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**Sustainability reporting and environmentally
sustainable investment**

Leonardo Becchetti, *University of Rome Tor Vergata*

Sara Mancini, *University of Rome Tor Vergata*

Nazaria Solferino, *University of Calabria*

+39 0543 62327
ecofo.aiccon@unibo.it
www.aiccon.it

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Sustainability reporting and environmentally sustainable investment

Leonardo Becchetti*, *University of Rome Tor Vergata , Department of Economics and Finance*

Sara Mancini, *University of Rome Tor Vergata , Department of Economics and Finance*

Nazaria Solferino, *University of Calabria, Department of Economics, Statistica and Finance*

Abstract

We investigate whether non financial reporting increases corporate environmental responsibility by exploiting the exogenous introduction of compulsory reporting for companies above a given size threshold (European Union Directive 2014/95). We make use of a unique and restricted-access dataset released by the Italian Statistical Institute allowing us to observe the universe of Italian firms. In particular, we show with a discontinuity design approach that the introduction of compulsory sustainability reporting is associated to significant positive effects in the following environmental domains: (1) waste management (2) recycle/reused material in inputs (3) pollution control (4) emission reduction. Our paper has important policy implications for the introduction of similar rules in other countries, especially in relation to the recent introduction in the European Union (December 2022) of more stringent conditions for sustainable reporting requirements.

Keywords

Environmentally sustainable investment, non-financial reporting, discontinuity design.

JEL Classification

D25 Intertemporal Firm Choice: Investment, Capacity, and Financing; D22 Firm Behavior: Empirical Analysis

*Corresponding author: becchetti@economia.uniroma2.it

1 INTRODUCTION

Ecological transition toward sustainable development is one of the main challenges of the global economy for the next decades. The United Nations Sustainable Development Goals - and especially goals 12 (sustainable production and consumption) and 17 (partnership for goals) - make it clear that it is not possible to achieve sustainable development without a strong corporate commitment. It is well known that corporate social responsibility is partially in the interest of profit maximising corporations as it can contribute to reduce exposure to ESG (Environmental, Social, Governance) risk (Becchetti et al. 2018; Lioui et al., 2018) and increase workers motivation and productivity (Edmans, 2011). It also allows entrepreneurs to create sustainable competitive advantage under the expectation of increasingly severe sustainability regulation and increase CSR-related willingness to pay of consumers and institutions (through green procurement rules).

Nevertheless, we as well know that corporate social responsibility involves costs of increasing benefits to stakeholders and adherence to more severe environmental norms. We therefore wonder what optimal policy measures could further stimulate corporate commitment in this direction.

Our paper aims to provide answers in this respect by investigating the effects of mandatory non-financial reporting (from now on also SR) on corporate environmentally sustainable investments (CESI).

To test our research hypothesis, we use as identification strategy the exogenous variation the Law Decree 254/2016 (Italian implementation of Directive 2014/95/ EU of the European Parliament and of the Council of 22 October 2014) on non-financial reporting, which makes non-financial reporting compulsory for companies with 500 employees and above with minimal levels of either net sales or total assets. To test our research hypothesis, we estimate the causal effect of this measure with a fuzzy regression discontinuity design using data from the "Permanent Firms Census". The survey has been conducted by the Italian National Statistical Institute (ISTAT) and includes a large representative sample of companies below 250

employees and the universe of large sized companies above that size threshold.

Our paper contributes to the literature of environmental sustainability accounting recently enriched by several contributions (Cho and Patten, 2013; Laine and Michelon, 2020; Patten, 2013; Roberts, 2018). This literature includes contributions of Caputo et al. (2021) and Pizzi et al. (2021) investigating the effects of the transposition of the Directive 2014/95/EU on environmental transparency and Gebhardt et al. (2022) finding that the implementation of environmental, social and governance (ESG) key performance indicators in the Internal Management System increases ESG performance of the largest German listed companies. Cho (2020) provides an overview of the literature and Patten (2013) classifies it in three waves. A broader survey of the management accounting research in the area of corporate responsibility/sustainability can be found in Soderstrom et al. (2017).

Our research contributes more specifically to the literature on the impact of non-financial reporting. This literature regards non-financial reporting (intended as formal communication of policies and practices not included in standard financial accounting) as a form of "soft" regulation affecting and stimulating corporate social and environmental responsible choices, even though not imposing specific rules about modalities of information disclosure (Jackson et al. 2019; Stolowy and Paugam, 2018). Christensen et al. (2017) examine the real effects of mandatory social-responsibility disclosures. According to their findings increased awareness of firms' safety records affects political costs, reputational concerns, and/or activism by investors or other parties and through these channels could provide an incentive for managers to improve mines safety. By comparing mines owned by SEC-registered issuers with mines that are not, they find that safety records in financial reports decrease mining-related citations and injuries but reduce labor productivity.

Loprevite et al. (2018) compare the effects of voluntary (Europe) with mandatory (South Africa) integrated reporting. The authors find that both voluntary and

mandatory disclosure have positive effects on corporate social responsibility, higher for voluntary disclosure, and that corporate social responsibility is market value relevant.

This literature has as well shown that SR has significant effects on stock market value (Bernardi and Stark, 2018) with its impact being not unambiguous since voluntary disclosure and legitimacy theories predict two opposite effects of sustainability disclosure on performance (Hummel and Schlick, 2016). The same authors show that superior sustainability performers can choose high-quality sustainability disclosure to signal their superior performance to the market, while poor sustainability performers prefer low-quality sustainability disclosure to disguise their true performance and to simultaneously protect their legitimacy. Disclosure channels are also affected by several factors since environmental crises and bad environmental reputation impact on whether information is provided in annual report or through websites (De Villiers and Van Staden, 2011), while the association between environmental performance and the publication decision can be related with the environmental performance and the nature of the competitive environment (Ott et al. 2017).

The increasing set of recommendations on the adoption of SR from supranational institutions¹ confirms the importance of its role and the belief of its function of stimulus to the development of corporate social responsibility investment and practices.

Following these recommendations several countries have started to adopt rules of mandatory SR for large firms (Jackson et al., 2019; La Torre, Sabelfeld, Blomkvist, Tarquinio and Dumay, 2018). In China companies of particular interest are obliged to publish non-financial actions since 2008. In South Africa, the so-called King Report ask for transparency in corporate governance practices since 2016, while in India, the top

500 listed companies are obliged to publish a Business Responsibility Report based on nine principles of National Voluntary Guidelines covering environmental, social and governance issues. In the US, since 2010 the US Environmental Protection Agency imposes the release of this information to all facilities with annual carbon emissions exceeding 25 metric kilotons.

In Europe, the European Union (EU) Non-Financial-Reporting Directive (2014/95/EU) asked member States to force companies with 500 employees and above to fill a non-financial reporting form. Among EU member states, the Norwegian government introduced in 2013 some amendments requiring companies to report their policies on human and labor rights and social and environmental issues. In the same year in France, the introduction of Grenelle I and Grenelle II Acts extended the scope of the social report, which French authorities had been discussing since the 1970s.

The EU Non-Financial-Reporting Directive leaves partial freedom to each Member State when defining the companies or entities having “public interest”. In Italy, the Directive was implemented by means of the legislative decree 254/2016 that entered into force in January 2017 and made the social reporting compulsory for companies with 500 employees and above that, at the close of the annual budget, had at least one of the following two size limits: a) total assets not below 20 million euros; b) total net revenues from sales and services not below 40 million euros.²

In Italy, corporate non-financial reporting and relevance of non-financial issues at the board level are periodically monitored by Consob reports (Consob 2019). Results from the Report of the year 2019 show that in all the three clusters named Awareness, Capabilities and Engagement, Italian companies recorded improvement, which in some cases was really significant. However, a rigorous test on this claim that

An example is the 21 April 2021 EU proposal for a Corporate Sustainability Reporting Directive (CSRD) asking for the extension of reporting to all companies listed on regulated markets except listed micro-entreprises, requiring the audit of reported information and introducing more detailed reporting requirements ([https://ec.europa.eu/info/business-economy-euro/company-](https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en)

[reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en](https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en))

² For further information please see https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/non-financial-reporting_en

compares corporate behaviour after the introduction of SR with the counterfactual is still missing and is the goal of our paper.

A rigorous evaluation of the impact of SR is of utmost importance given that, when we consider the effective role of mandatory SR vis-à-vis other potential concurring

factors we must take into account that the pressure on CSR investment comes not only from the above mentioned recent regulatory development but also from financial investors in the private sector. As is well known, a growing share of investment funds have started evaluating ESG scores of listed companies in order to calculate exposure of their portfolios to the ESG risk factor, regarded as orthogonal and independent from the traditionally considered risk factors (Becchetti et al. 2018; Lioui et al., 2018). Part of this pressure comes in turn from the most recent financial regulation (ie. the EU Directive 2019/2088) requiring that individual investor preferences must be screened in order to match properly investors and financial asset risk profiles. Preference for investment in sustainable funds is among the most screened items and, when investors express their choices, the EU directive states that financial advisors can indicate only investment funds that can measure progress in ESG performance of their portfolios based on specific indicators (i.e. carbon footprint, water footprint, circularity index, polluting emissions). This new regulation is creating a dramatic pressure toward non-financial reporting making the latter a precondition to be included in sustainable investment funds. This pressure is going to work for listed companies but also for all smaller subcontractors and suppliers working in their product chains.

More recently the EU Directives 2004/109/CE, 2006/43/CE and 2013/34/UE have been amended by the new Directive (EU) 2022/2464 on 16 December 2022 (The Corporate Sustainability Reporting Directive – CSRD) applying to financial years starting on or after January 1, 2024. According to the CSRD "non-financial reporting" is renamed as "sustainability reporting".

Among the most important innovations, the CSRD extends the sustainability reporting obligations to all large companies (companies with more than 250 employees) and all companies listed on regulated markets (including listed SMEs but not listed micro-enterprises). It also makes mandatory to verify the sustainability information reported, introduces more detailed reporting and obligations following the EU sustainability reporting standards and requires companies to disclose information digitally to ensure transparency

The CSRD specifies disclosure principles as well regarding social factors, such as working conditions, the involvement of social partners, collective bargaining, equality, non-discrimination, diversity, inclusion, and human rights. It also underlines the importance that sustainability reporting principles adequately consider energy aspects, especially in relation to environmental issues, including those relating to climate change.

Based on the above-mentioned literature and the recent evolution of EU regulation the research hypothesis of our work is whether the introduction of mandatory non-financial reporting can create per se a stimulus for the adoption of CESI investment (and in what domains and sectors) in spite of concurring pressures that can however push companies to increase voluntarily their CESI stance.

In the light of the more recent regulatory changes our empirical analysis can help to predict the future effects of the CSRD reform starting from 2024. If our research hypothesis on the positive impact of mandatory non-financial reporting (even under the soft approach applied in our sample period before the introduction of the new EU regulation) it is likely to expect a significant impact of the new regulation with the extension to smaller forms and the introduction of more stringent accounting rules.

In testing our research hypothesis, we should expect to find a positive relationship if we assume that the introduction of mandatory rules produces per se a significant and positive impulse in corporate CESI choices. On the contrary, we should expect an

insignificant effect if we assume that companies will nonetheless follow that path for the strength of the other factors pushing them in that direction (i.e. the pressure of stakeholders and financial markets) or because the “soft regulation” on mandatory financial reporting without specific rules on the information disclosed is not strong enough to avoid the “green or social washing” nature of the reported information (Belal, Cooper and Roberts, 2013; Hrasky, 2012; Michelon, Pilonato and Ricceri, 2015).

Our empirical findings show a significant discontinuity in several CESI indicators around the employment/net sales mandatory SR threshold. More specifically, we find a significantly higher engagement in CSR investment in crucial environmental domains (waste management, recycle/reused material in inputs, pollution control, emissions reduction) in the SR mandatory versus non mandatory group of firms, with consistent results obtained with different methods such as i) preliminary t-tests on the significance of descriptive differences in CESI engagement on the overall sample; ii) “local” significance of the discontinuity in CSR engagement around the cutoff on a restricted number of observations based on optimal bandwidths and iii) significance of the treatment on all measures of CSR engagement in multivariate estimates (with and without the use of instruments) on the overall sample controlling for all relevant concurring factors.

Approaches ii) and iii) use a fuzzy discontinuity design strategy taking into account small, expected discrepancies in classification of mandatory and non-mandatory SR groups due to lack of information about companies’ total assets in the data provided by ISTAT. Policy implications of our findings are that the reduction of the threshold for mandatory SR and the introduction of more stringent accounting rule from 2024 could further stimulate corporate engagement in

CESI activities and more specifically could push toward a stronger commitment on environmentally sustainable practices.

2 RESEARCH HYPOTHESIS

Our research hypothesis hinges on the fact that, in spite of the light obligations (i.e., absence of rules about mandatory reporting of specific ESG indicators) contained in the introduction of the mandatory non-financial reporting rules in Italy, the obligation to provide publicly such information stimulates companies to perform CESI actions that can give value to their own non-financial reporting content. The implied assumption is that the SR document will be scrutinised by third parties and relevant stakeholders (i.e., financial investors, local communities, customers) and is expected by them to shed light on corporate behaviour in the social and environmental domains. Actions reported in the document indicating a strong CESI stance that is consistent with actual corporate behavior can produce several positive effects. First, they can significantly affect the willingness to invest in the company by responsible financial investors. The share of financial investors looking at corporate ESG characteristics has enormously grown in the last years. Most financial investors measure exposure to ESG risk, and an increasing share of them is adopting engagement and exclusion rules for selecting stocks in their portfolios. Financial investors have become in fact progressively more aware that exposure to ESG risk dictated by low corporate social and environmental responsibility is an orthogonal risk factor and they want to reduce exposure of their portfolios to such risk.³ Second, CSR actions described in the sustainability report can trigger willingness to pay of consumers and institutions for products/services sold by companies due to their social and environmental characteristics. The effect on the willingness to pay of local, national

³ Richard Fund, the CEO of the largest world investment fund, BlackRock, has emphasised in its annual (January 2021) letter to CEO of the largest multinational that “From January through November 2020, investors in mutual funds and ETFs invested \$288 billion globally in sustainable assets, a 96 percent increase over the whole of 2019. I believe that this is the beginning of a long but rapidly accelerating transition – one that will unfold over many years and

reshape asset prices of every type. We know that climate risk is investment risk” concluding that companies who will fail to keep pace with ecological transition will lose trust from stakeholders and financial investors (<https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter>).

and supranational institutions is expected to become gradually stronger with the progressive growth of green procurement rules. Third, they can ease access to soft loans that regional, national or supranational authorities offer for investment of companies above a given CSR threshold to pursue their goal of ecological transition and achievement of the UN Sustainable Development Goals.

On the other hand, it must be considered that publicly available information on corporate social responsibility in non-financial reporting under inspection by relevant stakeholders and third parties significantly increases the cost of false information, given the high probability that false information is screened and detected, and the reputational costs incurred by the company in case of cheating (as shown for instance by the Volkswagen case).⁴

For all these reasons we argue that mandatory non-financial reporting, even though it does not imply obligation to report a specific set of indicators, creates a strong incentive for CESI actions to avoid the cost of a too vague and disappointing non-financial report.

What just said creates additional interest for testing the hypothesis, since the above-described pressure toward ecological transition can also lead to conclude that companies are induced to invest in CSR even if SR is not mandatory. It is therefore important to see whether the obligation to report creates a further and stronger stimulus to do it by raising the cost of too vague or missing reported action with respect to the counterfactual of non-mandatory SR.

Ho1: mandatory non-financial reporting significantly affects corporate propensity to invest in social and environmental responsibility.

3 DATABASE DESCRIPTION AND DESCRIPTIVE STATISTICS

Our data source is the Multiscopo Survey, the permanent census of Italian firms that includes a sample of about 280,000 companies with 3 and more

employees (representing a universe of just over a million units) corresponding to 24 percent of Italian companies, which however produce 84.4 percent of the national added value, employ 76.7 percent of the total workforce and 91.3 percent of Italian employees. Above the 250 employees' threshold all companies of the Italian universe are included in the Survey. The Survey was carried out between May and October 2019, the reference year of the data acquired by the companies is 2018.

Descriptive findings from the Multiscopo Survey show that more than half of the companies are active in the North (29.2 percent in the North-West and 23, 4 percent in the North-East) against 21.4 percent in the Center and 26.0 percent in the South. The average number of employees is 39.5, 59.3 percent of respondents have used external finance for their investment, large companies (with 500 employees or more) are 8.62 percent of the sample.

Descriptive findings on our main variables of interest (variable legend in **Table 1**) show that only 2.78 percent of companies declare high intensity of investment in social and environmental responsibility, against 14.34 percent declaring medium intensity and 17.19 percent low intensity (**Table 2**). This implies that almost two third of companies (65.60 percent) declare no CSR investment in the 2016-2018 sample period. When we go beyond this general definition of CSR investment and go into more specific domains we find that 30.97 percent of companies underwent a process of CO₂ emission reduction, 20.1 percent have evaluated their environmental performance, 12.1 percent have involved their suppliers into their CSR policies, 83.07 percent companies in the sample have performed at least one of the following circular economy strategies beyond what required by the law (reuse/recycle of waste water, saving material used in production process, use or recycled or reused material as input, differentiated or reused waste).

More specifically on environmental sustainability, investment made in the three-year period 2016-2018 mainly concerned the installation of efficient

⁴ Volkswagen stock recorded a 20 percent loss on 21 September 2015 after the Environmental Protection Agency's notice of violation

became public. The price remained 30 percent lower at a one-year distance.

machinery, systems and/or appliances that reduce energy consumption (31.3 percent of companies). 10.0 percent of the surveyed companies have installed plants for the production of energy from renewable sources, in 5.6 percent of cases electric and 3.3 percent thermal, while 3.8 percent bought electric or hybrid vehicles. Regarding company's actions to reduce the consumption of resources and manage sustainably waste and emissions, 77.8 percent of companies carried out separate waste collection and recycling, 48.4 percent performed more efficient water management, 46.8 percent managed waste in order to contain and control pollutants and 42.2 percent saved part of the material used in the production processes especially in the sector of water supply, sewerage, waste management and remediation activities. Overall, 83.8 percent of the companies turned out to be active in actions that aimed to reduce their negative impact on the environment.

4 THE DISCONTINUITY DESIGN EMPIRICAL ANALYSIS

The European Directive 2004/195 imposes non-financial reporting requirements for companies with 500 employees and above that possess at least one of the following two characteristics:

- a) total assets in the balance sheet: 20 million euros and above;
- b) total net revenues from sales and services: 40 million euros and above.

By analysing ISTAT data, we develop a discontinuity design approach where the cut-off identified by the EU directive implies participation or non-participation to the “treatment”, that consists of a legal obligation, namely, the issue of the non-financial report.

Data from the Multiscopo survey provide information on the number of employees and net revenues, while not on total assets. This makes our discontinuity design necessarily fuzzy. There can be in fact cases of companies above 500 employees with net revenues below 40 million having however total assets above 20 million that we incorrectly classify in the non-mandatory group, while they actually belong to the

mandatory group. We reasonably assume that these cases are infrequent, but this nonetheless imposes us to adopt a fuzzy discontinuity design approach.

A further relevant issue to be considered is timing. Mandatory SR starts from the beginning of 2017 while our information on CSR investment is aggregate over the 2016-2018 period. This implies that our results can be downward biased since the treatment is actually in action for only two of the three years. We consider however that companies were aware of the preparation of the EU Directive in advance so that they could have reasonably anticipated the year before the oncoming national regulation and that it is enough to have invested in one of the three years to have positive values in the selected CSR investment dependent variables. We therefore regard the impact of this timing problem as negligible and, in any case, working in the direction of a downward bias on the estimated treatment effect, thereby making our findings stronger and more reliable if significant.

To perform our analysis, we consider different CESI variables. The first synthetic variable is the intensity of investments in CSR in the three-year period 2016-2018. This is an ordinal categorical variable, where 0 indicates that the firm made no investment in CSR, 1 corresponds to low intensity, 2 to medium, while 3 indicates that the firm declared a high investment intensity in the considered period. Other CESI variables are (0/1) dummies measuring investment in circular economy, investment to reduce pollution, waste management aimed to reduce CO₂ emissions, use of reused/recycled production waste as input for new production, reduction of environmental impact of corporate activities.

The first step in the discontinuity design approach is a graphical inspection of the phenomenon around the most important qualifying (compulsory and not optional) condition (no less than 500 employees) (see Figure 1, panels A-F). As it is customary in this case CSR investment values conditional to the number of employees are interpolated with a second or third order polynomial in order to model nonlinearities in the relationship between the two variables. What the graph does is calculating the conditional average value

of the CESI variable for each defined interval of the X-axis variable (number of workers). All graphs with different CESI investment variables show a discontinuity around the 500-employee threshold, identifying a jump at its right and, in some cases, a fall of CESI investment at its left. The rightward jump is what we expect, based on our research hypothesis. The decline at the left of the cutoff observed in some plots can lead to think of manipulation of the running variable (e.g., strategic permanence before the employment threshold not to incur in mandatory SR). Our descriptive evidence on the probability density function of workers in the Istat Multiscopo sample however does not detect any discontinuity around that threshold (see Figure 2).

In order to evaluate the magnitude of the effect described by our figures we present in **Table 3** the average value of CSR variables in the SR mandatory and non-mandatory groups with t-tests evaluating whether the difference is significant or not. Our findings show that average CSR intensity among companies of 500 employees and above is 1.5 against 0.5 of the complementary group. More in detail CSR investment above zero is reported by 81 percent of respondents in the mandatory group against 33 percent in the non-mandatory group.

All the other differences in CSR variables between the SR mandatory and non-mandatory groups are significant. More specifically we find that a difference of 91 against 83 percent for investment in circular economy, 66 against 50 percent for investment to reduce pollution, 88 against 80 percent for waste management aimed to reduce CO₂ emissions, 28 against 20 percent for use of reused/recycled production waste as input for new production, 54 against 30 percent for investment in emission reduction.

All the described differences among the SR mandatory and non-mandatory groups observed on the overall Multiscopo sample can obviously also depend on other factors correlated with size.

The methodological approaches that follow will control for the impact of these concurring factors by

investigating of local variability of the outcome around the cutoff within an optimal bandwidth.

In order to test our research hypothesis with the first approach we identify the local interval where the only factor expected to vary is the cutoff. To do so, we first calculate optimal bandwidth for each variable following the approach described by Calonico, Cattaneo, and Titiunik (2014a) and Calonico et al. (2017) identifying the optimal number of observations across the trade-off between sufficient degrees of freedom and definition of a small interval around the running variable where other factors are expected not to vary. We then calculate local polynomial regression-discontinuity (RD) point estimators with the robust bias-corrected confidence intervals and inference procedures developed in Calonico, Cattaneo, and Titiunik (2014b), Calonico, Cattaneo, and Farrell (2019), and Calonico et al. (2017). We do so by implementing a fuzzy RD estimation considering the characteristics of our data and of the cutoff requirements explained above. Note that other two crucial conditions needed to perform RD - a large number of observations around the cutoff and the fact that the forcing variable takes continuous values – are met in our study.

Our findings confirm that all the considered CESI variables vary significantly around the cutoff. The observed differences between mandatory/non mandatory groups are in general higher than those observed with descriptive findings (15 percent for waste reduction, 23 percent for reuse/recycle of materials, 24 percent for pollution control, 32 percent for emission reduction, 20 percent for circular economy, **Table 4**). We consider these magnitudes the best proxies of the SR mandatory treatment because they come out from an approach that limits the analysis in an interval around the treatment where the treatment is the only factor that is expected to vary significantly, thereby controlling for the concurring impact of unobservable.

5 ROBUSTNESS CHECKS

The second above mentioned approach followed to test our research hypothesis departs from the local analysis performed above and uses information

throughout the entire range of our running variables. In this case we must consider the impact of all the other regressors that can affect CESI intensity.

We therefore estimate the following model:

$$\begin{aligned} \text{CESI}_i = & \alpha_0 + \alpha_1 \text{Treatment}_i + \alpha_2 \text{Employees}_i \\ & + \alpha_3 \text{Treatment} * \text{Employees}_i + \alpha_4 \text{NetSales}_i + \alpha_5 \text{Treatment} * \text{NetSales}_i \\ & + \alpha_6 \text{ExternalFinance}_i + \alpha_7 \text{HumanResource}_i + \alpha_8 \text{FamilyOwnership}_i \\ & + \alpha_9 \text{NonEUCOMPETITOR}_i + \sum_d \gamma_d \text{DIndustry}_i + \sum_f \delta_f \text{DProvince}_i + \varepsilon_i \end{aligned} \quad (1)$$

where the dependent variable (*CESI*) is one of the CESI investment variables considered in our research (and the estimated model is an ordered logit for the CSR intensity variable and a logit for all other CSR 0/1 dummy variables).

Our main regressor of interest is *Treatment*, a dummy taking value one when the firm meets the two observed conditions (500 employees or above and net sales of 40mln or above) on mandatory SR. We then introduce first as controls the two running variables (*Employees* and *NetSales*) and the interactions between them and the treatment (*Treatment*Employees* and *Treatment*Net Sales*). Among other controls, *ExternalFinance* is a (0/1) dummy for companies declaring external finance among financing sources at end 2018, *HumanResource* is a (0/1) dummy for companies that increased their workforce in the 2016-2018 period, *FamilyOwnership* is a (0/1) dummy for companies controlled directly or indirectly by an individual or a family, *Non-EU Competitor* is a (0/1) dummy measuring if the main competitors of the company are located in countries outside the EU. Finally, 111 province and 96 Industry (NACE2) dummies are included in the estimate.

Our findings show that the *Treatment* dummy variable is significant for almost all CESI dependent variables (**Table 5**). This implies that the two conditions for mandatory SR (firm size equal/above 500 employees and net sales equal/above 40 million) have a positive and significant effect on CSR investment beyond the separate effect of the positive and significant impact of the number of employees on the dependent variable. These findings are consistent

with those obtained with the different methodological approaches followed above and with the hypothesis that compulsory non-financial regulation has a positive and significant effect on CSR adoption.

In order to take into account that our treatment is fuzzy we use an IV approach (Lee and Lemieux, 2010; Marie, 2008). The selected instruments are the two distances of the running variables (employees and net sales) from their respective cutoffs. The instruments are by construction relevant (they are significantly correlated with the treatment dummy) and valid (they do not affect per se the CESI dependent variables) (**Table 5**). Findings from the multivariate IV approach show that the instrument treatment remains highly significant in the second stage.

We alternatively estimate our multivariate approach with a quadratic specification where equation (1) is augmented with squared running variables and interactions between them and the treatment. Our main findings are unchanged and the treatment significant for all CSR variables (**Table 6**).

6 CONCLUSIONS

The 2021 IPCC report indicates that the average hearth temperature has almost risen 1.1 degrees Celsius and that not much time is left for a thorough change of the global production system to become more energy efficient and avoid the threat of a climate disaster. The change must inevitably occur through a replacement of old with new processes in human activities where emissions are generated (industry, agriculture, mobility, energy production, housing). Corporate socially and environmentally responsible investment plays therefore a crucial role to pursue ecological transition and achieve the sustainable development goals set by the world community and a key open question in economic research is to understand which drivers can accelerate the required change.

In our paper we wonder whether one of these drivers, at zero cost for public finances, can be making non-financial reporting mandatory. More specifically, with our research hypothesis we wonder whether mandatory non-financial reporting significantly affects

CSR investment with a fuzzy discontinuity design identification strategy that exploits the introduction of mandatory non-financial reporting for companies of 500 employees and above and minimal net sales or total assets levels in Italy.

By using data from the ISTAT Multiscopo survey containing information for all large sized companies (above 250 employees) and a large representative sample of companies between 3 and 250 employees we find that companies above the cutoff invest significantly more in crucial environmental domains (waste management, recycle/reused material in inputs, pollution control, emission reduction). The magnitude of the change can be estimated around 20 and 30 percent of additional companies pursuing CSR investment.

Our findings have relevant policy implications on the effects of the introduction of mandatory non-financial reporting in other countries and, more specifically, related to the likely impact of the recent reform of the EU regulation. More specifically, our results on the relevant CESI effect of the introduction of compulsory SR for firms with 500 employees and above (plus the additional balance sheet requirements) could be a lower bound for the impact of the new EU April 2021 directive extending the obligation to all companies above 250 employees with the addition of much more rigorous accounting standards. Further testing on this related research hypothesis stemming from our work is left for future research that will be possible as soon as member countries will implement the new directive and effects around the discontinuity could be eventually evaluated at a reasonable distance of time.

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Tables

Table 1. Variable legend

Dependent Variables

CESI Intensity	Categorical variable ranging from 0 to 3 if in the three-years period 2016-2018 “the company has introduced a production, process, marketing or organizational innovation to reduce its environmental impact”. The variable takes four value: zero, low CESI intensity=1, medium CESI intensity=2, high CESI intensity=3.
CESI above zero	(0/1) dummy taking value one if the company in the three-years period 2016-2018 the company gives a nonzero answer to the question on whether it has introduced a production, process, marketing or organizational innovation to reduce its environmental impact”
CESI Circular Economy	(0/1) dummy =1 if the company answered yes to at last one of the options “ <i>Reuse and recycling of waste water; Saving of the material used in the production processes; Use of secondary raw materials; Separate collection and recycling of waste; Waste management aimed at containment; Containment of atmospheric emissions</i> ” to the question: “in the three-year period 2016-2018, in addition to what is required by law, what actions have been taken by the company to reduce the consumption of natural resources and manage waste in a sustainable way?

Reuse/recycled materials as inputs	(0/1) dummy =1 if the company answered yes to the option <i>“Use of secondary raw materials”</i> to the question: “in the three-year period 2016-2018, in addition to what is required by law, what actions have been taken by the company to reduce the consumption of natural resources and manage waste in a sustainable way?”
Waste reduction	(0/1) dummy =1 if the company answered yes to the option <i>“Separate collection and recycling of waste and waste management aimed at containment”</i> to the question: “in the three-year period 2016-2018, in addition to what is required by law, what actions have been taken by the company to reduce the consumption of natural resources and manage waste in a sustainable way?”
Pollution control	(0/1) dummy =1 if the company answered yes to the option <i>“waste management aimed to pollution control”</i> when answering to the question: “in the three-year period 2016-2018, in addition to what is required by law, what actions have been taken by the company to reduce the consumption of natural resources and manage waste in a sustainable way?”
Emission reduction	(0/1) dummy =1 if the company answered yes to the option <i>“Containment of atmospheric emissions”</i> when answering to the question: “in the three-year period 2016-2018, in addition to what is required by law, what actions have been taken by the company to reduce the consumption of natural resources and manage waste in a sustainable way?”

Controls

Net sales per Employee	Firm’s revenues at the end of the year 2018 (in millions of euro) divided the average number of employees in the years 2016-2018
Employees	Average Number of employees in the years 2016-2018
Net Sales	Firms’ revenues at the end of the year 2018 (in millions of euros)

Treatment	A dummy taking value one when the firm meets the two observed conditions (500 employees or above and net sales of 40mln or above) on mandatory SR.
Age	Year 2018-year of firm birth
Human Resources	(0/1) dummy =1 if the company answered yes to the question: "In the three -year period 2016-2018 has Company increased her endowment of Human Resources?"
Competitor Extra EU	(0/1) dummy =1 if in the year 2018 the company's main competitors were in Other European countries outside the EU.
Family Ownership	(0/1) dummy =1 if the company answered yes to the question: "was the company, directly or indirectly, controlled by an individual or a family on 31 December 2018?"
External Finance	(0/1) dummy =1 if the company answered yes to all the questions: "At the end of the Year 2018 what have been the main financial sources?" corresponding to sources different from self-financing.
Coeffin	Sampling weight attached to each unit in the Multiscopo survey

Table 2. Descriptive findings

Independent Variables	Mean	Std.	Dev.	Min	Max
Size	196,982	378.017	3.244.767	2.5	34271,31
Net sales	195,795	1.03e+07	1.68e+08	0	7,76E+12
Net Sales per employee	195,795	47729.23	89704.93	-2285079,9	7589006
Age	196,982	216.076	1.490.418	0,8	138.4
Treatment	189,651	.006301	.0791289	0	1
External Finance	196,98	.5927658	.4913204	0	1
Family Ownership	196,982	.6618371	.4730855	0	1
Human Resources	196,982	.6897635	.4625915	0	1
Competitor Extra EU	196,982	.0938157	.2915729	0	1
Province	196,982	4.447.572	2.935.285	1	111
Nace2	196,982	4.758.573	2.244.971	6	96
Dependent Variables					
CESI Intensity	196,982	.5414048	.8364753	0	3
CESI intensity=3	196,982	.0275152	.1635795	0	1
CESI intensity=2	196,982	.1431552	.350232	0	1
CESI intensity=1	196,982	.1725488	.3778577	0	1
CESI Circular Economy	196,982	.8319491	.3739124	0	1
CESI Environment	196,982	.6940685	.460802	0	1
Reuse/recycled materials as inputs	196,982	.2015514	.4011599	0	1
Waste Reduction	196,982	.797616	.4017779	0	1
Pollution Control	196,982	.5060665	.4999645	0	1
Emission Reduction	196,982	.3129778	.4637066	0	1

Table 3. CESI differences between the mandatory/non mandatory SR groups on the overall sample

CESI variable	Mandatory SR		Non mandatory SR		T-stat
	Percent	N. of obs.	Percent	N. of obs.	
CESI intensity	1.55	1196	0.515	188456	43.52
CESI intensity above zero	0.810	1196	0.330	188456	35.27
Circular economy	0.915	1196	.830	188456	7.79
Pollution control	0.656	1196	0.501	188456	10.67
Waste reduction	0.880	1196	0.796	188456	7.30
Reuse/recycled materials as inputs	0.280	1196	0.199	188456	7.03
Emission reduction	0.537	1196	0.306	188456	17.23

Average levels of CESI variables in the mandatory versus no mandatory SR groups, with t-test on the significance of the difference between the two groups.

Table 4. RD test on the CESI differences between mandatory and non-mandatory SR firms

CESI variable	Treatment effect	n. of obs. below cutoff	n. of obs. above cutoff	Z stat	p-value
CESI intensity	0.609	470	377	3.675	0.000
CESI intensity above zero	0.327	460	376	4.149	0.000
Circular economy	0.199	836	433	3.813	0.000
Pollution control	0.242	501	385	3.212	0.001
Waste reduction	0.156	507	385	2.389	0.017
Reuse/recycled materials as inputs	0.231	396	357	3.346	0.001
Emission Reduction	0.319	214	278	3.248	0.001

Local polynomial regression-discontinuity (RD) point estimators with the robust bias-corrected confidence intervals and inference procedures. Optimal bandwidth for each variable are calculated following the approach described by Calonico, Cattaneo, and Titiunik (2014a) and Calonico et al. (2017) identifying the optimal number of observations across the trade-off between sufficient degrees of freedom and definition of a small interval around the running variable where other factors are expected not to vary.

*Notes: Results from ordered logit regressions. The dependent variable (1) is a categorical variable ranking from 0 to 3 depending on the level of CESI practices implemented by the Italian companies, while (2-7) are dummy variables where 0 means NO and 1 YES. The main independent variable is Treatment measuring the effect of the mandatory non financial report. Province and Industry Sectors (NACE2) fixed effects are always included. Robust standard errors clustered at country level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.*

Table 5. Instrumental variable estimates

DEP VARIABLES	CESI intensity above zero	Circular economy	Pollution control	Waste reduction	Reuse/recycled materials as inputs	Emission Reduction
Instrument type	(2)	(3)	(4)	(5)	(6)	(7)
Second stage						
Treatment (instrumented)	2.695201*** (.8694362)	.4391797*** (.1653224)	.4465243*** (.0745099)	.301967*** (.0790668)	.3224683** (.1014347)	.8557702 *** (.1164843)
Instrument Significant in First Stage						
(a) Employees-500	.0000948*** (.0000338)	.0000948*** (.0000338)	.0000948*** (.0000338)	.0000948*** (.0000338)	.0000948*** (.0000338)	.0000948*** (.0000338)
(b) Net Sales- 40mln	5.84e-11 (5.22e-11)	5.84e-11 (5.22e-11)	5.84e-11 (5.22e-11)	5.84e-11 (5.22e-11)	5.84e-11 (5.22e-11)	5.84e-11 (5.22e-11)

Notes: Results from IV. The dependent variable (1) is a categorical variable ranking from 0 to 3 depending on the level of CESI practices implemented by the Italian companies, while (2-7) are dummy variables where 0 means NO and 1 YES. The main independent variable is Treatment measuring the effect of the mandatory non financial report. Employees-500 is a dummy taking value one if the company has more than 500 employees, Net Sales-40mln is a dummy taking value one if the company's net revenues are higher than 40 million. Province and Industry Sectors (NACE2) fixed effects are always included. Robust standard errors clustered at country level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 6. Econometric findings – quadratic specification

VARIABLES	CESI Intensity	CESI Circular Economy	Reuse/Recycled materials as inputs	Waste Reduction	Emission Reduction	CESI above zero	Pollution control
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Treatment & Interactions</i>							
Treatment	1.7659*** (0.0850)	0.7315*** (0.1743)	0.4754*** (0.1002)	0.5096*** (0.1484)	0.8737*** (0.0998)	1.6243*** (0.1282)	0.5244*** (0.0942)
Treatment*Employees	-0.0019*** (0.002)	0.0004 (0.0003)	(0.0012)*** (0.0003)	(0.0003) (0.0002)	-0.0007*** (0.0002)	-0.0002 (0.0005)	-0.0001 (0.0002)
[Treatment*Employees] ²	0.0001 (0.0003)	0.0002* (0.0001)	0.0002 (0.0002)	0.0003 (0.0005)	0.0003 (0.0006)	0.0002 (0.0004)	0.0004** (0.0007)
Treatment*NetSales per employee	-0.0003*** (0.00003)	-0.0001*** (0.00004)	-0.0001* (0.00006)	-0.0001*** (0.00003)	-0.0001*** (0.00004)	-0.0003*** (0.00002)	-0.0001*** (0.00003)
[Treatment*NetSales per employee] ²	0.0001** (0.0003)	0.0002 (0.0005)	0.0002 (0.0004)	0.0005 (0.0006)	0.0003 (0.0008)	0.0002 (0.0004)	0.0001 (0.0001)
<i>Forcing variables</i>							
Employees	0.0020*** (0.0002)	-0.0005* (0.0003)	-0.0012*** (0.0003)	-0.0003 (0.0002)	0.0007*** (0.0002)	0.0003 (0.0005)	0.0002 (0.0002)
[Employees] ²	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)	0.0002 (0.0003)	0.0001 (0.0001)	0.0001 (0.0001)
Net Sales per employee	0.0003*** (0.0001)	0.0001*** (0.00001)	0.0002* (0.0001)	0.0001*** (0.0003)	0.0001*** (0.0004)	0.0003*** (0.00006)	0.0001*** (0.00002)
[Net Sales per employee] ²	-0.0001** (0.00004)	-0.0001 (0.0003)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)

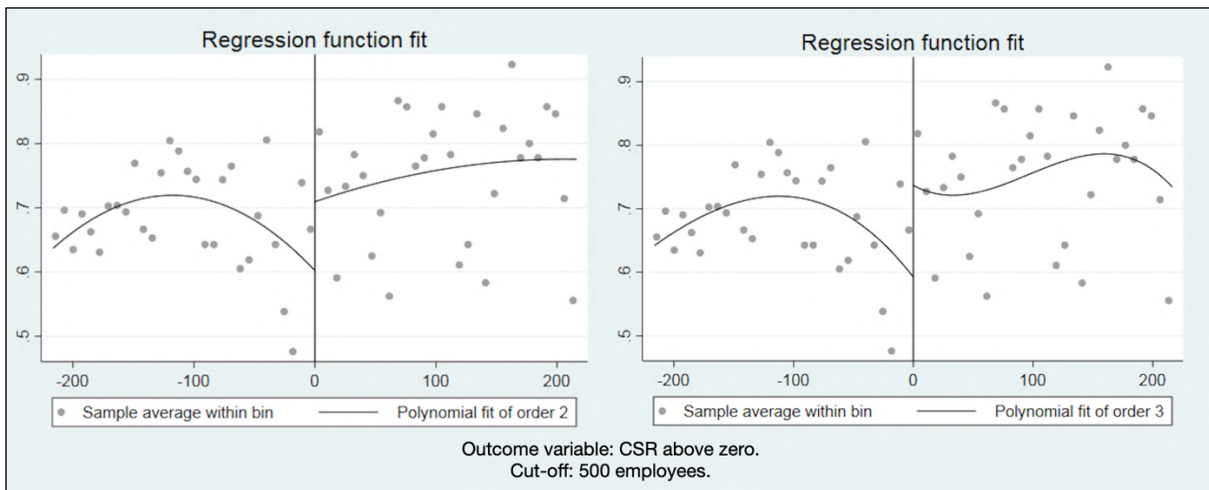
Notes: Results from ordered logit regressions with quadratic terms. The baseline specification is augmented with squared running variables and interactions between them and the treatment. The dependent variable (1) is a categorical variable ranking from 0 to 3 depending on the level of CESI practices implemented by the Italian companies, while (2-7) are dummy variables where 0 means NO and 1 YES. The main independent variable is Treatment measuring the effect of the mandatory non financial report.

Province and Industry Sectors (NACE2) fixed effects are always included. Robust standard errors clustered at country level in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

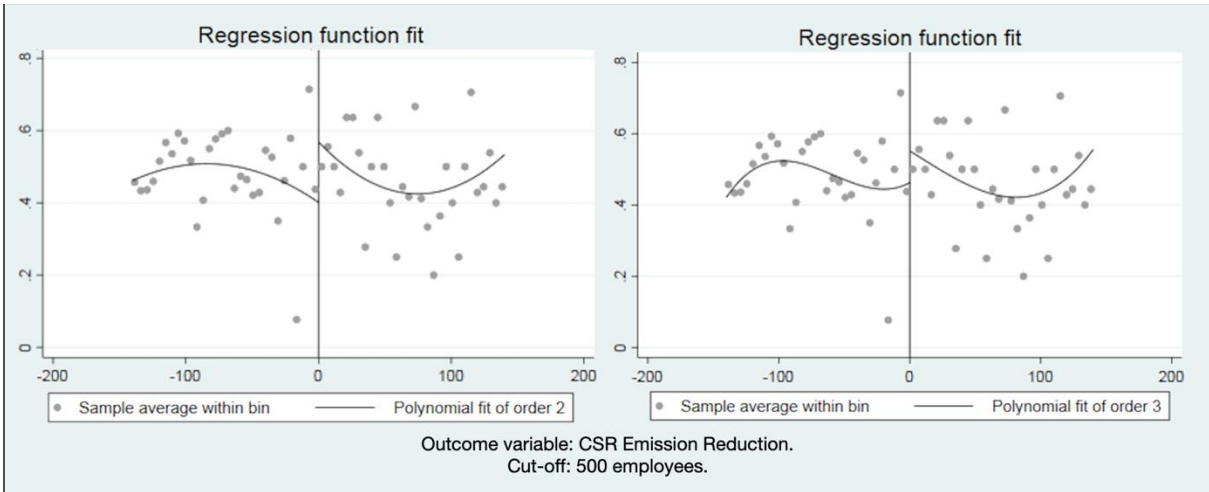
Figure 1. Regressions Discontinuity Plots

CESI investment values conditional to the number of employees are interpolated with a second or third order polynomial in order to model nonlinearities in the relationship between the two variables. Points in the graph are conditional average values of the CESI variable for each defined interval of the X-axis variable (number of workers).

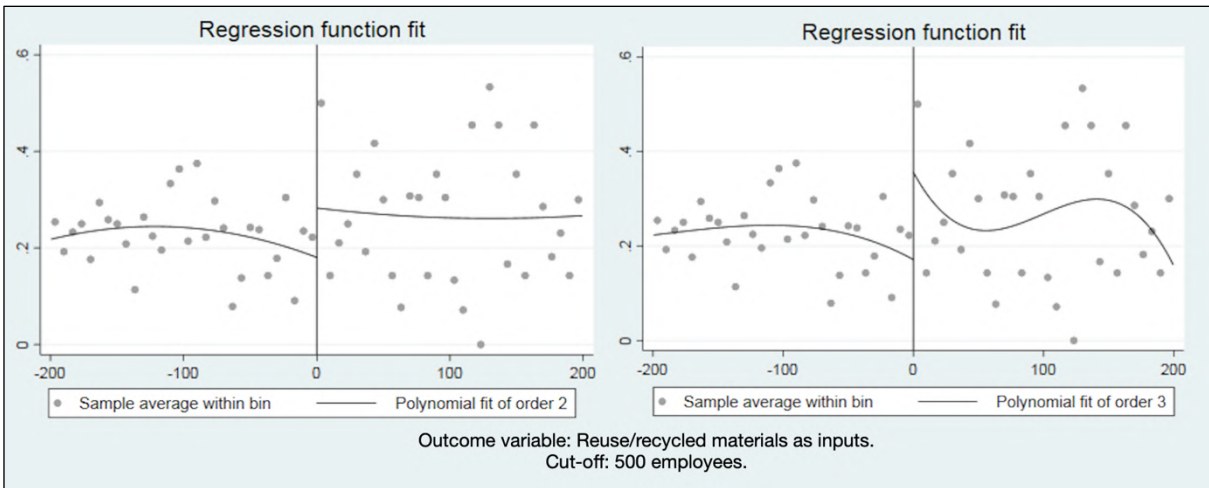
Panel A. CESI Intensity above zero



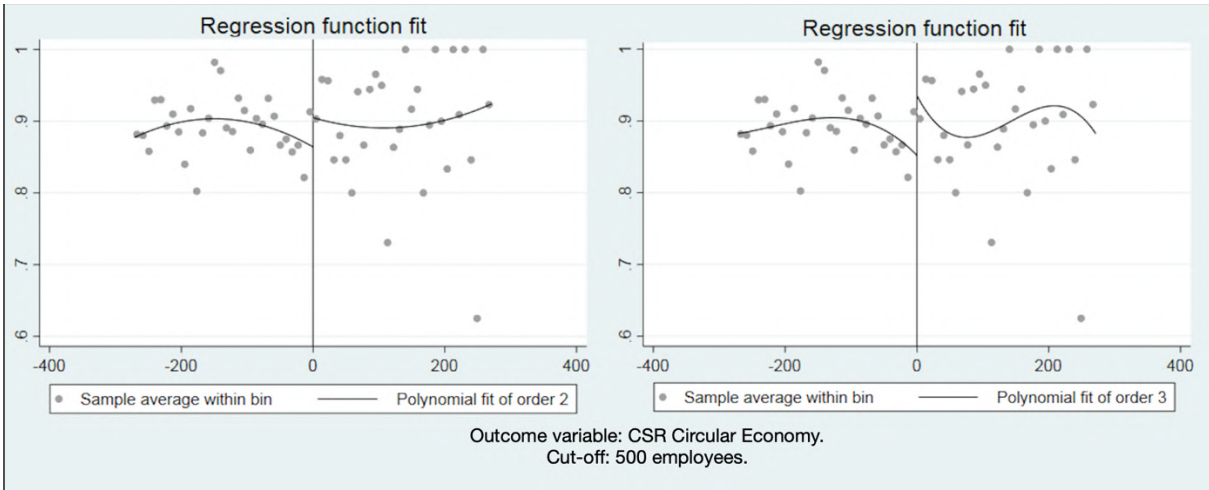
Panel B. Emission reduction



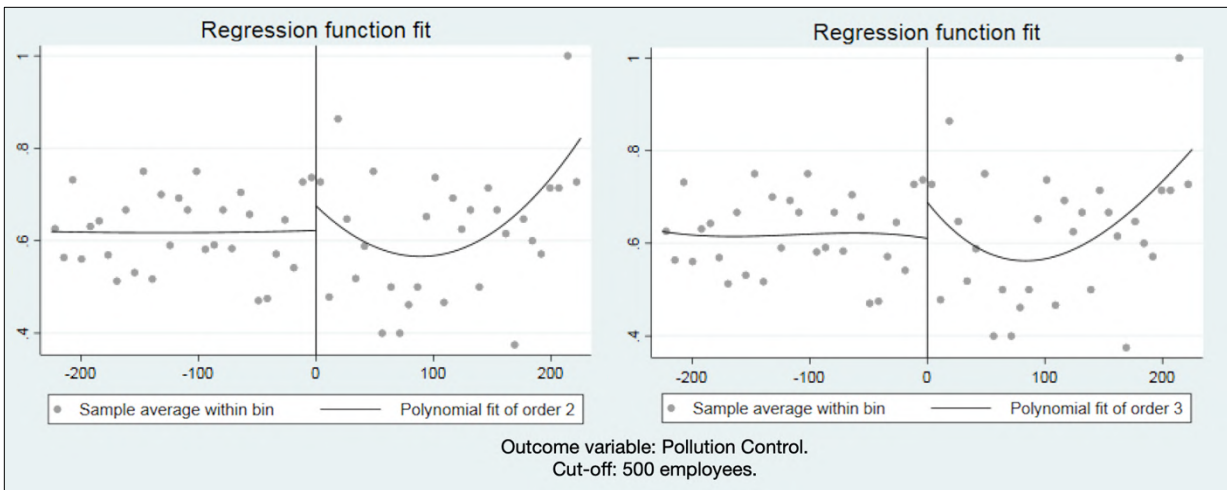
Panel C. Reuse/Recycled materials as inputs



Panel D. Circular Economy



Panel E. Pollution Control



Panel F. Waste Reduction

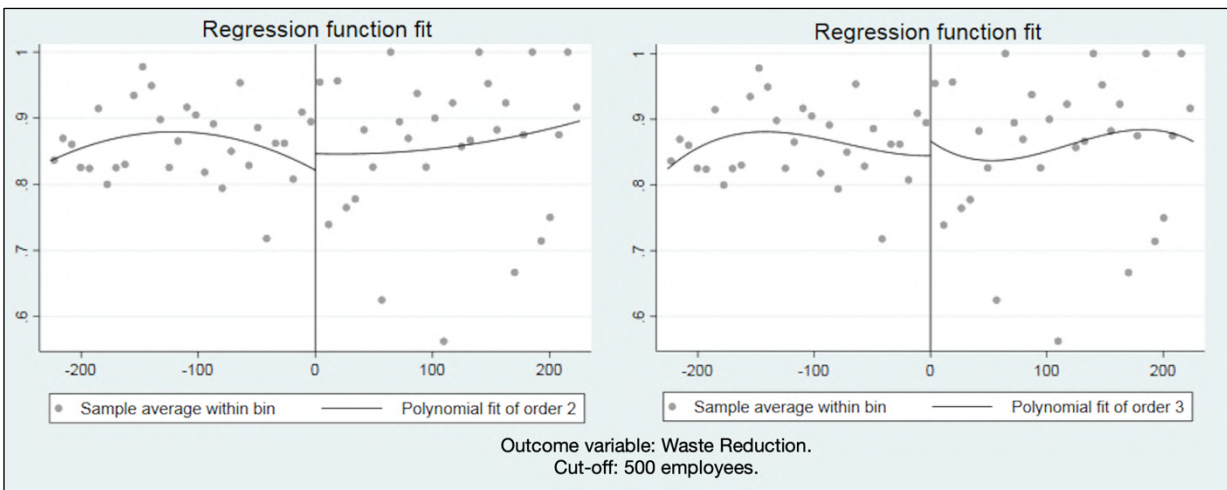
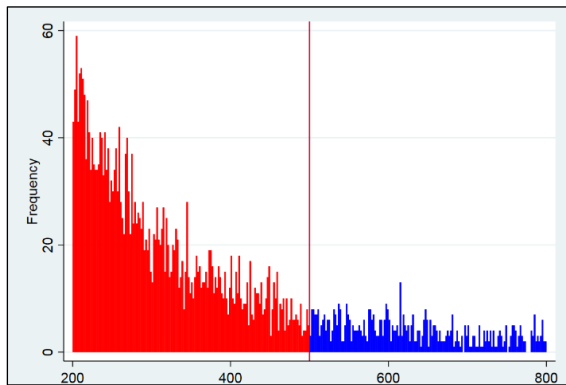
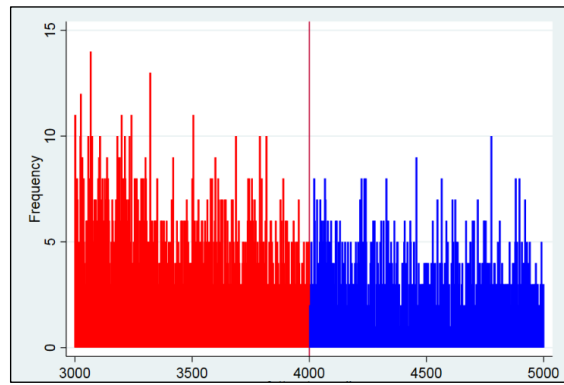


Figure 2. Probability density functions

Panel A. Number of employees



Panel B. Net Sales



Notes: Histograms representing frequency distributions of Number of Employees and Net Sales around the Non Financial Reporting mandatory threshold (500 employees and 40 millions net sales). The absence of peaks or discontinuities near the cutoff allows us to validate our RD design.