Do People Mean What They Say ? Implications for Subjective Survey Data. Am Econ Rev 91:67–72. doi: 10.2139/ssrn.260131

Blanes JV, Busom I (2004) Who participates in R&D subsidy programs? The case of Spanish manufacturing firms. Res Policy 33:1459–1476. doi: 10.1016/j.respol.2004.07.006

Brown R, Mawson S, Mason C (2017) Myth-busting and entrepreneurship policy: the case of high growth firms. Entrep Reg Dev 29:414–443. doi: 10.1080/08985626.2017.1291762

Busom I (2000) An Empirical Evaluation of The Effects of R&D Subsidies. Econ Innov New Technol 9:111–148. doi: 10.1080/10438590000000006

Cainelli G, D'Amato A, Mazzanti M (2020) Resource efficient eco-innovations for a circular economy: Evidence from EU firms. Res Policy 49:103827. doi: 10.1016/j.respol.2019.103827

Calantone RJ, Cavusgil ST, Zhao Y (2002) Learning orientation, firm innovation capability, and firm performance. Ind Mark Manag 31:515–524. doi: 10.1016/S0019-8501(01)00203-6

Caloghirou Y, Kastelli I, Tsakanikas A (2004) Internal capabilities and external knowledge sources: Complements or substitutes for innovative performance? Technovation 24:29–39. doi: 10.1016/S0166-4972(02)00051-2

Cecere G, Corrocher N, Mancusi ML (2020) Financial constraints and public funding of eco-innovation: empirical evidence from European SMEs. Small Bus Econ 54:285–302. doi: 10.1007/s11187-018-0090-9

Colombelli A, Krafft J, Quatraro F (2015) Eco-innovation and firm growth: Do green gazelles run faster? Microeconometric evidence from a sample of European firms. Welf. Wealth Work Eur. Work Packa:

Costantini V, Crespi F, Martini C, Pennacchio L (2015) Demand-pull and technology-push public support for eco-innovation: The case of the biofuels sector. Res Policy 44:577–595. doi: 10.1016/j.respol.2014.12.011

Costantini V, Mazzanti M (2012) On the green and innovative side of trade competitiveness? the impact of environmental policies and innovation on EU exports. Res Policy 41:132–153. doi: 10.1016/j.respol.2011.08.004

Czarnitzki D, Wastyn A (2010) Competing internationally: On the importance of R&D for export activity. ZEW Discuss Pap 10:1–36.

Decker RA, Haltiwanger J, Jarmin RS, Miranda J (2016) Where has all the skewness gone? The decline in high-growth (young) firms in the U.S. Eur Econ Rev 86:4–23. doi: 10.1016/j.euroecorev.2015.12.013

Diederich H (2016) Review of the Porter Hypothesis and the related literature. Environ Policy Renew Energy Equip Export. doi: 10.1007/978-3-658-13558-4

Dinkelman T (2011) The Effects of Rural Electrification on Employment: New Evidence from South Africa. Am Econ Rev 101:3078–3108.

Doran J, Ryan G (2012) Regulation and firm perception, eco-innovation and firm performance. Eur J Innov Manag 15:421–441. doi: 10.1108/14601061211272367

Ekins P (2010) Eco-innovation for environmental sustainability: concepts, progress and policies. Int Econ Econ Policy 7:267–290. doi: 10.1007/s10368-010-0162-z

EU (2012) The treaty on the functioning of the European Union. Brussels, Belgium

European Commission (2020a) Europe’s moment: Repair and Prepare for the Next Generation - COM(2020) 456. doi: 10.1017/CBO9781107415324.004

European Commission (2020b) Identifying Europe’s recovery needs: Europe’s moment - SWD(2020) 98. Brussels, Belgium

European Commission (2018) Financial Regulation applicable to the general budget of the Union. doi: 10.2761/506169

European Council (2020) Special meeting of the European Council (17, 18, 19, 20 and 21 July 2020) - Conclusions. Brussels, Belgium

Ferrando A, Pal R, Durante E (2019) Financing and obstacles for high growth enterprises: the European case.

Fh-ISI, Wuppertal Institute, Arthur D. Little GmbH (2005) Studie zur Konzeption eines Programms für die Steigerung der Materialeffizienz in mittelständischen Unternehmen. Wiesbaden, Germany.

Flachenecker F, Bleischwitz R, Rentschler JE (2017) Investments in material efficiency: the introduction and application of a comprehensive cost–benefit framework. J Environ Econ Policy 6:107–120. doi: 10.1080/21606544.2016.1211557

Flachenecker F, Gavigan J, Goenaga Beldarrain X, et al. (2020) High Growth Enterprises: demographics, finance and policy measures. doi: 10.2760/34219

Flachenecker F, Kornejew M (2019) The causal impact of material productivity on microeconomic competitiveness and environmental performance in the European Union. Environ Econ Policy Stud 21:87–122. doi: 10.1007/s10018-018-0223-z

Galdeano-Gómez E (2008) Does an endogenous relationship exist between environmental and economic performance? A resource-based view on the horticultural sector. Environ Resour Econ 40:73–89. doi: 10.1007/s10640-007-9141-4

Ghisetti C (2017) Demand-pull and environmental innovations: Estimating the effects of innovative public procurement. Technol Forecast Soc Change 125:178–187. doi: 10.1016/j.techfore.2017.07.020

Ghisetti C (2018) On the Economic Returns of Eco-Innovation: Where Do We Stand? In: Horbach J, Reif C (eds) New Dev. Eco-Innovation Res. Springer International Publishing, Cham, pp 55–79

Ghisetti C, Pontoni F (2015) Investigating policy and R&D effects on environmental innovation: A meta-analysis. Ecol Econ 118:57–66. doi: 10.1016/j.ecolecon.2015.07.009

Ghisetti C, Rennings K (2014) Environmental innovations and profitability: How does it pay to be green? An empirical analysis on the German innovation survey. J Clean Prod 75:106–117. doi: 10.1016/j.jclepro.2014.03.097

Giovannini E, Niestroy I, Nilsson M, et al. (2015) The Role of Science, Technology and Innovation Policies to Foster the Implementation of the Sustainable Development Goals (SDGs) Report of the Expert Group " Follow-up to Rio + 20 , notably the SDGs ". Eur Comm. doi: 10.2777/485757

Hallak I, Harasztosi P (2019) Job Creation in Europe: A firm-level analysis. Eur Comm. doi: 10.2760/590043

Harabi N (2000) Employment Effects of Ecological Innovations: An Empirical Analysis. MPRA

Harris R, Moffat J (2011) R&D, innovation and exporting - SERC DISCUSSION PAPER 73. Glasgow, UK

Hashi I, Stojčić N (2013) The impact of innovation activities on firm performance using a multi-stage model: Evidence from the Community Innovation Survey 4. Res Policy 42:353–366. doi: 10.1016/j.respol.2012.09.011

Hekkert MP, Janssen MJ, Wesseling JH, Negro SO (2020) Mission-oriented innovation systems. Environ Innov Soc Transitions 34:76–79. doi: 10.1016/j.eist.2019.11.011

Hojnik J, Ruzzier M (2016) The driving forces of process eco-innovation and its impact on performance: Insights from Slovenia. J Clean Prod 133:812–825. doi: 10.1016/j.jclepro.2016.06.002

Horbach J (2010) The impact of innovation activities on employment in the environmental sector - Empirical results for germany at the firm level. Jahrb Natl Okon Stat 230:403–419. doi: 10.1515/jbnst-2010-0403

Horbach J (2014) Determinants of Eco-Innovation from a European-wide Perspective - an Analysis based on the Community Innovation Survey (CIS). Seeds Work. Pap. Ser. 07:

Horbach J, Rammer C (2019) Circular economy innovations, growth and employment at the firm level Empirical evidence from Germany. J Ind Ecol 1–11. doi: 10.1111/jiec.12977

Horbach J, Rammer C, Rennings K (2012) Determinants of eco-innovations by type of environmental impact - The role of regulatory push/pull, technology push and market pull. Ecol Econ 78:112–122. doi: 10.1016/j.ecolecon.2012.04.005

Horbach J, Rennings K (2013) Environmental innovation and employment dynamics in different technology fields - An analysis based on the German Community Innovation Survey 2009. J Clean Prod 57:158–165. doi: 10.1016/j.jclepro.2013.05.034

Horváthová E (2010) Does environmental performance affect financial performance? A meta-analysis. Ecol Econ 70:52–59. doi: 10.1016/j.ecolecon.2010.04.004

Imbens GW, Angrist JD (1994) Identification and Estimation of Local Average Treatment Effects. Econometrica 62:467–475.

Jaffe AB, Palmer K (1997) Environmental Regulation and Innovation: A Panel Data Study. Rev Econ Stat 79:610–619.

Jaffe AB, Peterson S, Portney P, Stavins R (1996) Environmental regulation and the competitiveness of U.S. manufactoring: What does the evidence tell us? J Econ Lit 12:658–712.

Jove-Llopis E, Segarra-Blasco A (2018) Eco-Efficiency Actions and Firm Growth in European SMEs. sustainability 10:1–26. doi: 10.3390/su10010281

Kemp R, Arundel A, Rammer C, et al. (2019) Maastricht Manual on Measuring Eco-Innovation for a Green Economy. Maastricht, The Netherlands

Kraay A (2012) Instrumental Variables Regressions with Uncertain Exclusions Restrictions: a Bayesian Approach. J Appl Econom 27:108–128. doi: 10.1002/jae.1148

Kunapatarawong R, Martínez-Ros E (2016) Towards green growth: How does green innovation affect employment? Res Policy 45:1218–1232. doi: 10.1016/j.respol.2016.03.013

Lachenmaier S, Wößmann L (2006) Does innovation cause exports? Evidence from exogenous innovation impulses and obstacles using German micro data. Oxf Econ Pap 58:317–350. doi: 10.1093/oep/gpi043

Lanoie P, Laurent-Lucchetti J, Johnstone N, Ambec S (2011) Environmental policy, innovation and performance: New insights on the porter hypothesis. J Econ Manag Strateg 20:803–842. doi: 10.1111/j.1530-9134.2011.00301.x

van Leeuwen G, Mohnen P (2017) Revisiting the Porter hypothesis: an empirical analysis of Green innovation for the Netherlands. Econ Innov New Technol 26:63–77. doi: 10.1080/10438599.2016.1202521

Leitner A, Walter W, France C (2010) The impact of regulation and policy on radical eco-innovation: The need for a new understanding. Manag Res Rev 33:1022–1041. doi: 10.1108/01409171011085877

Leoncini R, Marzucchi A, Montresor S, et al. (2019) 'Better late than never': the interplay between green technology and age for firm growth. Small Bus Econ 52:891–904. doi: 10.1007/s11187-017-9939-6

Li Y (2014) Environmental innovation practices and performance: Moderating effect of resource commitment. J Clean Prod 66:450–458. doi: 10.1016/j.jclepro.2013.11.044

Llorente-González LJ, Vence X (2020) How labour-intensive is the circular economy? A policy-orientated structural analysis of the repair, reuse and recycling activities in the European Union. Resour Conserv Recycl 162:105033. doi: 10.1016/j.resconrec.2020.105033

Lööf H, Johansson B (2009) Innovation, R&D and Productivity: Assessing alternative Specifications of CDM-Models. CESIS 1–34.

Malerba F (1992) Learning by Firms and Incremental Technical Change. Econ J 102:845–859.

Marin G (2014) Do eco-innovations harm productivity growth through crowding out? Results of an extended CDM model for Italy. Res Policy 43:301–317. doi: 10.1016/j.respol.2013.10.015

Marin G, Lotti F (2017) Productivity effects of eco-innovations using data on eco-patents. Ind Corp Chang 26:125–148. doi: 10.1093/icc/dtw014

Mazzanti M, Cainelli G, Zoboli R (2007) Environmentally-Oriented Innovative Strategies and Firm Performances in Services - Micro-Evidence from Italy. Fond Eni Enrico Mattei. doi: 10.2139/ssrn.1076322

Mazzucato M (2016) From market fixing to market-creating: a new framework for innovation policy. Ind Innov 23:140–156. doi: 10.1080/13662716.2016.1146124

Mazzucato M, Semieniuk G (2017) Public financing of innovation: new questions. Oxford Rev Econ Policy 33:24–48. doi: 10.1093/oxrep/grw036

OECD/Eurostat (2018) Oslo Manual 2018. Handb Innov Indic Meas. doi: 10.1787/9789264304604-en

Olmos L, Ruester S, Liong SJ (2012) On the selection of financing instruments to push the development of new technologies: Application to clean energy technologies. Energy Policy 43:252–266. doi: 10.1016/j.enpol.2012.01.001

Orlitzky M, Schmidt FL, Rynes SL (2003) Corporate social and financial performance: A meta-analysis. Organ Stud 24:403–441. doi: 10.1177/0170840603024003910

Panizza U, Presbitero AF (2014) Public debt and economic growth: Is there a causal effect? J Macroecon 41:21–41. doi: 10.1016/j.jmacro.2014.03.009

Pfeiffer F, Rennings K (2001) Employment impacts of cleaner production - Evidence from a German study using case studies and surveys. Bus Strateg Environ 10:161–175. doi: 10.1002/bse.285

Porter M (1990) The Competitive Advantage of Nations. Harv Bus Rev March/Apri:1–18.

Porter M, Linde C Van Der (1995) Toward a new conception of the environment-competitiveness relationship. J Econ Perspect 9:97–118.

Reed WR (2015) On the Practice of Lagging Variables to Avoid Simultaneity. Oxf Bull Econ Stat 77:897–905. doi: 10.1111/obes.12088

Rennings K (2000) Redefining innovation — eco-innovation research and the contribution from ecological economics. Ecol Econ 32:319–332. doi: 10.1016/S0921-8009(99)00112-3

Rennings K, Rammer C (2011) The impact of regulation-driven environmental innovation on innovation success and firm performance. Ind Innov 18:255–283. doi: 10.1080/13662716.2011.561027

Rennings K, Ziegler A, Zwick T (2004) The effect of environmental innovations on employment changes: an econometric analysis. Bus Strateg Environ 13:374–387.

Rennings K, Zwick T (2001) The Employment Impact of Cleaner Production on the Firm Level Empirical Evidence from a Survey in Five European Countries. ZEW Discuss Pap. doi: 10.2139/ssrn.336522

Rexhäuser S, Rammer C (2014) Environmental Innovations and Firm Profitability: Unmasking the Porter Hypothesis. Environ Resour Econ 57:145–167. doi: 10.1007/s10640-013-9671-x

Del Rio P, Penasco C, Romero-Jordan D (2016) What drives eco-innovators? A critical review of the empirical literature based on econometric methods. J Clean Prod 112:2158–2170. doi: 10.1016/j.jclepro.2015.09.009

Rubashkina Y, Galeotti M, Verdolini E (2015) Environmental regulation and competitiveness: Empirical evidence on the Porter Hypothesis from European manufacturing sectors. Energy Policy 83:288–300. doi: 10.1016/j.enpol.2015.02.014

Sakamoto T, Managi S (2017) New evidence of environmental efficiency on the export performance. Appl Energy 185:615–626. doi: 10.1016/j.apenergy.2016.10.126

Soltmann C, Stucki T, Woerter M (2014) The Impact of Environmentally Friendly Innovations on Value Added. Environ Resour Econ 62:457–479. doi: 10.1007/s10640-014-9824-6

Szücs F (2020) Do research subsidies crowd out private R&D of large firms? Evidence from European Framework Programmes. Res Policy 49:103923. doi: 10.1016/j.respol.2020.103923

Triguero A, Moreno-Mondéjar L, Davia MA (2013) Drivers of different types of eco-innovation in European SMEs. Ecol Econ 92:25–33. doi: 10.1016/j.ecolecon.2013.04.009

Vértesy D, Sorbo D, Damioli M (2017) High-growth, innovative enterprises in Europe Counting them across countries and sectors. Eur Comm. doi: 10.2760/328958

Veugelers R (2012) Which policy instruments to induce clean innovating? Res Policy 41:1770–1778. doi: 10.1016/j.respol.2012.06.012

Videras J, Alberini A (2000) The appeal of voluntary environmental programs: Which firms participate and why? Contemp Econ Policy 18:449–461. doi: 10.1111/j.1465-7287.2000.tb00041.x

Wagner M, Hong SH (2016) Cointegrating Polynomial Regressions: Fully Modified Ols Estimation and Inference. Econom Theory 32:1289–1315. doi: 10.1017/S0266466615000213

Annex

Table 10: Robustness checks for employment growth.

	(1)	(2)	(3)	(4)
Environmental innovation	0.089**	0.088**	0.087**	0.094**
	(0.036)	(0.036)	(0.037)	(0.040)
Size in 2012 (turnover in billion)		-0.004***	-0.004***	-0.005
		(0.002)	(0.002)	(0.005)
Main market: EU			0.008	-0.009
			(0.031)	(0.033)
Main market: Local			-0.012	-0.033
			(0.030)	(0.032)
Main market: National			-0.022	-0.039
			(0.030)	(0.032)
Main market: Rest of world			-0.005	-0.023
			(0.034)	(0.036)
University degree of employees: 1-4%				-0.020
				(0.013)
University degree of employees: 5-9%				-0.022*
				(0.013)
University degree of employees: 10-24%				-0.024*
				(0.014)
University degree of employees: 25-49%				-0.039**
				(0.015)
University degree of employees: 50-74%				-0.028*
				(0.016)
University degree of employees: 75-100%				-0.016
				(0.016)
Country FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
R^2	0.017	0.017	0.018	0.013
N	61,683	61,589	61,589	53,224

Dependent: Change in log employment, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Table 11: Robustness checks for turnover growth.

	(1)	(2)	(3)	(4)
Environmental innovation	0.116**	0.116**	0.115**	0.138***
	(0.047)	(0.047)	(0.047)	(0.053)
Size in 2012 (turnover in billion)		-0.009***	-0.009***	-0.012*
		(0.003)	(0.003)	(0.007)
Main market: EU			-0.003	0.040
			(0.065)	(0.038)
Main market: Local			-0.047	-0.004
			(0.063)	(0.035)
Main market: National			-0.055	-0.011
			(0.064)	(0.034)
Main market: Rest of world			-0.051	-0.005
			(0.068)	(0.045)
University degree of employees: 1-4%				-0.006
				(0.014)
University degree of employees: 5-9%				-0.028*
				(0.016)
University degree of employees: 10-24%				-0.027
				(0.020)
University degree of employees: 25-49%				-0.015
				(0.020)
University degree of employees: 50-74%				0.009
				(0.020)
University degree of employees: 75-100%				-0.002
				(0.026)
Country FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
R^2	0.015	0.015	0.017	0.007
N	61,592	61,592	61,592	53,226

Dependent: Change in log turnover, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Table 12: Robustness for market share growth.

	(1)	(2)	(3)	(4)
Environmental innovation	0.117**	0.117**	0.117**	0.136***
	(0.047)	(0.047)	(0.047)	(0.052)
Size in 2012 (turnover in billion)		-0.005**	-0.005**	-0.010*
		(0.002)	(0.002)	(0.006)
Main market: EU			-0.009	0.038
			(0.065)	(0.039)
Main market: Local			-0.048	-0.003
			(0.063)	(0.035)
Main market: National			-0.055	-0.009
			(0.064)	(0.035)
Main market: Rest of world			-0.049	-0.002
			(0.068)	(0.045)
University degree of employees: 1-4%				-0.009
				(0.015)
University degree of employees: 5-9%				-0.030*
				(0.016)
University degree of employees: 10-24%				-0.028
				(0.020)
University degree of employees: 25-49%				-0.014
				(0.020)
University degree of employees: 50-74%				0.009
				(0.020)
University degree of employees: 75-100%				-0.003
				(0.026)
Country FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
R^2	0.031	0.031	0.033	0.032
N	61,518	61,518	61,518	53,200

Dependent: Change in log market share, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Table 13: Additional robustness check for employment growth.

	(1)	(2)	(3)	(4)	(5)	(6)
Excluding	Trademark	Patents	Exporter	M&A	Network	Gov. contract
Environmental innovation	0.089**	0.096**	0.089**	0.089**	0.103**	0.108**
	(0.042)	(0.040)	(0.036)	(0.040)	(0.052)	(0.045)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.017	0.016	0.017	0.017	0.014	0.013
N	51,538	53606	61683	58076	54804	52342

Dependent: Change in log employment, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Table 14: Additional robustness check for turnover growth.

	(1)	(2)	(3)	(4)	(5)	(6)
	Trademark	Patents	Exporter	Merger	Network	Gov. contract
Environmental innovation	0.070	0.108**	0.116**	0.132***	0.111*	0.142**
	(0.043)	(0.048)	(0.047)	(0.050)	(0.062)	(0.057)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.020	0.016	0.015	0.013	0.016	0.010
N	51,457	53,524	61,592	57,991	54,715	52,258

Dependent: Change in log turnover, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Table 15: Additional robustness check for market share growth.

	(1) Trademark	(2) Patents	(3) Exporter	(4) Merger	(5) Network	(6) Gov. contract
Environmental innovation	0.071*	0.107**	0.117**	0.135***	0.116*	0.141**
	(0.043)	(0.049)	(0.047)	(0.050)	(0.063)	(0.057)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.041	0.037	0.031	0.029	0.033	0.029
N	51,386	53,450	61,518	57,922	54,656	52,198

Dependent: Change in log market share, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Table 16: Sub-samples for employment growth.

	(1) SMEs	(2) Manufacturing (C)
Environmental innovation	0.102**	0.071**
	(0.041)	(0.031)
Country FE	Yes	Yes
Sector FE	Yes	Yes
R^2	0.016	0.016
N	51,625	31,316

Dependent: Change in log employment, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Table 17: Sub-samples for turnover growth.

	(1) SMEs	(2) Manufacturing (C)
Environmental innovation	0.132**	0.144***
	(0.053)	(0.055)
Country FE	Yes	Yes
Sector FE	Yes	Yes
R^2	0.032	0.007
N	51,473	31,286

Dependent: Change in log market share, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Table 18: Sub-samples for market share growth.

	(1) SMEs	(2) Manufacturing (C)
Environmental innovation	0.131**	0.144***
	(0.053)	(0.055)
Country FE	Yes	Yes
Sector FE	Yes	Yes
R^2	0.012	0.001
N	51539	31288

Dependent: Change in log turnover, 2012-14. 2SLS estimates. Robust standard errors in parenthesis. *** p<0.01, ** p<0.05, * p<0.10

Figure 1: Overview of EU funds supporting environmental innovations. Sources: Horizon Europe 2020 work programme; Life multiannual work programme; Interim evaluation of COSME program; European Commission, ESIF, finances; EIB, EFSI Investment by sector.