Sustainable development and supply chain coordination: the impact of corporate social responsibility rules in the European Union food industry.

Stefanella Stranieri, stefanella.stranieri@unimi.it, Department of Environmental Science and Policy, University of Milan, Milan, Italy.

Luigi Orsi, Corresponding Author, luigi.orsi@unimi.it, Department of Environmental Science and Policy, University of Milan, Milan, Italy.

Alessandro Banterle, alessandro.banterle@unimi.it, Department of Environmental Science and Policy, University of Milan, Milan, Italy.

Elena Claire Ricci, elenaclaire.ricci@unimi.it, Department of Environmental Science and Policy, University of Milan, Milan, Italy.

Abstract

Corporate social responsibility has become a strategic asset for food firms to demonstrate their good environmental conduct. The aim of this paper is to investigate the role of the implementation of corporate social responsibility activities on the reorganization of vertical relationships within food supply chains. Applying content analysis techniques to the Global Reporting Initiative reports, we collected qualitative data on investments in environmentally friendly options, the adoption of standards, stakeholder engagement, information searches, impact monitoring activities and chain coordination to transform it into quali-quantitative data. We find that the variables affecting chain coordination relate to the presence of sourcing standards, effort in discussing with chain partners ways to prevent and manage chain environmental impacts, and costs related to stakeholder feedback collection. The results of the analysis confirm corporate social responsibility as a strategic tool to improve supply chain relationships through an augmented vertical coordination and to integrate environmental policy.

Keywords: Corporate Social Responsibility, CSR, Environmental sustainability, Environmental policy, Vertical coordination, Transaction Costs, Food sector.

1. Introduction

The threats that economic growth poses to the environment are now clearer than ever; as pollution and environmental degradation worsen, the awareness of consumers and governments also increases (Harper and Snowden, 2017; Ricci et al., 2018). Supply chain stakeholders have a great deal of power in steering the trend of markets towards greener alternatives, but they can do it only through the adoption of reliable codes of conduct and by providing adequate information on the environmentally friendly activities adopted (Ashby et al., 2012; Walker and Jones, 2012; Illge and Preuss, 2012). Indeed, certifications and claims are part of this bridge between consumers and companies, but greenwashing and a lack of reliable data can lead customers towards uninformed choices (Zhang et al., 2014). Reliable and comparable corporate social responsibility (CSR) reports can constitute a valid source of information on companies' environmental conduct, allowing for better informed choices by the market and by supply chain stakeholders. CSR has become one of the main strategic activities of food firms.

Several definitions of CSR exist. Among these, the European Commission (2001, p. 6) defines CSR as "a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis". In the food sector, an increasing number of food companies have introduced voluntary certifications to communicate the efforts of their businesses towards the social and environmental aspects of production (Del Giudice et al., 2018).

Empirical research related to CSR has mostly explored the relationships between corporate social performance and competitiveness (Ambec and Barla 2006; Pasurka 2008, Marin et al., 2017, Briones Peñalver et al., 2018), the incentives that firms have to adopt CSR standards (Shauki, 2011), the financial consequences related to the implementation of such rules (Hartmann, 2011), and the effects of CSR rule implementation on human resource management (HRM) (Celma et al, 2011). To the best of our knowledge, no study has yet investigated the effects of CSR activities on supply chain coordination.

We aim to contribute to fill this knowledge gap and extend the existing literature by addressing the following research questions.
RQ1: Does the implementation of CSR rules lead to a reorganization of supply chain relationships?
RQ2: How might the activities conducted to implement CSR rules affect the reorganization of vertical relationships?
To answer to these research questions, we consider CSR rules institutions, and we refer to transaction cost economics (TCE) (Williamson, 1985) as the framework for our analysis to explain possible vertical coordination variations due to the implementation of such rules. According to TCE, the choice of economic agents among different forms of transaction governance depends on transaction costs, i.e., information, negotiating and monitoring costs, and transaction attributes associated with vertical exchanges, i.e., transaction asset specificity, uncertainty and frequency. We believe that the adoption of CSR rules impacts the characteristics of the transactions and, thus, transaction costs. Consequently, the implementation of such rules should have an impact on the level of vertical coordination among supply chain agents.
To collect data on CSR rules and activities implemented by food firms, we conducted a content analysis on the Global Reporting Initiative (GRI) reports of European companies operating in the food and beverages sector. GRI standards are disclosure guidelines for CSR reports aimed at standardizing CSR reporting practices. The information included in the reports was categorized on the basis of Williamson's theory. More specifically, we analyzed the relations between transaction costs and transaction characteristics with the variation of vertical coordination established to apply the GRI rules. We position our analysis within the context of the European agrofood industry.
Within this context, the research questions of the study find strong support in the stream of literature that shows the significant contribution of voluntary standards to the coordination of supply chains. Its contribution to the stream relates to investigating how CSR rules implemented by food firms may influence the management and governance of vertical relationships. Such an analysis is also crucial for firm management because it not only considers CSR rules firm communication tools it also analyzes them as possible instruments for effective firm strategic management. From a policy point of view, the study highlights if and in which way voluntary sustainability standards can be considered alternative policy instruments to guarantee efficiency in supply chain relationships.
The structure of the paper is as follows. The next section is devoted to building the conceptual framework. We define and justify the main relationships linking CSR rules and chain coordination. In section 3, we address the methodology, and in the following section, we present the main results. Section 5 is devoted to discussing the results and implications. The last section summarizes the main conclusions, including some limitations and future research trajectories.

2. Conceptual Framework

2.1 Corporate social responsibility and sustainability reporting

The interest in social responsibilities connected with the economic activity of firms has emerged in the last 60 years. Even though some concerns regarding these issues began to spread in the 1930s and 1940s, the analysis of company approaches to social responsibility tends to consider more developed and recent versions of the concept, starting from the 1950s and 1960s (Carroll, 1999). In the last decades, it has gained momentum, as consumers are becoming more aware and concerned about the environmental and social impacts of economic activities (Lerro et al., 2018). CSR activities are indeed viewed as a means of differentiating otherwise quite similar products and, thus, as a way to gain reputation and, quite likely, market shares.

One of the ways in which CSR can be manifested is via sustainability reports. Sustainability reporting is the practice of disclosing the extent to which the organization has contributed positively or negatively to the sustainability of the planet (Gray and Milne, 2002). Sustainability reports usually also include details about the values, goals, commitments, and strategies of the corporation in relation to the different aspects of sustainability. In recent years, an increasing number of firms has compiled and made public reports about the impacts of their economic activities and their CSR rules (Kolk, 2008). In December 2014, the European Commission required that certain large EU companies (more than 500 employees) also disclose nonfinancial and diversity information, which includes sustainability aspects of the firm's activities. The regulation targets 'public interest entities' and is expected to affect approximately 6000 companies across all sectors. More precisely, Regulation 2014/95/UE requires firms, beginning in 2017, to 'include in the management report a nonfinancial statement containing information to the extent necessary for an understanding of the undertaking's development, performance, position and impact of its activity, relating to, as a minimum, environmental, social and employee matters, respect for human rights, anti-corruption and bribery matters'. The report needs to present the firm's business model, policies, outcomes of the policies, principal risks, and performance indicators related to the abovementioned issues. The report may be independent or integrated with the financial report. One of the aims is to improve the disclosure of social and environmental information in order to increase transparency about firm operations. This may allow stakeholders to get a better picture of the sustainability performance of large corporations and, possibly, increase (or decrease) investor and consumer trust (Lo and Kwan, 2017). For firms who have not done so already, sustainability reporting may be an occasion for firms to start measuring, monitoring and managing the impacts of corporate activities on the environment and on society.

Sustainability reporting may be accomplished independently by each firm; however, reporting standards exist. Reporting standards have emerged to try to reduce the likelihood of sustainability reports being tailored to highlight only the positive impacts of firm activities and the improvements generated by CSR rules. The most famous and widespread sustainability reporting standard is the GRI standard developed by the Global Reporting Initiative, an independent international organization that has addressed sustainability reporting since 1997. This is a voluntary reporting standard that aims at improving the 'rigour, comparability, auditability and general acceptance' of sustainability reporting practices so that they may become comparable to financial ones (Willis, 2003). Indeed, providing a long list of indicators that should be included in a sustainability report, minimum requirements to reach different application levels, making reports easier to compare and, thus, to evaluate for stakeholders are all ways of increasing the likelihood of information being trustworthy. GRI also encourages and provides indications on how to perform external and independent assurance of sustainability reports (Toppinen et al. 2011; GRI, 2013).

In the present analysis, we use sustainability reports as a means to capture how environmentally related activities and objectives are integrated along the chain.

2.2 CSR and vertical coordination

We consider CSR rules institutions. According to Davis and North (1971), institutions are 'a set of rules that establishes the basis for production, exchange, and distribution'. Such rules influence the behavior of economic agents (North, 1990) and have the aim of reducing transaction uncertainty and minimizing transaction costs (Ménard, 2017).

However, the reduction of economic uncertainty can be achieved if economic agents effectively reorganize transactions on the basis of the activities and efforts conducted to implement CSR rules.

To analyze the effect of GRI rules on the coordination of food supply chains, we referred to the New Institutional Economics approach. More precisely, the analysis of the organizational changes within the food chain is conducted throughout the theoretical framework of TCE. We analyze whether the implementation of such rules leads to a different structure of transaction characteristics, costs and vertical coordination of food supply chains.

Following Williamson's theory, the adoption of CSR rules should lead to a variation of transaction attributes, i.e., the level of transaction asset specificity, uncertainty and frequency. The asset specificity of transactions refers to the specific investments that are necessary to conduct a specific transaction among supply chain agents (Williamson, 1991). Transaction asset specificity includes specialized human, physical, geographical, and intangible investments. Transaction uncertainty represents the probability that the conditions set up in vertical agreements will be accomplished. Such a transaction attribute is influenced by the lack of information transparency among the economic subjects of transactions. The transaction frequency refers to the lapse of time between one exchange and another (Hobbs, 1996). In this analysis, we did not consider the level of frequency because the implementation of CSR rules does not affect the frequency of transactions in the supply chain.

The variation of transaction attributes leads to a variation in transaction costs, i.e., information, negotiating and monitoring costs. Information costs are related to the time spent to acquire the necessary information to finalize transactions. Negotiating costs are related to the difficulty in settling agreements. Monitoring costs are correlated to the necessary resources spent to ensure the respect of transaction conditions (Stranieri et al., 2017). TCE postulates that the higher the transaction costs are, the higher the probability that economic agents will choose a more coordinated form of transaction governance, i.e., hybrids or hierarchy.

In accordance with Williamson (1979, 1985), the implementation of CSR rules should lead to a variation in the characteristics of the transactions. More precisely, the introduction of such rules implies an increase in transaction asset specificity, namely, the level of bilateral dependency of economic agents, due to the resources invested to fulfil the conditions of the sustainable practices of the firms.

In accordance with Williamson's theory, higher levels of transaction specific investments lead to higher transaction costs and more coordinated vertical relationships.

Moreover, the level of uncertainty increases within the augmentation of the specificity of the transactions. Thus, transaction uncertainty will depend on the bilateral dependency among transacting parties. As a consequence, the use of more coordinated transaction governance forms depends mainly on the level of the asset specificity of the transactions (Hobbs, 2004; Boger, 2001; Ménard and Klein, 2004), whereas the level of transaction uncertainty only conditionally affects the transaction governance (Williamson, 1979).

The introduction of CSR rules and the related set of transaction characteristics lead to a different structure in transactions costs. Such structures are mainly related to the selection of suppliers in compliance with the company sustainability-related rules, i.e., information costs, and the time spent to ensure that transacting parties respect the rules established, i.e., monitoring costs. In accordance with Williamson (1985) and Ménard and Valceschini (2005), higher levels of information and monitoring costs, in our case due to the implementation of CSR rules, could lead to a higher level of vertical coordination.

3. Methodology

3.1 Data collection

To operationalize the variables of our conceptual framework, we use the information disclosed by European food industry firms that adopt the GRI standard for sustainability reporting. Specifically,

the data were collected via the GRI reports of all the firms included in the 'Food and Beverage Products' sector of the GRI Sustainability Disclosure database whose report had been released after 2010 and in English.
This selection criterion, in April 2016, led to a total of 69 entries. However, some of these had to be excluded because of the absence of the report in the database, because the firm was not part of the food industry (but part of the retailing, distribution or input sectors) or its activities in the food sector were not its main focus, or because only one GRI report was available. The final sample consisted of 53 reports by 53 food and beverage firms, which corresponds to 77% of the entire target universe. All the reports considered followed either the GRI-G3 (12 reports), GRI-G3.1 (9 reports) or GRI-G4 (32 reports) standards.
All the sustainability reports were read thoroughly, and their text was analyzed and evaluated according to content analysis techniques. The reports vary in length, detail, structure and style. The analyzed reports ranged from 20 to 260 pages, with an average of 88 pages, for a total of 4672 pages. Some reports include the firm's annual report, and other reports are entirely dedicated to corporate sustainability reporting. The use of content analysis allowed us to transform the qualitative data into quali-quantitative data, which may more easily be compared and analyzed quantitatively. This conversion is based on an explicit coding process (Chen et al., 2015). Indeed, following previous literature (Montabon et al., 2007), to operationalize the vertical coordination, transaction characteristics and cost variables, the content of the text of each report was analyzed in detail, and the firm's performance on the different dimensions was assessed on a 5 point scale defined as follows: level 0 indicates that the issue at stake is not discussed in the report; level 1 is assigned when the issue is only briefly or implicitly mentioned; level 2 is applied when the issue is described, but in a vague manner; level 3 indicates that there is a detailed description of the actions taken to tackle the issue under consideration; level 4 is assigned to firms that include in the report a very detailed and quantitative (when applicable) discourse of the issue, including foreseen efforts to improve operations in the future.
For each of the firms included in the final sample, financial data was also collected from the Amadeus Database published by Moody's Analytics / Bureau van Dijk. These consist of data on the firm's employees and the firm's public/private status (See Table 1 for a more detailed description).

3.2 Variable description

On the basis of our conceptual framework and on data availability, we built thirteen variables pertaining to vertical coordination on environmental sustainability issues and transaction characteristics and related costs. Four of these variables were directly taken by the GRI standard indicators, the other eight variables were created on the basis of our research interest and the previous literature (Chen et al., 2015; Montabon et al., 2007) and evaluated by analyzing all the parts of the reports that could be relevant.

More specifically, the dependent variable adopted to test the conceptual framework is the level of coordination of the firm with its suppliers through the collaboration on environmental issues (Coord_Env). The dependent variable was operationalized using the latest report available, while we used the previous one to measure the explanatory variables in order to avoid unnecessary endogeneity and to have a minimum time of one year to evaluate the effects of CSR strategies on supply chain coordination.

There are twelve explanatory variables pertaining to environmental sustainability measures, and they relate to transaction asset specificity, information costs and monitoring costs (Stranieri et al., 2017). Among the transaction asset specificity variables, we consider four variables: specific investments for environmental sustainability (AS_{1i}), sourcing standards (AS_{2i}), local suppliers (AS_{3i}), and supplier competence (AS_{4i}). The first variable measures the level of specific investments adopted to improve the environmental sustainability performance of the firm. This variable includes, for example, the firm's investments in new packaging-related equipment for energy saving issues and the use of recyclable packaging material (Agrokor) or improvements in energy, water, waste and atmospheric emissions management (Bonduelle). The second variable is taken from one of the GRI guideline indicators specifically developed for the food processing sector: 'percentage of purchased volume from suppliers compliant with company's sourcing policy' (G4-FP1). This variable is related to firm sourcing management. The adoption of a sourcing policy means agents are locked into a transaction with specific characteristics. Suppliers invest to respect the sourcing policy requirements, and the firm itself will comply with the sourcing policy to build and maintain its brand equity. The variable measures if there are sourcing standards and how strongly these are followed. The third variable is related to geographical asset specificity and relates to a specific GRI guideline indicator: 'Proportion of spending on local suppliers at significant locations of operation' (G4-EC9). The last transaction asset specificity variable is instead related to human asset specificity, as it evaluates the firm investments/effort to build suppliers' competence and to intensify knowledge transfer along the chain.

Regarding information cost variables, we evaluate firm effort to identify and engage with environmentally responsible suppliers, discuss environmental impacts along the chain, identify stakeholders and their perceptions. More specifically, the 'environmentally responsible suppliers' variable (IC_{1i}) is built on the basis of the information disclosed in relation to the GRI guidelines indicator 'Percentage of new suppliers that were screened using environmental criteria' (G4-EN32). This variable aims at identifying the information costs incurred by searching and choosing suppliers on the basis of their environmental performance. Moreover, we evaluate the effort of identifying potential environmental impacts of chain activities. In this direction, variable 'impact discussion'

(IC_{2i}) evaluates the level of effort put into discussing how to prevent supply chain environmental impacts. Information costs related to the process of identifying and collecting data about chain stakeholders are comprised in the 'stakeholder identification' variable (IC_{3i}) and stakeholder environmental performance perception (IC_{4i}). The latter relates to the firm activities to gather information about customer and stakeholder perception about the chain's environmental performance.

The monitoring cost variables appraise the presence of control measures on the negative environmental impacts along the supply chain. Specifically, the first variable (MC_{1i}) is built on the basis of the GRI guidelines indicator 'Significant actual and potential negative environmental impacts in the supply chain and actions taken' (G4-EN33). This indicator is aimed at evaluating if an action is taken to monitor and respond to negative environmental impacts along the chain. An additional variable, namely, the stakeholder feedback variable, was built to capture the firm's effort to collect (and take into consideration) stakeholder feedback (MC_{2i}). Moreover, we also built a variable to account for costs related to actual performance audits (MC_{3i}) and/or life-cycle assessments (MC_{4i}). The former variable relates to independent external audits of environmental performance, looking also at how extensive they are and if the results are made public. The latter variable refers to the costs related to product life-cycle assessment analyses.

A set of four control variables (C_{zi}) were also included in the model. GRI experience (C_{1i}) is considered a proxy for the organizations' understanding and communication of the impact of their business on critical sustainability issues, such as climate change, human rights, corruption and many others. GRI experience is operationalized using the number of years of using GRI standards for sustainability reports calculated as a difference from the last available report to the first. Firm size (C_{2i}) is also a critical aspect. Researchers have demonstrated that this factor has a direct effect on the publication of sustainability reports (Lee, 2017). It has been observed that the larger the firm, the more likely it is to use resources for social and environmental reports (Guthrie et al., 2008). Firm size is measured using the number of employees reported in the last annual report. We also introduced the dummy variable 'firm status' (C_{3i}) to control for the status of the firm (1 = public company; 0 = private company) and to explore the impact of a more complex firm structure (public) on the level of coordination among supply chain partners on environmental issues with respect to simpler organizational forms (private). Finally, we controlled for the geographical location (C_{4i}) of the firm to investigate the possible effects of the area where the firms are established (Northern, Eastern, Western and Southern Europe) on the level of coordination among supply chain partners on environmental issues. Table 1 summarizes all the variables used in our analysis: their descriptions, average value, standard deviation, minimum and maximum value.

---------insert Table 1 around here----------

3.3 Data analysis

Our dependent variable measures the level of coordination among supply chain partners through collaboration on environmental issues. Because the dependent variable is based on ordered categorical data, cumulative link models are recommended. The definition of *cumulative link models* is adopted from Agresti (2002), but such models are often called *ordinal regression models* or *ordered logit/probit models* (Greene and Hensher, 2010). They represent by far the most popular class of ordinal regression models.

According to Agresti (2002), a *cumulative link model* with a logit link is defined as

$$logit(y_{i,j}) = logit[P(Y_i \leq j)] = \alpha_j + \boldsymbol{\beta x_i} \quad j = 1,2,\ldots,J-1 \qquad [1]$$

where $P(y_z \leq i)$ is the cumulative probability (i.e., the probability that the *i*th individual is in the *j*th or higher category at time *t+1*), $\boldsymbol{x_i}$ is a vector of explanatory variables for the *i*th observation at time *t*, $and\ \boldsymbol{\beta}$ is the corresponding set of regression parameters and tells us how a one-unit increase in the independent variable increases the log odds of being higher than category *j*. The parameter a_j provides each cumulative logit (for each *j*) with its own intercept, and it varies between categories and satisfies the constraints $a_1 \leq a_2 \leq \cdots \leq a_{j-1}$. A key point is that individuals in the sample are assumed to be categorized independently of each other. Our *cumulative link model* specification is the following:

$$logit(\text{Coord\_Env}_{i,j}) = \alpha_j + \beta Controls_{z,i} + \beta Asset\_spec_{z,i} + \beta Info\_cost_{z,i} + \beta Mon\_cost_{z,i}$$
$$j = 1,\ldots,4 \quad i = 1,\ldots,53 \qquad [2]$$

where $\text{Coord\_Env}_{i,j}$ is the vector of the dependent variable — the level of coordination of the firm with its suppliers on environmental sustainability issues; $Controls_{z,i}$ represents the vector of the *z*th control variables; and $\beta Asset\_Spec_{z,i}, \beta Info\_Cost_{z,i}, \beta Mon\_Cost_{z,i}$ represent the vector of the explanatory variables asset specificity, information costs and monitoring costs.

We used the *clm* command from the *Ordinal* package in the R 3.4.2 software to estimate the cumulative link model (R Core Team 2013). The coefficients from the model can be difficult to interpret because they are scaled in terms of logs. Another way to interpret logistic regression models is to use the antilog to estimate the coefficients into odds ratios (O.R.). This procedure allows for a better understanding and comparison of coefficients in the full model (Model V).

In addition, we assessed the Akaike information criterion (AIC) and the log-likelihood to evaluate the goodness of fit of the models. A general way to compare models is using the likelihood ratio test (LR). The LR statistic measures the evidence in the data that supports the extra complexity of nested models. As a base model that we compare our results against, we also present the outcome with only the control variables. Indeed, Model I in Table 3 reports the effect of the control variables on the dependent variable, *Coord_Env*. Model II shows the results of the controls plus those of the asset specificity variables. Model III provides the results of the controls plus those of the information cost variables, while Model IV provides the results of the controls plus those of the monitoring cost variables. Finally, Model V presents the results for the full model when all the variables are included (control variables, asset specificity variables, information cost variables, and monitoring cost variables).

Moreover, we tested the robustness of our results and the assumption of the proportional odds against alternative model specifications. One way to do this is by comparing the proportional odds logistic model with a multinomial logit model. The latter is typically used to model unordered variables, while the former is nested in the multinomial model; thus, we performed an LR test to see if the models are statistically different, but we found no significant differences. Hence, the results of the multinomial model are qualitatively consistent with those presented in Table 3.

4. Results

Table 1 and Table 2 report, respectively, the descriptive statistics and the correlation matrix. The data show that all the explanatory variables are positively correlated to the dependent variable, *Coord_Env*. The correlation values among the explanatory variables are relatively low, except for AS_{4i} with IC_{2i} and for IC_{3i} with MC_{2i} and MC_{1i}. To avoid serious collinearity bias and to optimize our estimations, we decided to remove from our models the variables AS_{4i}, IC_{3i} and MC_{1i}. Collinearity is further supported by measuring the variation inflation factors (VIFs) for each model and was found not to be a problem, with the VIF values below the cut-off point of 5 (O'Brien, 2007).

With regard to the firms' general characteristics (see Table 1), the average number of employees in our sample is approximately 16000, varying from a minimum of 45 employees for the Belgian company Warnez specialized in growing, washing, sorting and packaging potatoes for supermarkets and the catering sector to 328000 employees for Swiss multinational Nestlè. The sample is mainly composed of large and very large firms, such as Nestlè, Danone, Carlsberg and Heineken. This sample structure pinpoints that the use of GRI standards is a prerogative of medium and large businesses. On average, companies have adopted GRI sustainability standards for approximately 4 years, varying from a minimum of 2 years (e.g., Lavazza an Italian coffee roaster, Lotus bakeries a Belgium baked products producer or Grupo Calvo a Spanish fish producers) to a maximum of 12 years of commitment in GRI reporting in the case of Diageo plc., an English alcoholic beverage producer. Most of the agrofood firms in our sample are private companies (approximately 70%); in contrast, publicly quoted companies represent only 30% of the total sample. Finally, regarding the geographical distribution of the firms, 9% of the sample is located in Eastern Europe, 28% in Northern Europe, 19% in Southern Europe, and 44% in Western Europe.

----insert Table 2 around here-------

Table 3 reports the proportional odds logistic coefficient estimates for the cumulative link model regressions. The overall fit of the full model (Model V) increases compared to the baseline (Model I), denoting that the full model better fits our data (AIC values decrease, and log-likelihood increases). Moreover, the LR test shows that Models II, III, IV and V improve significantly with respect to the base Model I (Pr > LR test is 0.001). In other words, the introduction of the three classes of explanatory variables (transaction asset specificity, information costs, and monitoring costs) adds more explanatory power to our models in explaining our dependent variable.

Model I presents the effects of the control variables on the level of coordination among supply chain partners on environmental issues (*Coord_Env)*. The coefficient estimates of the variables regarding the firm's status ($p < 0.1$) and its geographical location ($p < 0.1$) are statistically significant, suggesting that more structured firms (as publicly quoted firms) are more likely to adopt a low level of coordination among chain partners, while agrofood companies located in Northern and Western Europe are more likely to adopt a significantly higher level of coordination on environmental sustainability issues compared to Eastern and Southern European firms. By contrast, the variables measuring the GRI experience and firm size do not appear to be significant. This latter result seems to support the view that the size of the firms is not relevant in changing vertical relationships on environmental matters. In this sense, we must keep in mind that our sample is mainly composed of medium and large companies. Small businesses are a priori excluded from this analysis because they most likely do not have enough financial and human resources to devote to environmental sustainability reporting.

Concerning Model II, we focus directly on the comment of the explanatory variables related to transaction asset specificity because the control variable signs and coefficients remain stable compared to the baseline model. This set of variables seems to be positively correlated with the level of coordination among supply chain partners on environmental issues, but the only statistically significant variable ($p>0.001$) is the sourcing standards variable (AS_{2i}). Specifically, if we look at the odd ratios of the asset specificity variables in Model V, we can see that the percentage of purchased volume from suppliers, compliant with company's sourcing policy, has one of the highest contributions to the dependent variable. Thus, firms with higher levels of compliance with sourcing standards tend have engaged in greater changes in vertical coordination in relation to collaboration on environmental issues. In contrast, the variables related to local suppliers (AS_{3i}) and specific investments for environmental sustainability (AS_{1i}) are positive, but there is no evidence to support a significant effect on the dependent variable.

Regarding information costs (Model III), all the variables, i.e., 'environmentally sustainable suppliers' (IC_{1i}), 'impact discussion' (IC_{2i}), and 'stakeholder environmental performance perception' (IC_{4i}), have a positive impact on the dependent variables, but only the effects of the first two variables seem to be significant. Indeed, seeking information and choosing environmentally sustainable suppliers ($p < 0.1$) and discussing prevention of chain environmental impacts ($p < 0.001$) seem to be relevant factors in impacting chain coordination.

Finally, we found that monitoring cost variables also has a positive influence on the level of coordination among supply chain partners on environmental issues. Specifically, if we look at the odds ratio in Model V, costs related to collecting stakeholder feedback (MC_{2i}) and to independent audits (MC_{3i}) have a significant impact on chain coordination (at the 0.001 and 0.1 levels, respectively), while those related to life cycle assessment analyses (MC_{4i}) do not seem to be statistically significant.

The analysis of the full model with all the explanatory variables (Model V) mainly confirms the previous results both in term of the effects of the control variables and the explanatory variables. The estimates and the significance of the coefficients of the control and independent variables remain stable compared to the baseline model and models II, III and IV, except for IC_{1i} and MC_{3i}, which lost their significance because they are very close to the threshold of acceptability.

-----insert Table 3 around here--------

5. Discussion

The data show that the explanatory variables are tightly correlated to the dependent variable that measures vertical coordination on sustainability performance. More specifically, the results suggest that the more structured firms, as publicly quoted firms, are more likely to adopt lower levels of chain coordination in relation to environmental issues. This is probably because such firms have to comply with specific procedures related to the disclosure of financial, social and environmental information in order to be listed on stock exchanges and to attract a large number of investors. This fact leads public companies to a more stringent implementation of CSR rules, but therefore, this does not also mean higher levels of environmental coordination along the supply chain. Public companies seem to be more opportunistic and driven by self interest in these kinds of relationships with suppliers than private and family firms. Public companies operating at a more global level and, consequently, more sensitive to sudden changes in the market tend to value flexibility, independence and short-term relationships with chain actors as a strategic tool than other types of businesses keener on exploiting value from long-term relationships (Peterson et al., 2001).

Moreover, our results suggest that there may be a geographical pattern in the effects of environmental sustainability on vertical relations. Indeed, we find that agrofood companies located in Northern and Western Europe are more likely to register higher levels in supply chain coordination compared with Eastern and Southern European firms. This could be related to the higher interest of stakeholders in those regions in environmental sustainability matters (Camarero et al., 2013; Beltrán-Esteve and Picazo-Tadeo, 2017). This could indeed induce companies to go the extra step in the adoption of CSR goals, which requires an integration of goals along the whole supply chain, and this can lead to more vertical collaboration and coordination. Furthermore, in our sample of medium to large food firms, experience with GRI reporting and the size of the firm do not seem to be relevant in shaping vertical relationships due to collaboration on environmental issues.

The results indicate that, instead, most of the transaction cost economic variables included in our conceptual framework are relevant in shaping coordination among supply chain partners. More specifically, we find that transaction asset specificity, information costs and monitoring costs show a relevant and positive impact on the level of vertical coordination. More precisely, we find that the most significant variables affecting chain coordination related to improved collaboration on environmental matters relate to the presence of sourcing standards, the augmented effort in discussing with chain partners ways to prevent and manage chain environmental impacts, and increased monitoring costs related to stakeholder feedback collection.

These results achieved in the analysis seem to suggest that TCE can be considered a useful framework to describe the organizational structures derived by the introduction of CSR rules within the food supply chain. Such a framework helps to answer to our research questions by highlighting that CSR rules may affect the reorganization of vertical relationships when economic agents carry out specific investments for their implementation, which imply different structures in transaction costs and, thus, a positive impact on the increased vertical coordination of economic relationships within food supply chains.

More precisely, the positive link between the specificities of transactions due to the implementation of CSR rules suggests that the implementation of CSR rules requires specific investments and increases transaction costs. Such a result corroborates the idea to consider CSR rules institutions, i.e., rules that affect the way economic agents conduct and coordinate business relationships. For example, the adoption of sourcing standards or the variations in supplier selection methods stress how food firms change business activities in order to comply with CSR rules.

Moreover, the analysis also highlights that such rules have an effect on the actual organization of transactions within the food supply chain. More precisely, it suggests that supply chain partners will construct more tightened relationships in order to mitigate the behavioral uncertainty that increases with the increased bilateral dependency among supply chain partners. Thus, CSR can be considered

not only a communication tool by food firms, able to inform customers about the way business is conducted, but also a way to foster more tight transactions among supply chain partners. Indeed, such rules can be considered instruments to improve collaboration and long-lasting vertical relationships.
From a managerial perspective, the findings of the analysis suggest that CSR can be considered a way to achieve more closed economic relationships in terms of more coordinated transactions. In the case of transactions regulated mainly through market-based governance forms, the introduction of rules related to the sustainability of business activities could help to achieve more efficient relationships in terms of increased coordination and, consequently, improved transparency. Indeed, from a managerial point of view, CSR could be a tool that promotes chain collaboration and, thus, a more efficient management of vertical relations that may improve performance and allow for differentiation opportunities in the market.
From a policy point of view, CSR rules can become an alternative form of transaction governance that may integrate public regulation for environmental matters. Indeed, it favors transparency, efficiency and environmental performance via self-regulation. These factors can also potentially strengthen chain relationships and performance and thus also economic gains, in addition to those related to better environmental performance.

6. Conclusion, limitations and future research directions

The results of the present analysis highlight the role of CSR rules in shaping vertical relationships within the food supply chain, and they suggest a new way to consider such rules. In addition to being considered part of the business strategy to build firm reputation and provide a means of differentiation, such rules can be considered a way to reorganize transactions by improving supply chain collaboration and to foster more transparent and efficient vertical relationships.
When analyzing the insights from this study, however, a few limitations and possible future trajectories should be taken into account.
First, qualitative research always raises questions about the quality of the data collected. Even if the data is collected and processed by experts with the utmost attention, data is strongly affected by which attributes are selected, and important dimensions might be left out.
Second, the analysis is applied to a single industry. In addition, only a relatively small number of medium and large enterprises disclose CSR reports in English using GRI standards. Thus, these results should be interpreted prudently. Similar studies could be extended to other sectors that present different structural characteristics in order to improve the generalizability of the results.
Finally, we used a cross-sectional analysis to investigate the links between CSR rules and chain coordination processes. Future analyses using longitudinal data (when more data and more CSR

reports are available) could improve our understanding of the dynamics of CSR rules on supply chain coordination; in this case, a longitudinal regression would better represent these dynamics.

References

Agresti, A. (2002). *Categorical Data Analysis* (2nd ed.). Wiley.

Ambec, S. & Barla P. (2006). "Can Environmental Regulations be Good for Business? An Assessment of the Porter Hypothesis." *Review of Energy Studies* 14 (2): 42–62.

Ashby, A., Leat, M., & Hudson-Smith, M. (2012). Making connections: a review of supply chain management and sustainability literature. *Supply Chain Management: An International Journal*, *17*(5), 497-516.

Beltrán-Esteve, M. & Picazo-Tadeo, A.J. (2017). Assessing environmental performance in the European Union: Eco-innovation versus catching-up. *Energy Policy*, 104, 240–252.

Boger, S. (2001). Quality and contractual choice: a transaction cost approach to the Polish hog market. *European Review of Agricultural Economics* 28 (3), 241–261.

Briones Peñalver, A. J., Bernal Conesa, J. A., & de Nieves Nieto, C. (2018). Analysis of Corporate Social Responsibility in Spanish Agribusiness and Its Influence on Innovation and Performance. *Corporate Social Responsibility and Environmental Management*, 25(2), 182-193.

Camarero, M., Castillo, J., Picazo-Tadeo, A. J., & Tamarit, C. (2013). Eco-efficiency and convergence in OECD countries. *Environmental and Resource Economics*, *55*(1), 87-106.

Carroll, A. B. (1999). Corporate Social Responsibility: Evolution of a Definitional Construct. *Business & Society*, 38(3), 268–295.

Celma, D., Martínez-Garcia, E., & Coenders, G. (2014). Corporate social responsibility in human resource management: An analysis of common practices and their determinants in Spain. *Corporate Social Responsibility and Environmental Management*, 21(2), 82-99.

Chen, L., Tang, O., & Feldmann, A. (2015). Applying GRI reports for the investigation of environmental management practices and company performance in Sweden, China and India. *Journal of Cleaner Production*, 98, 36–46.

Del Giudice, T., Stranieri, S., Caracciolo di Torchiarolo, F., Ricci, E.C., Cembalo, L., Banterle, A. & Cicia, G. (2018). Corporate Social Responsibility certifications influence consumer preferences and the seafood market price. *Journal of Cleaner Production*, 178, 526-533.

European Commission. Directorate-General for Employment. (2001). *Promoting a European Framework for Corporate Social Responsibility: Green Paper*. Office for Official Publications of the European Communities.

Gray R. e Milne M. (2002), Sustainability reporting: who's kidding whom?, *Chartered Accountants Journal of New Zealand*, 81(6), 66-70.

Greene, W. H., & Hensher, D. A. (2010). *Modeling ordered choices: A primer*. Cambridge University Press.
GRI (2013). The external assurance of sustainability reporting. Global Reporting Initiative Research and Development Publications, Amsterdam, The Netherlands.
Guthrie, J., Cuganesan, S., Ward, L. (2008). Industry specific social and environmental reporting: The Australian Food and Beverage Industry. *Accounting Forum* 32:1–15.
Harper, C., & Snowden, M. (2017). Environment and society: Human perspectives on environmental issues. Taylor & Francis.
Hartmann, M. (2011). Corporate social responsibility in the food sector. *European Review of Agricultural Economics*, 38(3), 297-324.
Hobbs, J. E. (1996). A transaction cost approach to supply chain management. *Supply Chain Management: An International Journal*, *1*(2), 15-27.
Hobbs, J.E. (2004). Markets in metamorphosis: the rise and fall of policy institutions. In: Van Huylenbroeck, G., Verbeke, W., Lawers, L. (Eds.), Role of Institutions in Rural Policies and Agricultural Markets. Elsevier, Amsterdam.
Illge, L., & Preuss, L. (2012). Strategies for sustainable cotton: comparing niche with mainstream markets. *Corporate Social Responsibility and Environmental Management*, *19*(2), 102-113.
Kolk, A. (2008). Sustainability, accountability and corporate governance: exploring multinationals' reporting practices. *Business Strategy and the Environment* 17, 1–15.
Lee, K-H. (2017). Does Size Matter? Evaluating Corporate Environmental Disclosure in the Australian Mining and Metal Industry: A Combined Approach of Quantity and Quality Measurement. *Business Strategy and the Environment* 26:209–223.
Lerro, M., Vecchio, R., Caracciolo, F., Pascucci, S., & Cembalo, L. (2018) Consumers' heterogeneous preferences for corporate social responsibility in the food industry. *Corporate Social Responsibility and Environmental Management*. In press.
Lo, K. Y., & Kwan, C. L. (2017). The effect of environmental, social, governance and sustainability initiatives on stock value–Examining market response to initiatives undertaken by listed companies. *Corporate Social Responsibility and Environmental Management*, 24(6), 606-619.
Marin, L., Martín, P. J., & Rubio, A. (2017). Doing good and different! The mediation effect of innovation and investment on the influence of CSR on competitiveness. *Corporate Social Responsibility and Environmental Management*, 24(2), 159-171.
Ménard, C., Klein, P.G. (2004). Organizational issues in the agri-food sector: toward a comparative approach. *American Journal of Agricultural Economics* 86(3), 750–755.
Ménard, C., Valceschini, E. (2005). New institutions for governing the agri-food industry. *European Review of Agricultural Economics* 32(3), 421–440.

Montabon, F., Sroufe, R., & Narasimhan, R. (2007). An examination of corporate reporting, environmental management practices and firm performance. *Journal of Operations Management*, 25(5), 998–1014. http://doi.org/10.1016/j.jom.2006.10.003

North, D.C., 1991. Institutions. Journal of Economic Perspectives 5(1), 97–112.

O'Brien, R.M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality & Quantity*, *41*(5), 673–690.

Pasurka, C. (2008). "Perspectives on Pollution Abatement and Competitiveness: Theory, Data, and Analyses." *Review of Environmental Economics and Policy* 2(2): 194–218.

Peterson, H. C., Wysocki, A., & Harsh, S. B. (2001). Strategic choice along the vertical coordination continuum. *The International Food and Agribusiness Management Review*, 4(2), 149-166.

R Core Team (2013) R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria

Ricci, E.C., Banterle, A. & Stranieri, S. (2018). Trust to Go Green: An Exploration of Consumer Intentions for Eco-friendly Convenience Food. *Ecological Economics*, 148, 54-65.

Shauki, E. (2011). Perceptions on corporate social responsibility: A study in capturing public confidence. *Corporate Social Responsibility and Environmental Management*, 18(3), 200-208.

Stranieri, S., Orsi, L., & Banterle, A. (2017). Traceability and risks: an extended transaction cost perspective. *Supply Chain Management: An International Journal*, *22*(2), 145-159.

Toppinen, A., Li, N., Tuppura, A., & Xiong, Y. (2012). Corporate responsibility and strategic groups in the forest-based industry: Exploratory analysis based on the Global Reporting Initiative (GRI) framework. *Corporate Social Responsibility and Environmental Management*, *19*(4), 191-205.

Walker, H., & Jones, N. (2012). Sustainable supply chain management across the UK private sector. *Supply Chain Management: An International Journal*, 17(1), 15-28.

Williamson, O.E (1985). The Economic Institutions of Capitalism. Firms, Markets, Relational Contracting. The Free Press, New York.

Williamson, O.E. (1979). Transaction cost economics: the governance of contractual relations. *Journal of Law and Economics* 22(2), 233–261.

Williamson, O.E. (1991). Comparative economic organisation: the analysis of discrete structural alternatives. *Administrative Science Quarterly* 36(2), 269–296.

Willis, A. (2003). The Role of the Global Reporting Initiative's Sustainability Reporting Guidelines in the Social Screening of Investments, *Journal of Business Ethics* 43: 233-237.

Zhang J., J., Joglekar, N., & Verma, R. (2014). Signaling eco-certification: Implications for service coproduction and resource efficiency. *Journal of Service Management*, 25(4), 494-511.

Table 1: Variables description and descriptive statistics

Variables	Description	Min	Max	Mean	Median	Std.dev
Dependent Variables						
Coord_Env	Coordination level among supply chain partners through improved collaboration on environmental issues (0=no coordination; 4=high level of coordination)	0	4	2.34	2	1.33
Control Variables						
GRI exp	Number of years in using GRI standards	2	12	4.42	4	3.19
Firm's size	Number of employees of the firm	45	328000	16169.70	1700	48525.69
Public (Yes=1)	The type of firm (Dummy variable: 1 = Publicly quoted company; 0 = Private company)	0	1	0.30	0	0.46
Geo area_East (Yes=1)	Geographical location of the firm (Eastern Europe)	0	1	0.09	0	0.30
Geo area_North (Yes=1)	Geographical location of the firm (Northern Europe)	0	1	0.28	0	0.45

Geo area_South (Yes=1)	Geographical location of the firm (Southern Europe)	0	1	0.19	0	0.39
Geo area_West (Yes=1)	Geographical location of the firm (Western Europe)	0	1	0.44	0	0.50
Exploratory variables						
AS_{1i}	Level of specific material investments for environmental sustainability (0=no investments; 4=high level of investments)	0	4	1.74	2	1.08
AS_{2i}	Level of sourcing standards for environmental sustainability (0=no sourcing standards; 4=high level of sourcing standards)	0	4	2.28	2	1.35
AS_{3i}	Level of purchase from local suppliers (0=no purchase; 4=high level of purchase)	0	4	1.64	2	1.47
AS_{4i}	Level of specific investments to build supplier competence (0=no investments; 4=high level of investments)	0	4	1.32	1	1.36
IC_{1i}	Level of effort/costs for identifying environmentally responsible suppliers (0=no effort; 4=high level of effort)	0	4	1.26	1	1.43
IC_{2i}	Level of effort/discussion with chain partners for preventing/managing supply chain environmental impacts (0=no discussion; 4=high level of discussion)	0	4	1.62	2	1.32
IC_{3i}	Level of effort/costs for identifying of chain stakeholders (0=no effort; 4=high level of effort)	0	4	2.74	3	1.15
IC_{4i}	Level of effort/costs to collect information on stakeholder environmental performance perception (0=no effort; 4=high level of effort)	0	4	1.21	1	1.29
MC_{1i}	Level of effort/costs for identifying and responding to negative environmental impacts in the supply chain (0=no effort; 4=high level of effort)	0	4	2.02	2	1.31
MC_{2i}	Level of effort/costs to collect stakeholder feedback (0=no effort; 4=high level of effort)	0	4	2.28	2	1.35
MC_{3i}	Level of independent audits of environmental performance (0=no audits; 4=extensive audits whose results are made public)	0	4	1.30	0	1.54
MC_{4i}	Level of effort/costs for product life-cycle assessment analyses (0= no LCA analyses; 4= extensive LCA analyses)	0	4	1.57	2	1.46

Table 2: Correlation matrix

	Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
1	*Coord_Env*	1																			
2	*GRI exp*	-0.24*	1																		
3	*Firm's size*	-0.06	0.16	1																	
4	*Public (Yes=1)*	-0.20	0.16	0.22	1																
5	*Geo area_East (Yes=1)*	-0.23*	0.04	-0.09	0.07	1															
6	*Geo area_North (Yes=1)*	0.12	0.18	-0.07	0.04	-0.20	1														
7	*Geo area_South (Yes=1)*	-0.23*	-0.08	-0.06	-0.32*	-0.16	-0.30*	1													
8	*Geo area_West (Yes=1)*	0.21	-0.13	0.17	0.17	-0.28*	-0.55***	-0.42**	1												
9	AS_{1i}	0.17	0.05	0.09	-0.03	0.02	-0.20	0.12	0.07	1											
10	AS_{2i}	0.62***	-0.28*	0.09	-0.02	-0.12	-0.04	-0.17	0.24*	0.18	1										
11	AS_{3i}	0.08	0.07	-0.10	-0.04	0.12	-0.16	0.09	0.01	-0.16	0.18	1									
12	AS_{4i}	0.65***	-0.20	0.27*	-0.07	-0.08	-0.03	-0.12	0.16	0.27*	0.44***	0.01	1								
13	IC_{1i}	0.36**	-0.15	-0.05	0.37**	-0.01	0.09	-0.26*	0.13	0.13	0.27*	0.22	0.29*	1							
14	IC_{2i}	0.70***	-0.20	0.09	-0.09	-0.15	0.15	-0.08	0.02	0.23	0.44**	0.09	0.80***	0.43**	1						
15	IC_{3i}	0.67***	-0.22	0.17	-0.10	-0.10	-0.15	-0.02	0.20	0.24*	0.46***	0.13	0.45***	0.22	0.48***	1					
16	IC_{4i}	0.31*	-0.03	0.09	-0.20	-0.05	-0.23*	0.19	0.10	0.15	0.12	0.09	0.35*	0.03	0.32*	0.49***	1				
17	MC_{1i}	0.66***	-0.05	0.04	-0.01	-0.10	0.02	-0.19	0.19	0.22	0.49***	0.16	0.46***	0.35*	0.47***	0.57***	0.26*	1			
18	MC_{2i}	0.26*	-0.03	0.22	0.05	0.17	-0.20	0.15	-0.04	0.32*	0.16	0.08	0.18	0.23*	0.26*	0.62***	0.44***	0.36**	1		
19	MC_{3i}	0.22	0.01	0.13	0.09	-0.15	0.15	0.06	-0.10	0.10	0.13	-0.06	0.06	0.14	0.10	0.41**	0.41**	0.22	0.33*	1	
20	MC_{4i}	0.23	-0.18	0.16	-0.06	-0.13	-0.04	0.18	-0.03	0.30*	0.34*	0.02	0.38**	0.17	0.33*	0.23*	0.00	0.19	0.25*	-0.02	1

Notes: Significance levels are *** p<0.001, ** p<0.01, * p<0.1

Table 3: Cumulative link model regression results

Dependent variable – Level of chain coordination (Coord_Env)	*Ordinal logistic regression models*					
	Model I	*Model II*	*Model III*	*Model IV*	*Full model V*	
Intercepts	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*Coeff.*	*O.R.*
ESE 0|1	-3.748 (0.844)***	-1.250 (1.028)	-2.609 (0.946)**	-0.524 (1.121)	1.236 (1.325)	
ESE 1|2	-2.887 (0.775)***	-0.252 (0.989)	-1.505 (0.885)**	0.771 (1.111)	2.758 (1.319)	
ESE 2|3	-1.252 (0.648)*	1.936 (0.977)*	0.589 (0.827)	3.579 (1.200)**	6.388 (1.598)	
ESE 3|4	0.010 (0.639)	3.635 (1.083)*	2.168 (0.882)*	5.839 (1.396)***	9.178 (1.903)	
Control variables						
GRI exp	-0.115 (0.087)	-0.043 (0.099)	-0.086 (0.093)	0.042 (0.108)	0.151 (0.122)	1.163
Firm's size	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)*	0.000 (0.000)*	1.000
Public (Yes=1)	-1.225 (0.604)*	-1.290 (0.639)*	-2.107 (0.743)**	-1.775 (0.702)*	-2.510 (0.902)**	0.081
Geo area_East (Yes=1)	-1.754 (0.905)*	-2.084 (1.013)*	-2.631 (1.046)*	-0.701 (1.018)	-1.605 (1.286)	0.201
Geo area_South (Yes=1)	-2.152 (0.849)*	-2.142 (0.971)*	-2.920 (0.997)**	-1.785 (0.905)*	-1.902 (1.165)*	0.149
Geo area_West (Yes=1)	0.048 (0.616)	-0.316 (0.686)	-0.174 (0.678)	1.281 (0.769)	1.015 (0.943)	2.760
Explanatory variables: Transaction asset specificity						
AS_{1i}		0.333 (0.285)			-0.051 (0.352)	0.950
AS_{2i}		0.982 (0.270)***			1.108 (0.344)**	
AS_{3i}		0.192 (0.207)			-0.060 (0.246)	0.942
						3.027
Explanatory variables: Information costs						
IC_{1i}			0.542 (0.245)*		0.241 (0.296)	1.273
IC_{2i}			1.756 (0.376)***		1.662 (0.454)***	5.270
IC_{4i}			0.393 (0.241)		-0.064 (0.343)	0.938
Explanatory variables: Monitoring costs						
MC_{2i}				0.453 (0.250)*	0.473 (0.284)*	1.604
MC_{3i}				0.518 (0.202)*	0.366 (0.26)	1.441
MC_{4i}				0.084 (0.235)	-0.316 (0.282)	0.729
No. of observations	53	53	53	53	53	
Akaike Information Criterion (AIC)	169.07	153.27	156.41	134.42	130.43	
Log likelihood	-74.49	-63.63	-65.21	-54.21	-46.21	
LR test (change over the base model)		21.73***	18.59***	40.57***	56.56***	

Notes: Standard errors are in parentheses; Significance levels are *** p<0.001, ** p<0.01, * p<0.1; link=logit; "Northern Europe" reference level for geo area; Likelihood-ratio (LR) test: models II, III, IV and V vs. model I.