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Does green corporate investment really crowd out other business investment?

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Does green corporate investment really crowd out other business investment?

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Abstract

Empirical studies on the link between green investment and other business investment at the firm level either focus on innovation specific types of investment or fail to consider the simultaneity of investment decisions. The analysis to be presented here offers a broad focus on different types of environmental protection investment and explicitly considers simultaneity issues, using newly created panel data for German manufacturing firms. Germany is an ideal case for testing the crowding-out hypothesis, due to its high level of environmental regulation and a significant presence of command-and-control style measures, which are especially under debate as a source of crowding-out. The estimation of a behavioral investment model supports a crowding-out of other business investment through environmental protection investment in general as well as its subcategories of add-on measures and investments in renewable energy. However, only the latter subcategory causes a crowding-out at the industry level.

JEL Classification: O32, O33, Q42, Q55

Keywords: green investment; business investment; renewable energy; crowding-out; manufacturing; Germany

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1 Introduction

The relation between environmental protection and competitiveness has long been the subject of academic research and public debate. Sceptics worry about mutually exclusive and countervailing effects, meaning that environmental protection weakens competition and vice versa. An alternative hypothesis is that environmental friendliness and efficiency overlap and are strongly related to innovation and technological progress. The concept of eco-efficiency essentially builds upon this alignment of economic and ecological performance by "creating more value with fewer environmental resources resulting in less environmental impact" (Guenster and Bauer, 2011, 680f.). The competition–environment nexus receives particular attention when it comes to mandatory environmental regulation. According to the so-called Porter hypothesis, it can be assumed that "well-designed environmental regulations might lead to improved competitiveness" (Porter and van der Linde, 1995, 115).

Nevertheless, empirical studies at the firm level do find a crowding-out effect of green investments on other productive investment, which can be regarded as a potential negative effect of environmental protection measures.[1] Gray and Shadbegian (1998) find that pollution abatement investment in US paper mill plants (1972–1990) tends to be scheduled together with other investment, but that plants with a constantly high level of abatement investment spend less on productive capital. Klassen (2000) presents regression estimates for two Canadian manufacturing industries and concludes instead that the share of investment in green technologies increases with rising overall business investments.[2] Other studies investigate the specific nexus

[1] Macroeconomic evidence for a crowding-out by pollution abatement measures in the US is presented by Rose (1983).

[2] Three more studies are to be mentioned in this context, although all of them offer solely descriptive evidence: Roediger-Schluga (2003) finds that environmental regulation does not unequivocally affect the competitiveness of Austrian manufacturers, and Salomaa (2014) rather finds a complementary relation between environmental expenditures and other investment for Finland. Another study by Heinbach and Krumm (2009) is restricted to the German federal state of *Baden-Württemberg* (1997–2005) and concludes that there is no crowding-out of other investment activities by environmental protection spending.

between strictly innovation-related green investment and other business investment. For example, Popp and Newell (2012) find alternative energy R&D crowding out other R&D efforts in the US (1971–2002), and Hottenrott and Rexäuser (2013) find that regulation-induced green technology crowds out other R&D investment in Germany (2006–2008). Although the R&D dimension is of great interest in the context of green investment, as it reflects one major channel of how green investment potentially improves efficiency and competitiveness, it does not cover the role of other types of green investment, such as pollution abatement measures, which may have a greater potential for hampering competitiveness.

One major caveat of studies that take a broader view of direct and indirect pollution abatement measures is that they fail to consider the potential simultaneity of that green investment with other business investment variables, and may therefore suffer an endogeneity bias. This is important because both investment decisions are typically the result of simultaneous and interrelated management decisions, which needs to be taken into account in any empirical estimation strategy. The present analysis tries to remedy this lack by explicitly considering the simultaneity of investment decisions. For this purpose, an instrumental variables approach is applied to a newly created representative dataset of German manufacturing firms. It is somewhat suprising that Germany is an underresearched country in this respect, because the German economy is an ideal case for testing this hypothesis, mainly for two reasons: First, Germany is a relatively highly regulated economy in terms of environmental protection and is characterized by a "rigorous implementation of environmental policies" (OECD, 2012). Klassen and Angel (1998) even described German environmental legislation as "the most stringent in the world." Second, a significant part of German regulation takes the form of command-and-control style measures (Frondel et al., 2007), which are especially under debate as a source of crowding-out. Germany therefore is an ideal case to test the hypothesis of a crowding-out by green corporate investment.

With the data used, it is possible to take into account the heterogeneity of environmental protection investment (EPI) by distinguishing between integrated measures and add-on/end-of-pipe measures. End-of-pipe measures are normally equipment which is physically separate from the other production facilities.[3] Integrated measures make the process of production generally more efficient in terms of a lower level of consumption and pollution and are therefore regarded as investment in cleaner production. Frondel et al. (2007) show that, among the seven OECD countries surveyed, Germany has the highest share of add-on measures due to their heavy support by Germany's command and control policy in the past. Both types of EPI are not necessarily complementary, but can as well be substitutes. EPI in renewable energy together with EPI in energy efficiency are considered separately, which is of special interest against the background of the German government's decision in favor of a nuclear phase-out by 2022.

This paper is structured as follows: Section 2 introduces the model and econometric strategy, the dataset and variables are described in Section 3, and Section 4 presents the empirical results. Section 5 concludes.

2 Model and econometric strategy

In the basic behavioral investment model used in the following analysis, investment decisions I are a function of sales Y, profits R, and the cost of capital C (in alignment with Onoran et al., 2013). While value added and profits are assumed to have a positive relation with investment, the cost of capital is assumed to have a negative relation with investment. Since the focus of this analysis is on the effect of environmental protection investment (EPI) on other investment (OI), both types have to be kept separate in the model:

$$OI = f(Y, R, C, EPI)$$

To test the hypothesis of a crowding-out effect of EPI, a negative relation between EPI and OI is expected. The reasoning behind this hypothesis is that firms face a particular investment budget and may increase the share allocated to pollution abatement, firstly, because environmental regulation forces firms to comply with

[3] End-of-pipe technologies are, for example, facilities for waste incineration or exhaust air filtration, sewage treatment plants, and noise barriers (Statistisches Bundesamt, 2011).

regulations, and secondly, because firms have an incentive to carry out voluntary EPI to retain a “clean” image in the context of reputational risk management (Lim and Tsutsui, 2012).[4] Based on the basic investment model, the estimation equation has the form

$$\begin{aligned}\Delta log\left(OI_{it}\right) &= \beta_1 \Delta log\left(EPI_{it}\right) + \sum_{j=1}^{2} \beta_{2j} \Delta\left(Y_{it-j}\right) \\ &\quad + \sum_{j=1}^{2} \beta_{3j} \Delta R_{it-j} + \sum_{j=1}^{2} \beta_{4j} \Delta C_{it-j} + \Delta u_{it}.\end{aligned}$$

Although investment decisions are based on expectations, these expectations heavily rely on past experiences. Due to this fact, and also because the process of decision making as well as the implementation of investment decisions take time, the determinants of investment are generally implemented with a lag structure (see, for example, Jorgenson and Stephenson, 1967, on this issue). Therefore, the investment decision in t (year index) is explained by value added (Y), profits (R), and capital costs (C) from the previous years $t-1$ and $t-2$ with the lag index j. All variables enter the model as first differences (FD) to mitigate potential problems of unobserved heterogeneity.[5] The remaining terms are the individual firm subscript i and the ideosyncratic error term u. The coefficient of main interest is β_1, which gives the percentage change of other investments for a one percent change of EPI. It is thus possible to figure out whether an increase in EPI goes along with a decrease or complementary increase of other investments, and in what proportion.

In order to consider potential heterogeneous effects among different types of EPI, EPI will be replaced by particular components: the subcategories of add-on EPI and EPI in renewable energy. This is motivated by the finding of Frondel et

[4] A study by AmCham and McKinsey (2011) finds that 70% of the companies surveyed have a sustainability strategy and sustainability targets, which they monitor regularly, going beyond legal compliance.

[5] To address potential problems of serial correlation, investments were also estimated in an autoregressive model including the lagged other investment OI ($j = 1$) as an exogenous variable in the estimation equation. However, since this does not change the results and leaves only two observation periods for the estimation due to the first differences and lag structure, these estimates are not reported separately.

al. (2007) that German command-and-control regulation may have forced firms to disproportionately invest in add-on measures (cf. Section 1). Increasing add-on EPI has been eventually compensated for through a reduction of integrated EPI and hence a crowding-out of OI through only add-on EPI may be masked. The motivation of separately looking at EPI in renewable energy results from its actual policy relevance and the fact that EPI in renewables accounts for more than 20% of all EPI and experienced the sharpest absolute increase of all EPI components during the time period considered in this analysis (five percentage points from 2007 to 2010; cf. Table A.1).

The first step is to perform estimations with Ordinary Least Squares (OLS) without considering the potential endogeneity of EPI. The second step is to consider endogeneity, by using instrumental variables (IV) in a Two Stage Least Squares (2SLS) estimation. To be valid instruments, the instrumental variables must fulfil two criteria: being highly (partially) correlated with the endogenous variable and being independent of the error term (Wooldrige, 2002). The literature does not offer approved instruments for EPI, but there is a set of potentially relevant and valid firm-level instruments in the data: i) An individual firm's pollution level must be regarded as a strong incentive for pollution abatement spending, for two reasons: first, firms that pollute more need to invest more in order to comply with environmental regulations, and, second, such firms need to invest more to retain or regain a "green" image. In contrast, the link with general business investment does not appear to be straightforward. Although pollution information is not available, it may be proxied by energy costs if it is assumed that bigger polluters have a higher energy consumption on average. ii) R&D efforts may also be likely to go hand in hand with pollution abatement as both may at least partly be driven by incentives to improve the resource efficiency of the production process. However, the (partial) link with general business investment remains unclear and it may be that R&D investment does not fulfil the exogeneity assumption. iii) Subsidies are a potential instrument as it seems plausible that green investment is more likely to be subsidized than general business investment (perhaps with the exception of R&D investment). iv) Further potential instruments are a firm's share of green investment as well as the per capita investment in integrated environmental protection measures. These potential instruments are to be checked with respect to their relevance for the particular dependent variable in the reduced form first stage regressions and only relevant instruments will be considered for the final estimates (cf. Table 4).

3 Data and variables

The dataset used involves four sources that were merged at the enterprise level and restricted to manufacturing firms for the years 2005–2010. The data is of particularly high quality because firms are legally required to respond to these surveys.

The first source is the Cost Structure Survey, which covers a stratified sample of up to 18,000 enterprises with at least 20 employees from the manufacturing as well as the mining and quarrying sectors (for further information, see Fritsch et al., 2004). The information about value added, rentability, capital costs, energy expenses, R&D investment, and subsidies was taken from this database for the years 2005–2010.

Information about overall business gross investment in tangibles was taken from the general investment survey of the official German business statistics (Statistisches Bundesamt, 2013) and the firm size was taken from the monthly and annual reports of establishments from the manufacturing, mining and quarrying sectors (for more information, see Konold, 2007).

The fourth source is the survey of environmental protection investment which is likewise conducted by the German Federal Statistical Office and the statistical offices of the German federal states, and is available for the years 2007–2010. This survey covers all firms which reported environmental protection investment (EPI) in the general investment survey (Statistisches Bundesamt, 2012) and provides information on seven areas of environmental protection: waste management, water protection, noise abatement, prevention of air pollution, nature protection and landscape preservation, soil rehabilitation, and climate protection.[6]

EPI in general includes investment that aims exclusively or predominantly at

[6] The area of climate protection is exempted from a differentiation into add-on and integrated EPI.

protecting the environment from a harmful impact of production. This includes *production related measures* such as the purchase of fixed assets to reduce pollution during the production process, as well as *product related measures* for the production of goods whose application or consumption reduces pollution. Within the category of production related EPI, end-of-pipe or add-on measures can be differentiated from integrated measures. End-of-pipe measures are normally equipment which is physically separate from the other production facilities and can therefore be identified relatively easily. Add-on technologies are, for example, facilities for waste incineration or exhaust air filtration, sewage treatment plants, and noise barriers (Statistisches Bundesamt, 2011). Integrated measures are more difficult to identify since they do not necessarily have to be technological elements.

Integrated measures make the process of production generally more efficient in terms of a lower level of pollution. They can therefore be technological elements (heat exchanger, absorbing filter, recirculation of cooling water), or it may be impossible to distinguish a specific component (moving to the use of environmentally friendly raw and auxiliary materials, changes in the forming process, changes in the structure of the combustion chambers). In the case of integrated EPI, firms are only obliged to report the environmentally relevant part of the costs, i.e., the difference between the actual investment and a comparable investment without this environmentally relevant factor (Statistisches Bundesamt, 2011).

The final analytical sample was restricted to firms that reported in all years in the respective surveys and, thus, does not consider firms that were established or exited the market during this period, nor firms that were subject to sample changes. Therefore the sample is biased towards larger, older, and more successful firms. The final sample covers 4629 enterprise observations in each year. The exact definitions of the variables are given in Table 1 and descriptive statistics are discussed in the following section.

[Table 1 about here]

4 Descriptive results

The descriptive statistics of the investment variables are reported in Table 2 and illustrated in Figure 1.[7] More than 25% of the firms in the sample invested in environmental protection in all years, in contrast to around 95% of all firms that reported general business investment. EPI per capita and other investment per capita both declined slightly over the sampling period with a drop during the crisis year 2009. The share of EPI in overall business investment increased gradually from 3% in 2007 to 4% in 2010. This could be initial evidence for the crowding-out effect of EPI, although it becomes obvious here that the scale of such an effect, if present, is rather low in absolute terms.

[Table 2 about here]

Within the category of EPI, the share of integrated measures declined from 24% in 2007 to 21% in 2010, and expenses for renewable energy EPI increased from 85 EUR per capita in 2007 to 102 EUR per capita in 2010. Only about 10% of the sample firms invested in clean production (integrated EPI) and renewable energy at all, demonstrating that these types of investment are by no means widespread among manufacturing firms (remember that the sample is biased towards relatively large firms). The relative weight of the particular EPI components is illustrated in Figure 2 and shows renewable energy EPI to be the category with the second sharpest relative increase (right after other climate protection) and the sharpest absolute increase (Table A.1).

[Figure 1 about here]

[Figure 2 about here]

[7] The descriptive statistics of the control variables can be found in Table A.2.

5 The crowding-out effect of green investment

Table 3 presents first difference OLS estimates of the behavioral investment model introduced in Section 2. Estimates are presented for three specifications: (1) considers the overall EPI as the dependent variable, whereas (2) and (3) consider add-on EPI and renewable energy EPI instead.

The value added coefficients have positive signs as expected, but only in the first lag period and they do not turn out to be statistically significant. Surprisingly, the coefficients of profitability also have negative signs in the period $j = 2$ and are all statistically insignificant. The same picture of statistical significance emerges from the coefficients of external capital costs.

However, the variables of main interest, the EPI variables, appear to have statistically highly significant coefficients at a 1%-level. All EPI variables have negative signs in all specifications, meaning that an increase in a firm's green investment is associated with a decrease in general investment, on average and ceteris paribus. This supports the hypothesis of a crowding-out of general business investment by EPI and, what is more, the link appears to be relatively strong: a one percent increase of EPI per capita comes along with a decline of other investment by 9%. The same applies to only add-on EPI and renewable energy EPI, where a one percent increase goes along with a 7% and 6% reduction in general investment.

[Table 3 about here]

In order to take into account the likely endogeneity of EPI, a set of potentially valid instruments (cf. Section 2) was used for identification. The results of IV estimates and associated test statistics are presented in Table 4. To begin with the suitability of the instruments, the particular combinations of instruments for each type of EPI appear to be relevant in terms of a correlation with the endogenous variables at high statistical significance levels. This is demonstrated by the reported p-values of F-tests that do not lead to a rejection of the null hypothesis that instruments are jointly relevant (for the importance of a large F-statistic, see Staiger and Stock, 1997). The overidentification restriction is tested via the Hansen J-statistic. Here, the null hypothesis, stating that the instruments are jointly valid and uncorrelated with the error, cannot be rejected at conventional significance levels, suggesting that the validity assumption is satisfied. Since the estimated model is overidentified, it is possible to test for exogeneity of the respective regressors. All tests suggest a rejection of the exogeneity assumption, pointing to a potential presence of endogeneity issues, although neither the sign nor the statistical significance of the coefficients of main interest differ from the non-IV estimates. The coefficients of the EPI variables still have negative signs and remain highly statistically significant. This result supports a crowding-out effect by green investments even when the simultaneity of investment decisions is taken into account.

[Table 4 about here]

Turning to the magnitude of the crowding-out effect, the non-instrumented first difference OLS estimates produce the intuitively more plausible results of an effect of between 6%–9%. The instrumented estimates produce very large crowding-out effects of even more than 100%. Although these numbers suggest a massive crowding-out of other business investment, the average per capita EPI across all firms in the sample actually decreased over the sample period (2007–2010) by 6% (cf. Table 2). An even sharper decrease of 23% can be observed for add-on EPI. Only average EPI in renewable energy increased by 21%. This leads to the conclusion that there is a crowding-out at the firm level, which does not translate into a crowding-out at the aggregated industry level. An exception is EPI in renewable energy and energy efficiency, which does crowd out other business investment also at the industry level. This makes sense, as firms located in Germany face strong incentives to become more energy efficient and less reliant on conventional energy, due to the nuclear phase-out and the political goal of carbon emission reduction.

6 Concluding remarks

Empirical studies on the link between green investment and other business investment at the firm level either focus on innovation specific types of investment or fail to consider the simultaneity of investment decisions. Using a newly created panel for German manufacturing firms, this analysis offers a broad focus on different types of environmental protection investment by explicitly considering simultaneity issues via an instrumental variable approach. The analysis is furthermore the first microeconometric study for Germany, which is of special interest in this context and is an ideal case for testing the crowding-out hypothesis. This is due to Germany's especially high level of environmental regulation and the fact that a significant part of German environmental regulation is takes the form of command-and-control style measures, which are especially under debate as a source of crowding-out.

The data allows a separate analysis of particular components of environmental protection investment, namely the role of add-on investment and investment in renewable energy and energy efficiency. The latter is of special interest against the background of the German government's decision in favor of a nuclear phase-out by 2022.

The estimation of a behavioral investment model reveals a negative relation between an increase in the annual volume of green investment and the volume of other business investment. This result applies to overall environmental protection investment as well as its subcategories of only add-on measures and renewable energy investment. This negative relation supports the hypothesis of a crowding-out of other business investment through green investment. It also turns out that simultaneity issues may play a significant role in this context and potentially bias the results if not taken into account.

Although the estimated elasticities suggest an enormous crowding-out of other business investment through green investment, the average investment in overall environmental protection as well as add-on measures actually decreased over the sample period by 6% and 23% at the aggregated industry level. This leads to the conclusion that there is a crowding-out at the firm level, which does not translate into a crowding-out at the aggregated industry level. An exception is environmental protection investment in renewable energy and energy efficiency, which increased by 21% during the sample period, and hence does crowd out other business investment also at the industry level. This appears plausible, since firms located in Germany face strong incentives to become more energy efficient and less reliable on conventional energy. However, the extent of the crowding-out may partly be driven by the specific time period observed, in which firms also reduced other investment in response to the global economic crisis. Another caveat is that the extent to which the re-labelling practices of firms, in which formerly non-green investment becomes labelled as environmental protection investment for image reasons or to enjoy subsidies, remains unclear.

However, it was demonstrated that green investment and other business investment at the firm level are not ancillary components but rather show a substitute relationship in which green-labelled investment replaces other business investment. This does not allow conclusions about the general competitiveness of firms at all but identifies a potentially negative channel of environmental regulation that needs to be further investigated and should be considered by policy makers. It is also possible that the findings indicate an increasing convergence between the two goals of resource efficiency and competitiveness. This may be motivated by environmental regulation, such as the introduction of market-based instruments to regulate the consumption of environmental goods (emissions trading) and expected increasing prices for conventional energy in the future.

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Figure 1: Changes in mean per capita investment (in %)

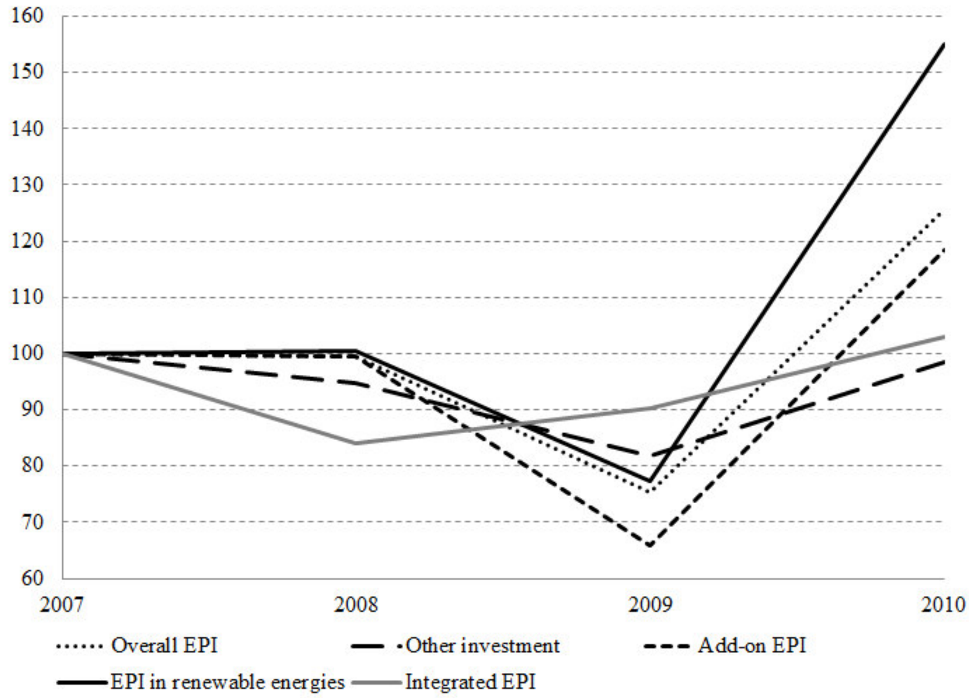

Figure 2: Changes in EPI components in %

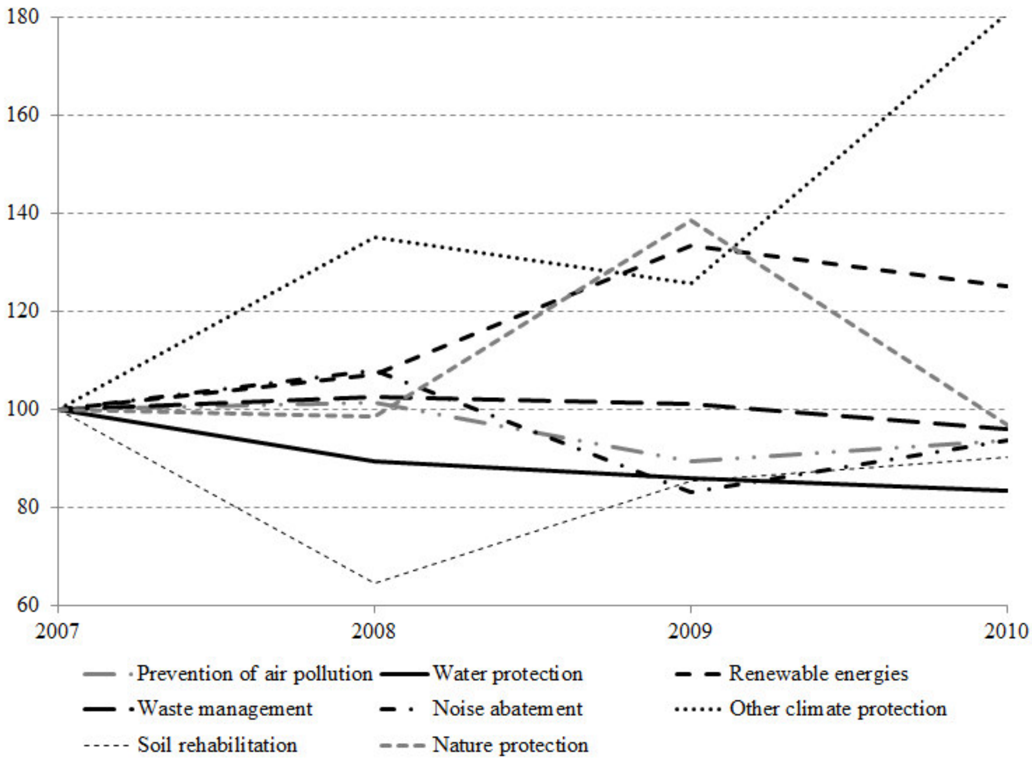

Table 1: Definition of variables

Variable	definition	source
Overall EPI	annual investments which aim exclusively or predominantly at protecting the environment from a harmful impact of production (in EUR); includes climate protection	SEPI
Add-on EPI	annual investment in equipment which is physically separate from the other production facilities (in EUR); excludes climate protection	SEPI
Integrated EPI	annual investments that make the process of production generally more efficient in terms of a lower level of pollution and do not have to be technological elements (in EUR); excludes climate protection	SEPI
EPI in renewable energies	annual investments in the use of renewable energies or energy efficiency (in EUR)	SEPI
Other investment	annual gross business investment in tangibles (in EUR)	I
Profitability	annual return on sales as gross surplus over total sales (in %)	CSS
Value added	annual total sales minus expenses (incl. taxes) plus stocks, subsidies, and self-produced equipment (in EUR)	CSS
Costs of External Finance	annual interest payments for external finance over total sales (in %)	CSS
Firm size	mean of annual employees	MR

Notes: Datasources are abbreviated as follows: SEPI = survey of environmental protection investments; I = general investment survey; CSS = cost structure survey; MR = monthly and annual reports of establishments from the manufacturing, mining and quarrying sectors.

Table 2: Descriptive statistics of investment variables

Continuous variables[a]

Variable	*2007*	*2008*	*2009*	*2010*
Overall EPI per capita	358.06	356.43	268.56	337.27
	(3821.97)	(3356.48)	(1893.10)	(2163.19)
Add-on EPI per capita	168.43	167.68	110.24	130.47
	(3082.05)	(2420.38)	(1031.61)	(965.07)
Integrated EPI per capita	94.31	79.21	71.41	73.49
	(1148.58)	(663.71)	(675.59)	(774.85)
EPI in Renewable Energies per capita	84.93	85.37	66.09	102.42
	(1194.08)	(77.67)	(477.84)	(1348.23)
Other Investment per capita	9341.59	8841.63	7238.78	7126.00
	(25724.93)	(19171.15)	(22163.47)	(18733.30)
Overall EPI (in % of all Investments)	3.15	3.46	3.65	4.11
	(12.27)	(13.22)	(13.61)	(14.38)
Integrated EPI (in % of all EPI)	23.67	23.41	21.54	20.95
	(36.41)	(36.63)	(35.36)	(34.77)
n	4629	4629	4629	4629

Binary variables[b]

Variable	*2007*	*2008*	*2009*	*2010*
Overall EPI	27.03	27.72	25.58	28.19
	(1251)	(1283)	(1184)	(1305)
Add-on EPI	19.79	19.62	17.95	19.90
	(916)	(908)	(831)	(921)
Integrated EPI	11.82	11.43	9.92	10.82
	(547)	(529)	(459)	(501)
EPI in Renewable Energies	10.00	10.95	11.49	12.21
	(463)	(507)	(532)	(565)
Other Investment	95.36	95.05	94.23	94.79
	(4414)	(4400)	(4362)	(4388)
n	4629	4629	4629	4629

Note: [a]Reported are mean values and standard deviations in parentheses; [b]Reported are the percentages of firms investing in the respective category and the number of firms in parentheses.

Table 3: First difference OLS estimates of log(other $investment_t$)

Variable	*(1)*	*(2)*	*(3)*
log(Overall EPI per $capita_t$)	-0.09***	-	-
	(8.16)		
log(Add-on EPI per $capita_t$)	-	-0.07***	-
		(5.92)	
log(EPI in renewable energie per $capita_t$)	-	-	-0.06***
			(4.92)
Value $added_{t-1}$	2.46e-10	2.24e-10	2.07e-10
	(1.10)	(1.01)	(0.95)
Value $added_{t-2}$	-1.60e-10	-1.11e-10	-1.31e-10
	(0.64)	(0.45)	(0.52)
$Profitability_{t-1}$	0.001	0.001	0.001
	(0.21)	(0.19)	(0.14)
$Profitability_{t-2}$	-0.01	-0.01	-0.01
	(0.82)	(0.95)	(0.98)
Costs of external $finance_{t-1}$	0.02	0.02	0.02
	(0.38)	(0.48)	(0.40)
Costs of external $finance_{t-2}$	0.01	0.01	0.004
	(0.28)	(0.24)	(0.09)
year dummies	yes	yes	yes
R^2	0.0186	0.0112	0.0091
n	4629	4629	4629

Note: Reported are estimated coefficients with |t-values| in parentheses; Significance at the 10% (*), 5% (**) and 1% (***) level; Standard errors are adjusted for heteroskedasticity and firm clusters; logarithms with zero values transformed to 0.001.

Table 4: Overidentified first difference IV estimates of log(other investment$_t$)

Variable	*(1)*	*(2)*	*(3)*
log(Overall EPI per capita$_t$)	-0.82***	-	-
	(22.44)		
log(Add-on EPI per capita$_t$)	-	-1.45***	-
		(15.53)	
log(EPI in renewable energy per capita$_t$)	-	-	-1.71***
			(13.78)
Value added$_{t-1}$	7.64e-10*	1.01e-09	8.06e-10
	(1.92)	(1.45)	(1.20)
Value added$_{t-2}$	-6.52e-10*	-2.75e-10	-9.01e-10
	(1.70)	(0.40)	(0.74)
Profitability$_{t-1}$	0.003	0.004	-0.001
	(0.44)	(0.47)	(0.15)
Profitability$_{t-2}$	0.01	0.01	0.01
	(1.03)	(0.98)	(0.96)
Costs of external finance$_{t-1}$	-0.002	0.06	-0.02
	(0.03)	(0.65)	(0.21)
Costs of external finance$_{t-2}$	0.08	0.13	-0.02
	(1.22)	(1.50)	(0.17)
year dummies	yes	yes	yes
F-test (p-value)	0.0000	0.0000	0.0000
Hansen J test (p-value)	0.3173	0.6026	0.3218
Test of exogeneity (p-value)	0.0000	0.0000	0.0000
n	4629	4629	4629

Note: Reported are estimated coefficients with |z-values| in parentheses; The dependend variable is other investment in EUR per capita; Significance at the 10% (*), 5% (**) and 1% (***) level; Standard errors are adjusted for heteroskedasticity and firm clusters; The endogenous variables are instrumented by a firm's percentage share of overall EPI (all estimations), the amount of subsidies received (overall EPI), per capita investment in integrated EPI measures (add-on EPI), per capita R&D investment, and per capita energy expenses (both EPI in renewable energy); logarithms with zero values transformed to 0.001.

A Appendix

Table A.1: Composition of EPI (in % of all EPI)

Area	*2007*	*2008*	*2009*	*2010*
Renewable energies	20.48	21.97	27.31	25.61
	(34.88)	(36.17)	(38.95)	(37.62)
Other climate protection	2.76	3.73	3.47	4.99
	(13.31)	(16.11)	(14.58)	(18.26)
Soil rehabilitation	2.26	1.46	1.93	2.04
	(12.12)	(9.94)	(10.36)	(11.11)
Nature protection	1.30	1.28	1.80	1.26
	(8.36)	(8.33)	(10.81)	(8.06)
Prevention of air pollution	27.96	28.36	25.04	26.17
	(37.18)	(36.90)	(36.14)	(36.33)
Noise abatement	6.67	7.21	5.54	6.25
	(19.54)	(20.88)	(18.37)	(18.81)
Water protection	26.66	23.81	22.91	22.25
	(36.30)	(33.99)	(34.38)	(33.65)
Waste management	11.90	12.19	12.03	11.43
	(25.88)	(26.62)	(26.65)	(26.06)
n	1251	1283	1184	1305

Note: Reported are mean values and standard deviations in parentheses.

Table A.2: Descriptive statistics of covariates

Variable	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*
Profitability (%)	8.77	9.37	9.49	8.41	4.81	8.36
	(10.18)	(9.91)	(10.25)	(10.08)	(12.01)	(10.15)
Value added (EUR)	4.93e+07	5.36e+07	5.60e+07	5.37e+07	4.35e+07	5.68e+07
	(2.99e+08)	(3.45e+08)	(3.57e+08)	(3.05e+08)	(2.42e+08)	(3.96e+08)
Costs of External	0.91	0.88	0.92	0.99	0.99	0.92
Finance (%)	(1.20)	(1.17)	(1.24)	(1.31)	(1.41)	(1.31)
n	4629	4629	4629	4629	4629	4629

Note: Reported are mean values and standard deviations in parentheses.

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