

Financial and market impacts of buyer-supplier sustainability asymmetries: Empirical evidence from sensitive industries

Abstract

The aim of this study is to analyze how environmental and social sustainability asymmetries in buyer-supplier relationships affect the buyer financial and market performance. In particular, we draw from legitimacy theory to explain how sustainability asymmetries affect firm performance. The hypotheses are tested using a longitudinal dataset of 516 buyer firms belonging to sensitive industries and their top suppliers. Results suggest that, contrary to earlier studies, sustainability asymmetries may have a positive effect on financial performance. Moreover, we detected that whereas environmental asymmetries have a significant impact on firm performance, social asymmetries do not. In addition, results suggest that, within the environmental dimension, asymmetries have different effects, depending on the environmental sub-dimension. For example, while having a higher buyer-supplier asymmetry in the resource reduction area improves buyer profitability, in the area of emissions it leads to a negative performance. Also, research shows that such impact will depend on which party is leading the sustainability initiatives (i.e. buyer or supplier). The main managerial implication is that investing in reducing buyer-supplier sustainability asymmetries can be counterproductive in certain dimensions, whereas in other ones it could actually improve financial and market performance.

Keywords: Environmental and Social Sustainability; Buyer-supplier relationships; Asymmetry; Financial and market performance; Sensitive industries.

1. Introduction

“The universe is asymmetrical” (Louis Pasteur)

In recent years, sustainability has become the center of the global agenda of firms and society in general (Awan et al., 2021). However, it has been argued that sustainability cannot be achieved without considering how global supply chains operate and to what extent their members are aligned (Awan et al., 2018; Bastas and Liyanage, 2018; Quarshie et al., 2016). Previous research suggests that the sustainability level of a particular supply chain cannot be stronger than its weakest supply chain member (Tachizawa and Wong, 2014). However, supply chain managers are typically faced with a reality in which there are different perspectives and tensions among supply chain partners when sustainability programs are introduced (Tura et al., 2019). Empirical evidence suggests that it is highly unlikely that all firms along a supply chain are at the same stage in terms of sustainability development, not only due to differences in their business models, but also because of different institutional pressures (Meqdadi et al., 2019). Buyers and suppliers may present sustainability asymmetries (i.e., the buyer and supplier have different levels of development in sustainability issues). For example, IKEA has been considered a supply chain sustainability leader and a reference in responsible management. However, an investigation by London-based environmental group Earthsight found that IKEA had likely been using illegally-obtained Russian wood in its children's furniture for years (Business Insider, 2022), which demonstrates a clear misalignment between the firm sustainability policies and its suppliers' practices. This sort of asymmetry could have a negative effect in the financial and market performance of the IKEA, due to reduced sales and negative impacts on reputation and market value.

Cases where buyer firms with higher sustainability implementation levels are confronted with the non-alignment of suppliers are well documented and numerous (e.g. Villena and Gioia, 2021; Leon-Bravo et al, 2020; Macchion et al, 2018). According to a recently published Barclays's report, in the last 12 months, 21% of the UK's largest retailers cancelled contracts with suppliers on the grounds that they failed to meet environmental, social and governance (ESG) standards (Barclays, 2022). Although less discussed, suppliers might also have higher levels of sustainability than their customers (e.g., Nudie Jeans and Armed Angels are suppliers to the fast fashion retailer Zalando).

The main motivation for this study is to understand this apparent dichotomy between theory and practice – i.e. if buyer-supplier sustainability alignment is required for supply chains to be successful (according to the theory), then firms should be financially penalized for not achieving this. However, given the frequency of cases where buyers and suppliers are not aligned in their sustainability initiatives, we expect this relationship between buyer-supplier asymmetry and performance not to be so straightforward. In this study, we aim at better comprehending this relationship.

The current knowledge on the environmental and social asymmetries between buyer and supplier firms and the assessments of their impacts is still limited. Despite the anecdotal evidences coming from scandals such as the palm oil for Nestlé and the Rana Plaza disaster (Szekely and Dossa, 2017), there are very few empirical, rigorous studies that analyze to what extent the existence of buyer-supplier sustainability asymmetries affects the buyer's financial and market performance. An exception is Blome et al. (2014), who analyze the deviation from an optimal profile of supply chain collaboration and its detrimental effect on sustainability as well as market performance. Using data collected from 259 European manufacturing firms and advanced structural equation modeling approach, the study shows that an alignment between supply chain initiatives does pay

off. However, this study relies on indirect measures (i.e. based on supply chain collaboration), and does not measure directly buyer-supplier asymmetry level, or the direction of such asymmetry. Similarly, Frempong et al. (2021) examines the impact of sustainability-oriented supplier partnership on firm performance, but their independent variable is essentially a supply chain collaboration measure (rather than asymmetry). Finally, Hao et al. (2022) investigates how the configuration of a supplier's sustainable operations practices affects a buyer's operational and financial performance. However, they do not analyze it jointly with the buyer characteristics. Therefore, literature on buyer-supplier sustainability asymmetries lacks systematic studies that identify to what extent they affect firm performance.

Therefore, in this study, we pose the following research questions:

RQ1: What is the effect of buyer-supplier sustainability asymmetries on financial and market performance?

RQ2: Does it matter who is leading the sustainability initiatives (i.e. buyer or supplier)?

RQ3: Does this effect depend on the dimension of sustainability?

Our main research objective is to answer these questions by analyzing empirical data on buyer-supplier asymmetries in several dimensions of sustainability, combining this with data on buyers financial performance.

In order to achieve our research objectives, we build a dataset by combining several databases (Refinitiv Eikon, Standard and Poor's Compustat, and Bloomberg), focusing in "sensitive" sectors. Several scandals have raised the societal awareness to supplier practices, lowering the tolerance for irresponsible behaviors, especially in sensitive industries (Riera and Iborra, 2017). We consider "sensitive" as industries which are "under increased scrutiny and regulatory pressure", e.g. mining, oil exploration, paper,

chemical and allied products, petroleum refining, metals or utilities (Garcia-Meca and Martinez-Ferrero, 2021). In particular, our sample consists of firms with headquarters in the United States that belong to environmental/social sensitive sectors (identified by the U.S. Small Business Administration or Responsible Business Alliance).

In this study, we draw on legitimacy theory, which posits that the survival of an organization will depend not only on market forces, but also on the fulfillment of social expectations (Meyer and Rowan, 1977). However, stakeholders may demand different developments of sustainability for distinct firms (Villena et al., 2021). Thus, the presence of sustainability asymmetries can lead to mixed outcomes. Furthermore, we defend that when buyers in sensitive industries lag behind suppliers' developments in sustainability areas, the existence of these asymmetries will be perceived by the different segments of society in a more negative way. Therefore, they will negatively affect the profitability and market valuation of the buyer firm.

This study makes several contributions. Firstly, by simultaneously assessing both environmental and social sustainability dimensions, and by expanding the examination beyond the firm-unit perspective, we provide a comprehensive understanding of the relationship between sustainability and performance. In fact, this paper is one of the first large-scale empirical studies that systematically examines both environmental and social sustainability dimensions over several years in the sustainable supply chain management context (see also Dabhilkar et al., 2016; Toubolic et al., 2014). Secondly, we question the assumption that alignment between supply chain partners is always beneficial. Through examining the buyer performance in terms of return on assets and tobin's q, we broaden the understanding of the financial and market impacts in relation to the existence of sustainability asymmetries between supply chain members. Lastly, the analysis of a wide sample of 516 buyer firms belonging to sensitive sectors and their corresponding top

suppliers offers substantial insights on the effects of the different sustainability approaches. In particular, we draw from the notion of “leading” and “greening” approaches. In this study, we compare the impact on buyer performance of having a higher (i.e., leading approach) or lower (i.e., greening approach) sustainability development level than their top suppliers.

The paper is structured as follows: the next section briefly provides the theoretical background on legitimacy and asymmetry, and theorizes about the effects of sustainability asymmetries on the buyer’s financial and market performance, proposing several hypotheses to be tested. This is followed by detailed data description, variables, and applied methods. We then present the main results derived from the analysis. The final section contains further discussions and the primary conclusions, including certain managerial implications.

2. Theoretical background and hypotheses development

2.1 Legitimacy and sustainable supply chains

Institutional scholars have argued that in addition to organizational efficiency, legitimacy – i.e., conformity to the standards, rules, and beliefs of the reference context – is critical to understanding organizational growth and survival (Meyer and Rowan, 1977). According to Suddaby et al. (2017), legitimacy is a critical condition for corporate survival, as it is a prerequisite for the flow of resources and stakeholders’ support. By building legitimacy, firms can have unrestricted access to the market (Brown, 1998), easy access to resources including the strategic ones they need to survive (Zimmerman and Zeitz, 2002), goodwill during a time of crisis (Godfrey and Hatch, 2007), be assured of more business opportunities (Bansal and Clelland, 2004), garner stakeholder approval

(Rao, 1994), and long-term survival (Brown, 1998). Organizations, thus, will constantly attempt to ensure that society perceives their activities as legitimate (Suddaby et al., 2017) and the societal embedded beliefs and understandings will frame how organizations seek approval for their acts. In this study, we focus our analysis on customers and investors, since both are the first segments of society to react to sustainability issues.

In this study, we address legitimacy as defined by Suchman (1995, p. 574) as “a generalized assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions.” However, we frame it in terms of environmental and social sustainability, by extending Bansal and Clelland’s definition (2004). Accordingly, we consider sustainability legitimacy as the congruency between values implied by companies’ environmental and social developments and the norms of acceptable sustainability behaviors in the societal system in which they operate. Thus, organizations may be legitimized as environmentally and socially responsible entities, in addition to their economic strengths (Suddaby et al., 2017). This implies that when society perceives a gap between what is socially expected from firms regarding environmental and social sustainability and their actual developments, their future financial and market performance may be damaged, jeopardizing the economic legitimacy of the firm. Therefore, by focusing on the environmental and social dimensions, we can also take into consideration the indirect impacts on economic legitimacy. According to Suchman (1995), legitimacy also affects how people understand each company. This implies that society segments perceive a legitimate organization as being more meaningful, more predictable, and more trustworthy, in addition to being worthy. These last aspects are especially relevant when firms belong to sustainability-sensitive industries. As Brønn and Vidaver-Cohen (2009) state, firms tend to implement Corporate Social Responsibility (CSR) initiatives as a

strategic necessity in order to preserve organizational legitimacy. In the case of sensitive sectors, Vollero et al. (2019) posit that, in addition to communication strategies, organizations are more likely to favor initiatives that imply high level of commitments. Therefore, it is especially relevant to focus our study in sensitive industries.

While some researchers have predominantly focused on firms' motivations and actions to seek and gain legitimacy (Busse et al., 2016; Czinkota et al., 2014), we approach this issue from a different angle. In this study, we limit our attention to the potential loss of legitimacy derived from low developments in sustainability. This could happen in different ways. For example, firms can jeopardize their legitimacy status by symbolically adopting a policy, without implementing the corresponding process. Or they could have formal policy and processes, without actually performing effective monitoring and corrective actions.

Researchers have also expanded the congruency argument beyond a firm's boundaries and linked it to sustainable supply chains. In this sense, even if the root of a problem is located on a supplier, society may also tend to blame the focal company (Pizzetti et al., 2021). As anecdotal evidence suggests, it is very difficult to isolate the behavior of a firm from its supply chain partners. Therefore, when a supplier has lower developments in sustainability, customers may penalize the last stage of the supply chain (i.e., the buyer firm), by not buying its goods. Buyer firms are perceived as being primarily responsible for the harm to the natural or societal systems that their suppliers may cause, because consumers consider that it is part of the buyer's responsibility to inhibit and control such behaviors (Guo et al., 2015). If the buyer firm belongs to a sensitive industry, this effect may become even more salient. Recent sustainability scandals (e.g., the Boohoo labor exploitation crisis - The New York Times, 2020) have augmented societal pressure over buying firms (Jacobs and Singhal, 2017). The presence of sustainability asymmetries

between buyer and supplier firms, thus, can have a serious effect on the buyer's financial and market performance. In the next sections, we further explain the concept of buyer-supplier asymmetries and how they can affect firm's results.

2.2 Buyer-supplier asymmetries and sustainability

Studies on buyer-supplier relationships have analyzed the effects of the asymmetries with respect to a variety of supply chain factors: size (Villena and Craighead, 2017), dependence (Kim and Choi, 2018), and power (Talay et al., 2020). Despite these efforts, there are several research gaps in buyer-supplier asymmetries that need to be addressed. Firstly, a critical area that was not studied in the buyer-supplier asymmetries literature is sustainability. It has become a key area in management research, particularly supply chain management (Awan et al., 2020). Therefore, the asymmetries literature could benefit from studies focused on this area. For example, Awan et al. (2020) has analyzed how buyer-supplier knowledge transfer could reduce the gap in sustainability implementation at suppliers. Secondly, with respect to research methodologies, previous research examined the degree of asymmetry without capturing the direction of that asymmetry (Villena and Craighead, 2017). In other words, similar degrees of asymmetry may lead to different outcomes, depending on the party that has a higher level of the variable considered. In the case of sustainability, defining the supply chain member that leads the developments is important (Huo et al., 2019), especially if it belongs to a sensitive industry. For example, customers may have a different perception of a recycling initiative, depending on whether it is led by the retailer or a supplier. Second, it is still unclear how asymmetries affect performance in the supply chain. Although some studies claim a negative impact of buyer-supplier asymmetries on performance, other authors suggest the opposite. For example, when firms with complementary profiles collaborate, the total

value created in a buyer-supplier relationship is higher than the sum of the value created by the internal resources of each firm (Ahmed and Shafiki, 2022). On the other hand, in cases of resource redundancy (e.g. firms share similar characteristics), the value created in the relationship may be lower than the sum of the value created by each firm (Brito and Miguel, 2017). Therefore, although the existence of asymmetrical buyer-supplier relationships in terms of sustainability developments may affect buyer performance, due to legitimacy reasons (discussed in the previous section), the sign of this effect is unclear. In the next section, we further explore the relationship between sustainability asymmetries and performance.

2.3 Environmental and social sustainability asymmetries and performance

The effect of sustainability asymmetries on buyer performance involves several complex mechanisms which may generate either positive or negative final outcomes. When formulating the research hypotheses, it is important to consider the direction of the asymmetry and include, hence, both sides in the assessment. We argue that the mechanisms can be different, depending on which party (i.e., buyer or supplier) is leading the sustainability area. We also posit that this aspect might also explain differences in the magnitude of outcomes. In the following paragraphs, we analyze each possibility.

Firstly, the presence of sustainability asymmetries may have an overall *positive* effect on the buyer's financial and market performance. This is due to two main causes: specialization and reputational effects. First, *specialization*: In order to compete successfully in a particular market, firms have to prioritize among a set of competitive priorities, e.g. cost, quality, delivery, flexibility and sustainability, generating trade-offs that may affect supply chain management (Dhabilkar et al., 2016). Modern business firms

do not have access to unlimited resources, and decisions to deploy them are critical for a firm. In particular, rather than aiming at excelling on every sub-dimension of sustainability, resource constraints require that firms focus on the ones that are most relevant to them due either to economic reasons or stakeholder pressure (Ahmed and Shafiki, 2022). In this study, we posit that asymmetry allows specialization of each supply chain member in specific competitive dimensions, which makes it less necessary to have cooperation. This may be explained because one of the main obstacles for supply chain sustainability is the lack of cooperation among supply chain members, due to change resistance that create lock-in situations (Silvestre et al., 2020). For example, it is well-known the trade-off which purchasing professionals face between the potentially conflicting objectives of cost reduction and sustainability in alignment with the non-economic goals of the organisation (Reuter et al., 2012). Accordingly, a buyer could focus on improving sustainable product features, whereas a supplier would focus on reducing production cost of raw materials. In this case, little cooperation between buyer and supplier would be necessary, even though product profitability could be maintained high (due to the low production costs and high customer acceptance). Therefore, asymmetry could have a positive effect in terms of financial and market performance.

There is also the *reputation* effect derived from a particular buyer-led sustainability area, being reflected as well in the market valuation of the company, with investors being particularly aware of it. Buyer firms may also have the additional benefit of playing a dominant role in disseminating sustainability across their supply chain members (Meqdadi et al., 2019), increasing thereby their legitimacy status in the society. This is especially important when the focal companies belong to sensitive sectors, which tend to be more scrutinized. More generally, when the buyer firm takes a *leading* sustainability approach (i.e., the buyer's developments in sustainability is higher than the supplier's),

its profitability may increase. Both specialization and reputation effects increase the profitability of the focal firm, because they allow the firm to increase revenues. Actually, firms often improve their financial results by charging a “price premium” for higher sustainability (Schäufelle and Hamm, 2017). The concept of “price premium” is often used in Marketing, meaning customers willingness to pay an extra price for products or services from a brand compared to similar products or services from other relevant brands (Schäufelle and Hamm, 2017). Also, firms can reduce costs because increased sustainability reduces waste in production processes, and also because focal firms can spread the cost of sustainability initiatives across supply chain partners (Roehrich et al., 2014). Alternatively, when the buyer firm takes a *greening* approach (i.e., the supplier’s developments in sustainability is greater than the buyer’s), it can also indirectly obtain significant benefits from the suppliers’ developments. In this case, some of its suppliers will improve sustainability features and buyer firms will also obtain benefits from them in their final goods, even though they do not have to invest any financial resources in these developments. As a consequence, buyer financial performance may benefit from increased sales. Nevertheless, as buyer firms cannot be seen as contributing much to the global sustainability efforts of the industry, the market valuation of the company, while still remain positive, may not increase significantly as in the case of the leading approach.

Alternatively, sustainability asymmetries may have a *negative* effect on the buyer’s financial and market performance. A key characteristic of sustainability issues is that their effectiveness often depends on the interaction of several parties in a supply chain (Blome et al., 2014). Indeed, sustainability initiatives often involve collaboration between the buyer and supplier (e.g., by exchanging technical information, establishing joint teams, working on common goals, etc.) and the lack of collaboration and trust may decrease the sustainability features of the final goods (Brockhaus et al., 2019). In addition, Blome et

al. (2014) argue that firms who are not aligned with suppliers might find lower investments in the relationship, decreasing the level of relational rents which might enable higher levels of market performance. This will lower the buyer's financial results, for two reasons: Firstly, because buying firms cannot charge a sustainability "price premium" (due to the reduced level of sustainability features of the final product), and therefore they may not recover the development costs of investing in sustainability initiatives; secondly, sales of the final product do not increase, also because of the its reduced sustainability features. Moreover, any short-term saving in terms of reduced developments in sustainability may be jeopardized by the long-term risks of sustainability scandals. In addition, when the buyer belongs to a sensitive industry, it is even more exposed to society scrutiny and its market valuation can be more affected. Also, the presence of asymmetries may cause "blurred" responsibility boundaries between the buyer firms and their suppliers (Blome et al., 2014), damaging the effectiveness of sustainability initiatives and therefore negatively affecting the firm revenues and its market valuation. Buyer performance, therefore, may decrease, but the magnitude of this effect will be significantly different, depending on the buyer's sustainability approach: When the buyer firm takes a *leading* approach, its sustainability efforts may be ineffective, due to the lack of collaboration from the supplier, materializing in lower sustainability features of the offered goods. The implementation success of buying firms' Sustainable Supply Chain Management (SSCCM) practices (e.g., projects to reduce fine dust emissions) is not only a function of their own efforts, but it depends on the contributions made by upstream suppliers (Rauer and Kaufmann, 2015). This is more likely to occur when a sustainability initiative requires a significant information exchange between the buyer and supplier to be implemented (Green et al., 2012). In this case, buyer firms will have a lower performance. When the buyer firm takes a *greening* approach, the sustainability efforts

of the supplier may not lead to an increase in the buyer profitability, not only due to the lack of collaboration from the buyer, but also because of divergence from other suppliers who may not have a similar sustainability profile. This is especially likely when sustainability initiatives depend on the buyer coordinating efforts among several suppliers, or when supply chains are so fragmented that no isolated action can be effective (e.g., palm oil issues in the case of Starbucks), which greatly affects the legitimacy status. In this case, the buyer may save money by not investing directly in these developments. However, reduced sales (due to lower sustainability features and increased risk of sustainability scandals) can significantly override these savings. Furthermore, as the buyer firm belongs to a sensitive industry, this lagging behind in the sustainability path will be perceived by society segments in a more negative way. Therefore, the buyer firm will have a significant deterioration of the legitimacy status, compared to when it undertakes a leading approach, negatively affecting its financial and market performance. In this study, we analyze separately the effects of environmental and social asymmetries. This is because both dimensions have different characteristics that trigger different mechanisms. For example, environmental sustainability has a long tradition of being highly institutionalized among society segments compared to social sustainability, both in terms of technical details and formalization (Basta et al., 2018). We, thus, contend that the presence of asymmetries may affect buyer performance in different ways, including certain variations depending on the dimension considered (i.e., environmental or social), but we do not provide ex ante additional arguments. Consequently, we depict the research hypotheses in a general manner. We will refer to this issue in the discussion section and we will provide some explanations in accordance with our findings.

To summarize, the compound effect of the above mechanisms generate both positive and negative relationships between sustainability asymmetries and buyer performance. In this

study, we formulate the hypotheses by including both results (i.e., net positive or negative outcomes). Furthermore, we posit that the overall magnitude and sign will also depend on the buyer's sustainability approach, tackling the impacts on the buyer's financial and market performance. While the presence of sustainability asymmetries (and not the sustainability implementation level *per se*) will affect performance, we expect that when the buyer firm takes a greening approach, the overall effect will become negative as it belongs to a sensitive sector. In this case, societal attention to the sustainability developments will negatively affect the buyer's legitimacy status, compromising the profitability and market valuation of the buyer firm.

H1a. Buyer-supplier environmental asymmetries will have a positive effect on buyer profitability.

H1b. Buyer-supplier environmental asymmetries will have a negative effect on buyer profitability.

H2a. Buyer-supplier social asymmetries will have a positive effect on buyer profitability.

H2b. Buyer-supplier social asymmetries will have a negative effect on buyer profitability.

H3a. Buyer-supplier environmental asymmetries will have a positive effect on buyer market valuation.

H3b. Buyer-supplier environmental asymmetries will have a negative effect on buyer market valuation.

H4a. Buyer-supplier social asymmetries will have a positive effect on buyer market valuation.

H4b. Buyer-supplier social asymmetries will have a negative effect on buyer market valuation.

H5. When the buyer adopts a *greening* approach, buyer-supplier asymmetries will have a negative effect on its profitability.

H6. When the buyer adopts a *greening* approach, buyer-supplier asymmetries will have a negative effect on its market valuation.

3. Method

3.1 Data collection and sample

Our sample consists of firms with headquarters in the United States that belong to environmental/social sensitive sectors (identified by the U.S. Small Business Administration or Responsible Business Alliance) and are listed in Refinitiv Eikon, Standard and Poor's Compustat, and Bloomberg. Refinitiv Eikon (previously Asset4 Thomson Reuters) provides sustainability information that is predominantly derived from companies' annual reports, CSR reports, intergovernmental agencies, and NGO websites. It contains relevant data on environmental and social sustainability dimensions associated with emission reduction, resource reduction, health and safety, and human rights, among others. Within the Compustat datasets, we extract information from Compustat North America and Compustat Segment. While Compustat North America contains the financial information of publicly held companies, Compustat Segment encompasses customer data for about 70% of the listed companies in Compustat North America. Customer data comes from the information reported by the suppliers in file FASB No. 131's major customer disclosure, in which it is mandatory for suppliers to identify and report all buying firms that account for 10% or more of their total sales. The historical tracking of these interfirm relationships started in the late 1970s, being primarily U.S. suppliers. Lastly, Bloomberg provides interfirm relationship information through the *Supply Chain Function*, as a snapshot of the money flows between firms over recent years using the option "as date". In this source, relationship information is collected not only

from public registry files but also from news and firms' announcements, including non-U.S. suppliers.

To identify the buyer's top supplier and build the dyadic relationship, which is the unit of analysis, we supplemented the interfirm relationships data from the Compustat Segment with Bloomberg, covering both U.S. and non-U.S. first tier suppliers for each buyer and year. We then computed the total sales that each supplier sold to the buyer during the entire period of the study, and we selected the supplier with the highest revenue generated from the buyer. There were 516 buyer-supplier dyads that met the criteria of having at least two consecutive years of financial data and sustainability information, resulting in a total of 2,093 dyad-year observations across the 2011-2018 sample period. We did not require the buyer-supplier relationship to hold in the entire period of study, thus having an unbalanced sample.

Table 1 provides an overview of the buyer and supplier firms included in the sample and their associated sector, according to the Global Industry Classification Standard (GICS) system. The sample comprised a set of 516 buyer firms and 311 top supplier firms. As we analyze asymmetries between the buyer and its top supplier, it is worth highlighting that we had some top suppliers that were identified as being the top supplier for several buyer firms.

This methodology was based on similar studies that investigated the effect of supply chain asymmetries on performance (e.g. Villena and Craighead, 2017). However, a key difference lies on the dependent variables measuring firm performance. Whereas Villena and Craighead used a survey to gather this information, we relied on financial data (ROA and Tobin's q). This is explained in the next section.

Insert Table 1 about here

3.2 Measures

To assess the effects of the environmental and social sustainability asymmetries on the buyer's financial and market performance we used the measures of return on assets (hereafter ROA) and firm valuation (hereafter Tobin's q). ROA is computed as net income divided by the book value of total assets while Tobin's q is computed as the sum of the company's market equity value plus the book value of the debt divided by the book value of the assets.

The ROA measure reflects a firm's capacity to improve its performance through increasing its profit margins. This ratio is a measure of broader public scope information. The customer penalizations derived from the deterioration of legitimacy status are captured through the reduction of the buyer's sales, which impacts directly the ROA. In contrast, Tobin's q is highly specialized information, reflecting other stakeholders' reactions, especially the investors. It relies on the efficient market hypothesis, which suggests that the stock price of a firm reflects all currently available public elements, so information about unsustainable behaviors will also be integrated into the market valuation of the company. This means that the deterioration of sustainability legitimacy may negatively affect firm valuation, even if the customers do not end up reducing their purchases substantially. Thus, Tobin's Q can be used to evaluate the impact of sustainability asymmetries from the perspective of investors, whereas ROA reflects the perspective of the customers.

Our independent variables are the sustainability asymmetries, which were computed using information from Refinitiv Eikon regarding widely acknowledged areas of environmental and social sustainability dimensions (See details in Appendix A). We use a three-level status framework to operationalize the variables emission reduction and resource reduction for the environmental sustainability dimension, plus health and safety and human rights for the social sustainability dimension for buyer firms and top suppliers. The framework employed is described as follows. If a firm had only established a policy, and no additional steps were taken, we then classified it as having a “first level” development. If a firm had established a policy and put in place a process, we classified it as having a “second level”. When a firm had established a policy, put in place a process, and in addition had implemented a monitoring process, we then classified it as having a “third level”. Lastly, if a firm did not establish a policy in the area, we classified it as having a “zero level”. We, therefore, built four variables (one for each analyzed sustainability area), that annually capture the level reached for each firm and we then used them to compute the sustainability asymmetries at dyad level.

In this study, we computed the sustainability asymmetries using two different techniques: absolute values and the spline. We first operationalized asymmetries following the traditional technique of taking the absolute value of the difference between the buyer and supplier in the areas of emission reduction, resource reduction, health and safety, and human rights. The asymmetry variables reflect the *degree* of an unbalanced development presented in each of these sustainability areas.

In addition to the degree of asymmetry, we introduced into the analysis the *direction* of the asymmetry (i.e., whether it is the buyer leading or the supplier leading), by using the spline method. In line with previous asymmetries and supply chain studies (Nyaga et al., 2013; Villena and Craighead, 2017), we computed for each of the sustainability areas the

corresponding de-composed variables of the asymmetry. By adding direction into the analysis, we were able to tease out possible compound effects and obtain better insights regarding the financial and market impacts of the buyer's sustainability approach (i.e., greening versus leading sustainability). We performed this assessment of the diametrically opposite effects, which according to Kumar et al. (1998) increases the precision of the estimation. This means that we first estimated the differences between the buyer and its top supplier values in each sustainability area and then calculated the corresponding de-composed variables for each sustainability area. Using the area of emission reduction to illustrate both applied techniques: firstly, we included in the analysis a single variable labelled "Emission reduction asymmetry (degree)" when we employed the absolute value technique. Secondly, when we employed the spline technique, we used two variables instead, labelled "Emission reduction–Buyer asymmetry (degree & direction)" and "Emission reduction–Supplier asymmetry (degree & direction)". The variable labelled "Emission reduction–Buyer asymmetry" contained the difference between the buyer and its top supplier when the buyer was leading sustainability in the area of emission reduction; taking the value zero otherwise. Similarly, the variable labelled "Emission reduction–Supplier asymmetry" was equal to the absolute value of the difference between a buyer and its top supplier when the supplier was leading sustainability in this area; taking the value zero otherwise.

In order to mitigate having a potential omitted variable bias, we included several control variables at the buyer and relationship level. Following previous studies, we controlled for the main effects that the firm's characteristics have on performance. In other words, we included control variables if they could have a causal effect on the dependent variable (buyer performance). We analysed several variables that were used in similar studies (e.g. Villena and Craighead, 2017; Ahmed and Shafiki, 2022), and the selected buyer-level

control variables were: size, leverage, market share, business diversification, and R&D intensity. Size was operationalized as the natural log of total assets. Leverage was calculated by using the total debt to equity ratio. Market share was computed as the percentage of a buyer's sales over the total industry sales at the four-digit NAICS level. Business diversification was measured as the number of business segments. R&D intensity was computed as research and development expenses scaled by total assets. In addition, we also control for the relative environmental, social and governance (ESG) performance for both buyer and top supplier firms. The relative ESG firm performance variable was included as a firm's overall relative score with respect to other firms of its industry used as benchmarks, using a percentage score ranking from 0 to 100. Refinitiv Eikon estimated this score using annual public information based on the fiscal year and on a referential basis of multiple sustainability indicators. For relationship-level control variables, we included in the analysis the length of the relationship and mutual dependence. Relationship length was operationalized as the number of years since the supplier began to be part as a top supplier in the buyer's supply chain. Mutual dependence was measured as the product of two terms: the supplier's sales to the buyer over total supplier sales, and the supplier's sales to the buyer over the buyer's total costs of goods sold.

Lastly, we also controlled for the time effects associated with the evolution of economic activity by adding time dummy variables into the analysis and omitting the dummy for year 2011 to avoid collinearity associated with the dummy-variable trap. All independent and control variables are included in the analysis with a one-year time lag to avoid reverse causality.

3.3 Econometric model

We used the specification of fixed-effects regression with robust standard errors to test the effect of sustainability asymmetries on the buyer's financial and market performance for several reasons. Firstly, the proposed hypotheses were formulated in line with testing the causes of changes within each unit-interfirm, implying that every observation in each cross-section needed to refer to the same unit-interfirm, therefore failing to satisfy the independent errors assumption of OLS regression. A pooled regression with cluster by dyad, industry, and time-fixed effects could be used instead. However, this specification would not be suitable in the presence of significant panel data structure (Beck and Katz, 1995). In our case, the Breusch-Pagan Lagrange multiplier test rejected the null hypothesis that the variances across units-interfirm were zero, which means that the panel regression formulation should be used to empirically test the proposed hypotheses instead of the pooled regression. Secondly, the fixed-effects specification provides unbiased and consistent estimates of parameters when the correlation between the regressors and error is not equal to zero. In all performed modelizations, the Hausman test rejected the null hypothesis that the errors were uncorrelated with regressors, with the random effects being inappropriate to obtain consistent coefficients; this suggests the need to utilize the fixed-effects regression method. Lastly, estimated standard errors can be biased in the presence of non-constant variance for all units-interfirm. To test for homoscedasticity, we used the Modified Wald test for groupwise heteroscedasticity in the fixed effect model. It rejected the null hypothesis, meaning the robust standard errors option should be introduced to control for the presence of significant heteroscedasticity in our sample.

4. Results

Table 2 presents the descriptive statistics and correlations matrix for the variables used in the analysis. The sustainability asymmetries in the different areas exhibit, on average, superior levels for the buying firms than for the top suppliers. However, it also reveals the presence of cases where suppliers are ahead in some of the sustainability areas, with both sustainability approaches present (i.e., buyers leading and suppliers leading sustainability).

Insert Table 2 about here

Table 3 shows the results of the fixed-effects regression analysis for the first group of sustainability asymmetries, calculated as the absolute value of the differences between buyer firms and top suppliers. In this case, we examine the effects of having unbalanced developments in the areas of environmental and social sustainability on the buyer's financial performance (Model 1) and market performance (Model 2). The asymmetries associated with emission and resource reduction are both significant in Model 1 ($p < 0.05$ and $p < 0.10$, respectively). However, the sign of the effects is opposite. The results reveal that the existence of a sustainability asymmetry in the area of emissions reduction has a negative impact on ROA. Conversely, asymmetry in the area of resource reduction significantly increases ROA. In relation to the social sustainability dimension, the existence of asymmetries in the health and safety area positively impacts ROA, while the human rights area does not seem to affect buyer financial performance.

With respect to the market valuation (Model 2), the results substantially differ from those obtained in financial performance. The existence of asymmetries in the social sustainability areas does not appear to influence on the market value of the buyer firm.

This implies that the investors do not react to the presence of social sustainability asymmetries in the same way as customers do. For the environmental sustainability dimension, the market impacts of the asymmetries are limited to the emission reduction area. The effects of having unbalanced developments in emissions reduction affect negatively the market value of the buyer firm. In this sense, it is important to notice that both customers and investors agree to have balanced developments in the emissions reduction area, having negative impact otherwise. In all other sustainability areas, however, these segments of society react differently to the lack of congruency, with impacts ranging from none to significant.

Insert Table 3 about here

The results for the control variables are in line with prior studies. The variables buyer size, R&D intensity, and mutual dependence have effects on financial performance that are significant ($p < 0.01$). Additionally, the relative ESG performance of the buyer and its top supplier also positively affects the buyer financial performance, whereas only the ESG performance of the buyer influences the buyer market performance.

Nonetheless, the modelization based only on the degree of asymmetry does not allow us to examine whether the asymmetries effects will still be present in both buyer's sustainability approaches. To be able to fully examine the effect of different sustainability approaches the analysis needs to show the degree and direction of the asymmetry. Table 4 displays the results for the second group of sustainability asymmetries that gather both the degree and direction, which are estimated through the spline technique. In Model 3, we present the results for ROA. We show the results for Tobin's q in Model 4.

The results of the spline technique are aligned with those obtained by applying an absolute value difference technique. More precisely, the environmental asymmetries in the area of emissions reduction are negative, while in the area of resource reduction they are positive. However, with the spline technique we can examine each of the de-composed variables in depth and assess whether these effects exist only when the buyer firm (or the top supplier) is leading the sustainability area. For the emission reduction area, we found that both de-composed variables have a negative impact on the buyer's financial performance, but the results are significant ($p < 0.05$) only when the supplier is leading. This finding reveals that when the buyer firm is lagging behind in the emission reduction area, it will end up harming its profitability over time. In the case of resource reduction, we found positive and significant effects in both de-composed variables ($p < 0.05$ for the leading approach and $p < 0.10$ for the greening approach), implying a positive effect on the buyer's profitability regardless of who is leading in this particular area. This result can be interpreted as follows: by consuming fewer input resources on one side, independently of which firm it is, customers will always perceive it in a good manner, and the higher sustainability legitimacy will materialize in an increase of the buyer's financial performance. For the social sustainability dimension, the buyer's profits increase slightly only when it is leading in the health and safety area.

Regarding the market performance, we find that both buyer's sustainability approaches lead to negative impacts on buyer valuation in the area of emissions reduction ($p < 0.01$). As mentioned before, investors penalize the lack of congruency in this area, as they understand that firms along the supply chain should adopt similar reduction emission developments. Therefore, the undertaken efforts in the emissions reduction area should be aligned throughout the supply chain, playing the buyer firms a significant role to

continue progressing in this path and avoid free-rider behaviours; otherwise, it will negatively affect their market performance.

Insert Table 4 about here

As a summary, Table 5 shows the results found in each of the proposed hypotheses, and briefly describes in which specific area of sustainability the confirmation is obtained.

Insert Table 5 about here

We conducted several analyses to examine the robustness of these estimations. We first examined the hypotheses using alternative performance measures. In particular, we employed the return on sales (ROS) for the financial performance and earnings per share (EPS) for the market performance, obtaining similar results. Also, we extracted a subsample of 250 dyadic relationships using a random sampling procedure, and performed again the different analysis, with the results being consistent with those obtained for the entire sample. In addition, we ran tests for different means between the sustainability approaches, obtaining that profitability turns to significant downsize over time when buyer firms adopt a greening approach. Therefore, our findings are considered highly robust as they remain consistent across the different alternatives introduced in the assessment.

5. Discussion

In this section, we discuss the theoretical and managerial implications of our findings. In particular, we build on the important finding that asymmetries do not have a negative impact on performance necessarily. Moreover, we explain why environmental and social asymmetries have different effects on the buyer's financial and market performance. Additionally, we analyse the diverse results within several dimensions of environmental asymmetries.

Firstly, contrary to earlier studies, our findings suggest that sustainability asymmetries may have a positive effect on financial performance. Contrasting our results with the literature on supply chain alignment, our study contradicts assumptions that supply chain misalignment is always negative (e.g. Blome et al., 2014; Ahmed and Shafiki, 2022; Jia et al., 2021). In fact, our results suggest the opposite - that buyer-supplier asymmetries may lead to positive outputs. This can be explained by the specialization and reputational arguments in the hypothesis section. Asymmetry allows specialization of each supply chain member in specific competitive dimensions, and allows firms to reap the benefits of a higher reputation obtained by other firms in the supply chain.

With respect to the reputational argument, our study is in line with Busse (2016), who recognizes “promotion-induced benefits of the supplier's sustainability-related conditions that accrue to the buyer”, occurring for example when buyer's stakeholders reward the buyer by means of a better image or affective attachment. He argues that the buyer can benefit from this in three ways: direct promotion of the supplier's sustainability-related conditions by the buyer, indirect exploitation of the supplier's sustainability-related conditions through the marketing of sustainability standards of the buyer, and, finally, spillovers from the supplier's self-promotion.

Results suggest that having an asymmetrical relationship is a perfectly feasible option for many firms. This is in line with Selviaridis and Spring (2018), who argue that supply

chain alignment is not instantaneous or linear, and is never perfect, because firms in supply chains often have divergent priorities. Busse (2016) investigates how changes in sustainability-related conditions at a supplier influence buyers' economic performance. He argues that there is an inherent trade-off in supplier's sustainability initiatives that may compromise the buyer economic performance: "The better the sustainability-related conditions, the higher the purchasing costs. The higher the purchasing costs, the lower the buyer's performance" (Busse, 2016, p. 36).

Secondly, our results are in line with recent studies that consider that social and environmental aspects within supply chains should be treated separately, because of their different nature (Lopez and Rocio-Benitez, 2020; Villena et al., 2021). In particular, our data analysis identified that, whereas environmental asymmetries have direct effects on financial and market performance, the same is not necessarily valid for social asymmetries. This is in accordance with Villena et al. (2021), who argue that supplier social responsibility is much harder to address than environmental issues. Several factors might explain this. For example, environmental sustainability tends to have more technical standards and measurable metrics than social sustainability. It is also highly institutionalized along society segments, especially in the reduction emission area, and is therefore more easily scrutinized, even beyond a firm's facilities. Accordingly, buyer firms have to ensure that supply chains act in an aligned form with respect to their environmental sustainability approach, which requires coordinated efforts between the buyer and suppliers. Social sustainability, in contrast, is more difficult to be assessed objectively, being more prone to "greenwashing" campaigns. Moreover, the fulfilment of societal demands regarding the social sustainability dimension is often taken for granted, especially in areas such as human rights. Indeed, buyer firms have not yet broadened their scope of responsibilities in the social dimension to the same level as in the environmental

sustainability dimension. This could explain why the asymmetries on the social area have little effect on performance, when compared to the environmental dimension. One exception may be the health and safety dimension, in which we detected a small effect of asymmetries on performance. A plausible explanation for that result might be that the health and safety area has more technical standards and measurable metrics than other social areas (e.g. human rights), therefore it behaves in a way which is more similar to the environmental dimension. This result supports those researchers who claim that firms also need to advance in the social areas and appropriately quantify sustainability tensions and impacts (Bubicz et al., 2019; Walker et al., 2021; Yawar and Seuring, 2017).

Within the environmental dimension, our findings suggest that firms should undertake different sustainability approaches, depending on the area. While having a higher buyer-supplier asymmetry in the resource reduction area improves buyer profitability (regardless of which party is ahead), in the area of emissions it leads to a negative performance when the buyer is lagging behind the supplier. This finding is critical and deserves some analysis. Although both areas are within the environmental dimension, they have different implementation characteristics. In the case of emission reduction, a potential explanation is that coordination between supply chain members is key (e.g., when the buyer provides technical or financial support to the supplier in order to develop a lower carbon footprint process). The lack of collaboration may cause a failure in emission reduction initiatives, resulting in a negative effect on the external image of the buyer and, consequently, harming its legitimacy status, which materializes in a significant reduction in profitability and market value. Alternatively, in the case of resource reduction, results suggest that the presence of such asymmetry actually improves the buyer financial performance. This might happen because resource reduction initiatives are often implemented in one side of the supply chain, mainly at the suppliers rather than

at the buyers. As the final result is a product in which the production process has minimized the usage of resources, customer perceptions are mostly positive, no matter which party is leading. Moreover, another effect of resource minimization may be reduced production costs, which also positively affects profitability.

Our results also provide some practical guidance for managers. Firstly, our research suggests that in some situations investing in reducing buyer-supplier sustainability asymmetries can be counterproductive. Whereas aligning buyer and supplier emissions reduction can directly improve buyer profitability and market valuation, undertaking a similar approach in the health and safety areas do not lead to the same returns. This result demonstrates that not all dimensions of sustainability are equally important with respect to improving corporate performance. This is a relevant finding, because it implies that in a scenario of financial and time constraints, the managers in sensitive sectors should not adopt the same approach in all sustainability areas. Secondly, our results suggest that sustainability asymmetries can also lead to a net positive performance despite the fact that the buyer firm has shirked part of its responsibilities in the social contract. Indeed, in some of the sustainability areas (e.g., resource reduction), it can be interesting for buyers to decouple their actions from that of their suppliers. Another important managerial implication is that for other sustainability areas (e.g., health and safety), asymmetries will have a positive impact on buyer financial performance. This is highly relevant, because it implies that buyer firms could adopt a more internally-oriented approach (i.e. focusing on internal improvements rather than at suppliers) to enhance their profitability. Lastly, in specific areas (e.g., emissions reduction), buyers could benefit from reducing asymmetries by aligning their efforts with suppliers. This could be done by establishing common metrics, policies, and goals, and working in collaboration with suppliers, as an unbalanced approach would seriously harm their financial and market performance. For

example, BMW has integrated Carbon Disclosure Project (CDP) supply chain scores into its procurement process as part of its “Drive Sustainability” partnership, which aims to foster sustainability of some of the main players in the automotive supply chain (EPA, 2018). The high institutionalization of the emissions reduction area at the supply chain level can explain this, and also why it does not also happen in the social compliance area of health and safety, despite publicly available records of work-related accidents and death. This could also help explain why social issues have received less attention in sustainability literature (Meynhardt and Gomez, 2019; Yawar and Seuring, 2017).

6. Conclusions

In this study, we tackled the relationship between environmental and social sustainability asymmetries and the financial and market performance. Our research demonstrated that whereas environmental asymmetries have a significant impact on firm performance, social asymmetries do not. Also, results show that such impact will depend on which party is leading the sustainability initiatives (i.e. buyer or supplier). Finally, results suggest that effects also depend the type of initiative, with emission reduction being the only area of sustainability where asymmetries affect negatively firm performance from both customers and investors perspective. An intriguing result is that, contrary to previous studies assumptions, asymmetries in the resource reduction area have a positive effect on buyer profitability.

From a theoretical standpoint, our study has shown that concepts such as legitimacy are key to understand the effects of sustainability asymmetries. This confirms previous studies that argue that the deterioration of legitimacy can lead to organizational failure (Suddaby et al., 2017). However, it would be interesting to explore other frameworks that

could explain the effect of environmental and social asymmetries, such as dynamic capabilities, which has recently been applied to understanding sustainability implementation in supply chains (Rauer and Kaufmann, 2015). For example, researchers should verify to what extent and how SSCM-related dynamic capabilities could help firms mitigate the negative consequences of sustainability asymmetries. Also, the different impacts of environmental and social sustainability asymmetries on performance highlight the importance of extending the sustainability analysis beyond the boundaries of the own company. Future studies should continue disentangling the sustainability effects using a broader analytical perspective.

The study offers some potential implications for policy-makers. In particular, with respect to the design of incentives for supply chain sustainability. For example, results suggest that asymmetries in the resource reduction area have a positive effect on buyer profitability. Therefore, firms have a natural incentive to build asymmetric relationships in this dimension, which could be negative from a policy perspective. This means that policy-makers should focus on this area when designing sustainability incentives, if they want to reduce sustainability asymmetries in supply chains.

With respect to the practitioners, we demystify the assertion that having balanced developments in sustainability between buyer and supplier firms leads necessarily to positive returns (Blome et al., 2014). We identify areas in which reducing buyer-supplier asymmetry may be counterproductive, and we also locate areas in which it does compensate to reduce such asymmetry. Such findings may guide managers on developing their supply chain sustainability strategies.

As potential limitations of the paper, we could mention that it is focused on sensitive industries, and some of its findings could not apply to other sectors. For example, more “standard” sectors, where sustainability is not considered a critical issue, might present

less significant effects of buyer-supplier asymmetries on buyer performance. This should be verified in further studies.

There are several potential lines of research that could complement the present study. Firstly, it would be interesting to contrast results for different categories of materials, using for example the Kraljic matrix. Previous research shows that the implementation of supply chain sustainability initiatives depends on the Kraljic matrix material category. For example, the implementation of sustainable sourcing practices implies cost-related trade-offs for noncritical items, whereas strategic items require higher supplier integration and interdependence (Dhabilkar et al., 2016).

Secondly, results might be different for companies following different SSCM strategies. Following Grosvold et al. (2014)'s classification, in four approaches (i.e. reactive, defensive, accommodative and proactive), we would expect "reactive" SSCM to be associated with more "asymmetrical" relationships, whereas "proactive" would tend to have more "symmetrical" relationships.

Another interesting line of research could be to analyse how buyer-supplier sustainability asymmetries affect eco-innovation (i.e. "the development of products, processes, marketing methods, organizational structure, and new or improved institutional arrangements, which, intentionally or not, contribute to a reduction of environmental impact in comparison with alternative practices" - see Bossle et al., 2016). Also, there is an increasing amount of research exploring the factors that influence the relationship between interorganizational collaboration and innovation (e.g. Awan and Sroufe, 2020), and sustainability asymmetries could add to this debate. Similarly, it would be interesting to verify the influence of buyer-supplier asymmetry in different new product development (NPD) approaches. More specifically, Brockhaus et al. (2019) identified three different approaches companies pursue toward translating sustainability strategy into their supply

chain operations: “dabblers”, “Do it Yourself” and “codifiers”. We could expect that different NPD approaches would be differently affected by sustainability asymmetries.

In addition, a potential line of research could be to contrast the two main supplier sustainability strategies of monitoring vs. collaboration (Tachizawa et al., 2015), and relate them to sustainability asymmetries. More specifically, to verify whether one of the approaches is more affected by such asymmetries and if the results depend on the area of the asymmetry.

Lastly, it has been argued that most sustainability problems in supply chains come from the so-called “lower-tier” suppliers (Villena and Gioia, 2020). Nevertheless, this study focuses on 1st tier suppliers. This is an important limitation of this research that should be analysed in subsequent studies.

Overall, this is a new and exciting avenue of research that will provide companies and policy-makers with insights on how to better plan their sustainability approaches accordingly with the norms, values and beliefs embedded in the society, and thus work together to facilitate the transition to a more sustainable economy.

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Table 1

Buyer firms and top suppliers included in the sample.

NAICS code (2-digit level)		Buyer Firms	Top Supplier Firms
21	Mining, Quarrying, and Oil and Gas Extraction	49	31
23	Construction	12	2
31-33	Manufacturing	283	230
42	Wholesale Trade	36	13
44-45	Retail Trade	68	0
48	Transportation and Warehousing	29	9
51	Information	0	15
54	Professional, Scientific, and Technical Services	21	8
56	Administrative and Support and Waste Management and Remediation Services	7	3
62	Health Care and Social Assistance	11	0
	Total	516	311

Table 2

Descriptive statistics and correlation matrix.

	1	2	3	4	5	6	7	8	9	10
1 Return on asset (ROA)	1.00									
2 Tobin's Q	0.08*	1.00								
3 Emission reduction – Buyer level ⁽¹⁾	0.05*	0.07*	1.00							
4 Emission reduction – Supplier level ⁽¹⁾	-0.10*	0.06*	-0.28*	1.00						
5 Resource reduction – Buyer level ⁽¹⁾	0.06*	0.04*	0.53*	-0.24*	1.00					
6 Resource reduction – Supplier level ⁽¹⁾	0.08*	0.10*	-0.28*	0.52*	-0.30*	1.00				
7 Health & safety – Buyer level ⁽¹⁾	0.07*	0.00	0.54*	-0.18*	0.56*	-0.24*	1.00			
8 Health & safety – Supplier level ⁽¹⁾	0.01	0.02	-0.24*	0.47*	-0.22*	0.45*	-0.29*	1.00		
9 Human rights – Buyer level ⁽¹⁾	0.10*	0.01	0.48*	-0.20*	0.44*	-0.17*	0.40*	-0.21*	1.00	
10 Human rights – Supplier level ⁽¹⁾	-0.02	0.00	-0.23*	0.35*	-0.21*	0.32*	-0.21*	0.36*	-0.31*	1.00
11 Buyer's size	0.11*	-0.26*	0.29*	-0.21*	0.17*	-0.24*	0.13*	-0.18*	0.19*	-0.10*
12 Buyer's leverage	-0.03	-0.04*	-0.04	-0.01	-0.02	-0.03	0.01	-0.03	-0.05*	-0.03
13 Buyer's market share	0.10*	-0.05*	0.01	0.01	-0.03	0.02	0.05*	0.01	0.06*	-0.03
14 Buyer's business segment	0.03	-0.18*	0.17*	-0.15*	0.09*	-0.16*	0.11*	-0.13*	0.18*	-0.11*
15 Buyer's R&D intensity	0.43*	0.40*	0.09*	0.12*	0.08*	0.10*	0.06*	0.00	0.09*	0.03
16 Buyer's relative ESG performance	0.13*	0.09*	0.40*	-0.30*	0.30*	-0.37*	0.28*	-0.27*	0.40*	-0.23*
17 Supplier's relative ESG performance	0.05*	0.02	-0.42*	0.29*	-0.44*	0.25*	-0.37*	0.26*	-0.33*	0.29*
18 Relationship length	0.07*	-0.01	-0.01	0.03	-0.07*	-0.03	0.02	0.08*	-0.02	0.06*
19 Mutual dependence	0.05*	0.01	-0.06*	-0.02	-0.07*	-0.02	-0.10*	0.13*	-0.07*	0.00
Mean	0.05	1.87	1.81	1.25	0.88	0.29	1.94	1.23	0.98	0.57
SD	0.09	1.20	1.06	0.70	1.16	0.74	1.05	0.64	1.10	0.74

Table 2 (Cont.)

Descriptive statistics and correlation matrix.

	11	12	13	14	15	16	17	18	19
11 Buyer's size	1.00								
12 Buyer's leverage	0.05*	1.00							
13 Buyer's market share	0.23*	0.09*	1.00						
14 Buyer's business segment	0.41*	0.04	0.28*	1.00					
15 Buyer's R&D intensity	0.23*	0.05*	0.13*	0.13*	1.00				
16 Buyer's relative ESG performance	0.50*	0.04	0.19*	0.37*	0.11*	1.00			
17 Supplier's relative ESG performance	0.18*	0.06*	0.13*	0.05*	0.02	0.13*	1.00		
18 Relationship length	0.10*	0.07*	0.05*	0.00	0.04	0.17*	0.11*	1.00	
19 Mutual dependence	0.11*	0.01	0.06	-0.09	0.03	-0.05*	0.00	0.06*	1.00
Mean	9.52	1.06	20.94	3.10	0.06	53.81	39.51	5.05	0.95
SD	1.49	1.73	23.71	1.96	0.26	21.85	20.14	4.12	3.27

Notes: ⁽¹⁾ The asymmetry variables show the value for the buyer and its top supplier respectively within the three-level framework before computing the decomposed variables through spline technique.

N=2,093 observations.

* Statistical significance at 0.10 level.

Table 3

Panel fixed-effect regression analysis for buyer's performance (2011-2018): Buyer-supplier environmental & social sustainability asymmetries (degree).

Variables	ROA		TOBIN'S Q	
	Model 1		Model 2	
	Coef.	Std Err.	Coef.	Std Err.
Emissions reduction asymmetry (degree)	-0.0086**	(0.004)	-0.1296***	(0.033)
Resource reduction asymmetry (degree)	0.0034*	(0.002)	-0.0137	(0.023)
Health & safety asymmetry (degree)	0.0059*	(0.003)	-0.0033	(0.027)
Human right asymmetry (degree)	-0.0027	(0.004)	0.0000	(0.029)
Buyer size	0.0369***	(0.012)	0.3209**	(0.139)
Buyer leverage	0.0008	(0.002)	0.0070	(0.013)
Buyer market share	0.0005	(0.000)	0.0049	(0.005)
Buyer business diversification	-0.0011	(0.003)	0.0137	(0.022)
Buyer R&D intensity	0.0408***	(0.006)	0.2568**	(0.125)
Buyer-relative ESG performance	0.0005*	(0.000)	0.0022**	(0.001)
Supplier-relative ESG performance	0.0004*	(0.000)	-0.0019	(0.003)
Relationship length	-0.0001	(0.001)	0.0305**	(0.014)
Mutual dependence	0.0020***	(0.001)	-0.0157*	(0.009)

Notes: The sustainability asymmetries reflect the differences between buyers and suppliers in each of the environmental and social sustainability areas and they are calculated in absolute value terms (i.e. degree of the asymmetry). The sample size is 2,093 dyad-year observations for 516 dyads (i.e. buyer and its top first-tier supplier). Robust standard errors are in parentheses. Dummy variables for years are included in all models, but they are not reported.

Significant at: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 4

Panel fixed-effect regression analysis for buyer's performance (2011-2018): Buyer-supplier environmental & social sustainability asymmetries (degree & direction).

Variables	ROA		TOBIN'S Q	
	Model 3		Model 4	
	Coef.	Std Err.	Coef.	Std Err.
Emission reduction – Buyer asymmetry (degree & direction)	-0.0058	(0.005)	-0.1190***	(0.045)
Emission reduction – Supplier asymmetry (degree & direction)	-0.0123**	(0.006)	-0.1461***	(0.052)
Resource reduction – Buyer asymmetry (degree & direction)	0.0092**	(0.004)	-0.0055	(0.029)
Resource reduction – Supplier asymmetry (degree & direction)	0.0084*	(0.005)	-0.0341	(0.042)
Health & safety – Buyer asymmetry (degree & direction)	0.0063*	(0.004)	0.0111	(0.031)
Health & safety – Supplier asymmetry (degree & direction)	0.0059	(0.005)	-0.0336	(0.044)
Human rights – Buyer asymmetry (degree & direction)	-0.0019	(0.003)	-0.0182	(0.030)
Human rights – Supplier asymmetry (degree & direction)	-0.0045	(0.004)	0.0262	(0.035)
Buyer size	0.0362***	(0.007)	0.3282***	(0.066)
Buyer leverage	0.0008	(0.001)	0.0069	(0.012)
Buyer market share	0.0004	(0.000)	0.0050	(0.004)
Buyer business diversification	-0.0012	(0.002)	0.0137	(0.021)
Buyer R&D intensity	0.0406**	(0.017)	0.2559*	(0.147)
Buyer-relative ESG performance	0.0006*	(0.000)	0.0019*	(0.001)
Supplier-relative ESG performance	0.0004*	(0.000)	-0.0015	(0.002)
Relationship length	-0.0001	(0.001)	0.0301***	(0.008)
Mutual dependence	0.0020*	(0.001)	-0.0159*	(0.009)

Notes: The sustainability asymmetries are estimated using spline technique (i.e. degree and direction of the asymmetry). The sample size is 2,093 dyad-year observations for 516 dyads (i.e. buyer and its top first-tier supplier). Robust standard errors are in parentheses. Dummy variables for years are included in all models, but they are not reported.

Significant at: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5

Results summary.

	Hypotheses	Results
H1a	Buyer-supplier environmental asymmetries will have a positive effect on buyer profitability	Confirmed in the area of resource reduction.
H1b	Buyer-supplier environmental asymmetries will have a negative effect on buyer profitability	Confirmed in the area of emission reduction.
H2a	Buyer-supplier social asymmetries will have a positive effect on buyer profitability	Confirmed in the area of health & safety.
H2b	Buyer-supplier social asymmetries will have a negative effect on buyer profitability	Not confirmed.
H3a	Buyer-supplier environmental asymmetries will have a positive effect on buyer market valuation	Not confirmed.
H3b	Buyer-supplier environmental asymmetries will have a negative effect on buyer market valuation	Confirmed in the area of emission reduction.
H4a	Buyer-supplier social asymmetries will have a positive effect on buyer market valuation	Not confirmed.
H4b	Buyer-supplier social asymmetries will have a negative effect on buyer market valuation	Not confirmed.
H5	When the buyer adopts a greening approach , buyer-supplier asymmetries will have a negative effect on its profitability	Only confirmed in the area of emission reduction.
H6	When the buyer adopts a greening approach , buyer-supplier asymmetries will have a negative effect on its market valuation	Only confirmed in the area of emission reduction.