

Resilience and recovery dynamics: Assessing the impact of exogenous shocks on sustainable companies

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ABSTRACT

The resilience of companies to exogenous shocks is a critical determinant of their long-term viability. This study seeks to understand how companies, particularly those that adopt sustainable practices, respond to two different types of exogenous shocks: COVID-19 and the Russo-Ukrainian War. To do so, we use a sample of 471 European companies listed in the S&P Global Sustainability Yearbook from 2019 to 2022. Using an adaptation of Feltham and Ohlson's (1995) model, our results show significant differences in the intensity and speed of value recovery between companies with high and low levels of sustainability disclosure. However, the nature of the recovery differs between shocks, highlighting the need for tailored risk management strategies. These findings underscore the importance of integrating sustainability into strategic planning to enhance corporate resilience and long-term value creation in the face of unpredictable shocks.

1. Introduction

The Russo-Ukrainian (RU) War, characterised by geopolitical tensions and prolonged uncertainty, has disrupted energy markets, trade, and global supply chains, creating far-reaching implications for businesses and economies. The war has caused sharp increases in energy prices, supply shortages, and shifts in trade dynamics, forcing firms to adapt to an unpredictable and volatile environment (Saharti et al., 2024; Shen et al., 2023; Yarovaya et al., 2022). Its prolonged nature has further exacerbated uncertainty, challenging businesses to maintain operational continuity and stakeholder confidence. This shock presents a big different with the previous one, the COVID-19 pandemic. The pandemic emerged as an abrupt and widespread health crisis that disrupted global markets and operations with unprecedented speed (Ferriani & Gazzani, 2023; Grebe et al., 2024; Sulong et al., 2023). Lockdowns, travel restrictions, and supply chain bottlenecks created immediate operational and financial pressures, necessitating rapid adjustments in business models, workforce management, and stakeholder engagement. These two events underscore the need to understand how firms lead to, resist and recover from exogenous shocks that differ significantly in their nature, duration, and intensity.

Resilience is “a property of all systems and is related to how a system responds to a disturbance or stressor” (Zohuri & Moghaddam, 2017, p.3). The above-mentioned events have prompted research on how

companies respond to such challenges, with studies suggesting that those that implement sustainable practices would be better positioned to navigate periods of distress (Al-Ansi et al., 2023; Fiordelisi, Galloppo, & Paimanova, 2023). Derqui (2020) defines corporate sustainability as the simultaneous fulfilment of the needs of the company and its stakeholders, while safeguarding natural and human resources for the future. This holistic perspective integrates stakeholder interdependencies into business development, acknowledging their impact on the firm's management, economic activities and socio-environmental responsibilities (Salvioni & Gennari, 2016). From a theoretical viewpoint, diverse explanations can be found to provide a valuable lens to understand how sustainability can shape firms' responses to exogenous shocks. Stakeholder theory (Freeman, 1984) emphasizes the importance of building trust and cooperation with stakeholders, which can foster organisational stability during disruptions. Resource-based theory (Barney, 1991) positions sustainability as a strategic asset, enabling firms to develop capabilities that promote adaptability and long-term value creation. Signalling theory (Spence, 1973) highlights how sustainability practices signal reliability and ethical commitment to investors and other stakeholders, reinforcing confidence during periods of uncertainty. These theories collectively underscore the potential of sustainability practices to enhance resilience, emphasizing the ability of this type of firms to generate value in the long run.

Embracing corporate sustainability requires a permanent

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commitment to long-term economic, social, and environmental responsibilities, aligned with objectives centred on value creation (Amini & Bienstock, 2014; Lozano, 2015). Sustainability disclosure of environmental, social and governance practices also carries economic, financial, and environmental implications (Starks, 2023). Recent studies have shown that sustainability reporting can influence firms' cost of capital, investment efficiency, and market valuation by enhancing the informativeness of corporate disclosures (Christensen et al., 2021; Gibbons, 2023). High-quality sustainability information on material issues also strengthens investor confidence, improves stock price informativeness, and supports long-term financial stability (Grewal et al., 2021; Grewal & Serafeim, 2020). Additionally, centralized monitoring and disclosure mechanisms are associated with improved environmental outcomes and green revenue generation (Cao et al., 2025; Driss et al., 2024). Moreover, enhanced transparency in sustainability practices can reduce the risk of greenwashing and deceptive behaviour, particularly in some types of firms, such as family firms, where such risks are heightened (Zhang et al., 2024). While these studies underline the strategic value of sustainability disclosure in improving transparency, stakeholder trust, and long-term financial outcomes, an important question raises about how these sustainable practices operate under conditions of prolonged uncertainty. In particular, the long-term orientation and institutionalization of sustainability initiatives may reduce firms' capacity to pivot quickly or reprioritize under stress.

While these practices improve resilience to exogenous shocks that impact firm value in the short term, they can introduce limitations when a shock requires agility and adaptability to protect firm value in the long term. If firms prioritise the needs and expectations of stakeholders as postulated by the stakeholder theory, they must commit resources to long-term initiatives, which can reduce a firm's agility in reallocating resources or shifting priorities in response to an exogenous shock. Similarly, the resource-based view emphasizes that sustainability practices generate unique and valuable resources that confer competitive advantages. However, these advantages often stem from resource configurations optimized for long-term stability, making it challenging to adapt prolonged shocks. As a result, this emphasis on long-term stability may signal inflexibility or hesitance to take decisive actions in the face of shocks that demand adaptability. Thus, while sustainability practices provide firms with a foundation of resilience, their long-term focus can introduce challenges in responding effectively to shocks characterised by prolonged uncertainty changes.

Previous literature has omitted the effect of adopting sustainable practices when a firm faces an exogenous shock. In this regard, Izzeldin et al. (2021), Benkraiem et al. (2022) and Abbasi et al. (2023) have investigated the impact of shocks on the financial performance of companies, offering insights into the reactions of investors during crises. However, a critical gap exists in comprehensively examining how sustainability practices, often considered a strategic asset, influence organisational resilience under different shock scenarios. Building on the existing literature, this study not only analyses the value and expected value of companies during shocks, but also introduces sustainability practices as a crucial factor influencing their reactions. In addition, we examine the magnitude (intensity) of the impact of a shock and the time (speed) it takes a company to recover its pre-shock value, distinguishing between its short-term and long-term components.

Recent shocks provide a unique opportunity to test how different companies adapt to various events that impact their value in a differentiated way. Therefore, this study examines how corporate sustainability practices influence firms' resilience to different types of exogenous shocks—namely COVID-19 (type 1) and the Russo-Ukrainian War (type 2). Type 1 shocks are characterised by sudden and widespread disruptions to global markets and supply chains. Type 2 shocks, on the other hand, involve profound and long-lasting impacts caused by geopolitical tensions. Based on the referred theories, we hypothesize that firms with sustainable practices exhibit greater resilience to type 1 shocks due to their long-term focus, and stakeholder engagement.

However, we also propose that these same practices introduce vulnerabilities when facing type 2 shocks, where prolonged uncertainty and geopolitical instability demand a different set of organisational capabilities. To examine the responses to these two different types of shocks, we use a sample of 471 European companies listed in the S&P Global Sustainability Yearbook from 1 January 2019 to 31 December 2022. Employing an adaption of the Feltham and Ohlson (1995) model used by Bushee (2001), Del Río and Santamaría (2016), and Bofinger et al. (2022), we assess the valuation of companies during both shocks. This adapted methodology allows us to differentiate between short-term and long-term value responses, providing insights into the ability of companies to recover and regain previous valuations. Additionally, we integrate financial metrics with sustainability-related variables, enabling us to capture the differential effects of the shocks on firms' short-term and long-term value components. This methodology enables us to identify the timing and magnitude of shocks on firm valuations, integrating value-at-risk (VAR) analyses to evaluate the role of sustainability practices in moderating these effects. By isolating the long-term value component, the model provides insights into the ability of companies to recover their pre-shock valuations and the factors driving their resilience. The inclusion of financial market expectations further enhances our analysis, as it allows us to measure not only actual valuation changes but also how markets perceive the recovery trajectories of high and low sustainable companies.

Our results reveal that companies with sustainable practices have higher valuations in the long term and show greater resilience when confronted with the first type of shock. The rationale behind these outcomes lies in the long-term component, which serves as a financial safeguard for these companies. Conversely, this long-term component introduces vulnerabilities when companies face the second type of shock, so that the impact on their long-term value is greater although they recover in a shorter period of time. In addition, we show that the speed and intensity of the long-term recovery of sustainable companies not only increases their long-term value, but also influences financial market expectations. These results contribute to the previous literature in several ways. First, this study extends prior research on corporate resilience by examining how firms implementing sustainable practices respond to different types of exogenous shocks. Previous studies such as Izzeldin et al. (2021), Benkraiem et al. (2022), and Abbasi et al. (2023) have primarily focused on the financial performance of firms during crises. Our research introduces sustainability as an explanatory factor of firm value, distinguishing between short- and long-term components, offering a broader perspective on organisational resilience. Second, we contribute to the body of research on the long-term implications of corporate sustainability (e.g., Zheng et al., 2023; Zumente & Bistрова, 2021), by demonstrating how the long-term focus of sustainable practices influences resilience differently depending on the type of shock. By incorporating sustainability into the analysis, this study extends resource-based and stakeholder theories, as well as the signalling theory literature, by showcasing how sustainable practices enhance trust, cooperation, and organisational capabilities, while also identifying limitations when agility and adaptability to maintain firm value over the long-term are critical to recovery from type 2 shocks. Third, from a methodological perspective, our adaptation of the Feltham and Ohlson (1995) model to include sustainability-related variables contributes to the literature on corporate valuation models, providing a tool for assessing firm resilience and recovery dynamics in the context of sustainability. By integrating short-term and long-term value components, this study offers a comprehensive framework for analysing the impact of shocks on corporate performance, which can be further explored in future research. Finally, from a practitioner perspective, this study underscores the importance of embedding sustainability into strategic planning. For CEOs, business leaders, and risk managers, the findings highlight that while sustainable practices can strengthen long-term resilience, they may also require strategic adjustments to improve agility during prolonged or unanticipated shocks. For investors, the

research provides nuanced insights, showing that while sustainable companies may offer long-term stability, these firms may experience a greater negative impact on their value.

This study is structured as follows. The next section reviews the previous literature and defines the working hypotheses. Section 3 presents the sample, main variables and proposed statistical techniques. The results and conclusions of this study are summarised in sections 4 and 5, respectively.

2. Theoretical framework

2.1. Resilience and corporate sustainability

Cheema-Fox et al. (2020, p.6) define resilience as “the ability to withstand negative effects from a negative event”. Tang et al. (2022) identify two basic elements behind this definition: size and time. The former quantifies the intensity of a negative impact on the firm (Chabot et al., 2019), while the latter takes into account the time it takes an organisation to return to its pre-shock level (Broto & Lamas, 2020). Albuquerque et al. (2020) and Ameer and Boussetta (2023) provide evidence that companies that implement sustainability practices are more resilient in terms of both size and time, as they can recover faster than those organisations with poor sustainability levels. Specifically, these companies can recover previous levels of sales and profits, reduce their volatility and achieve a higher level of survival than those entities with a weaker commitment to sustainability disclosure (Abbasi et al., 2023; Albuquerque et al., 2020; Ortiz-de-Mandojana & Bansal, 2016; Tang et al., 2022).

Several explanations have been put forward to explain why companies with sustainable practices are more resilient in the face of exogenous shocks. Using stakeholder theory, Ortiz-de-Mandojana and Bansal (2016) and Lins et al. (2017) discuss that these firms are able to build stronger relationships through sustainable practices, improving legitimacy, reputation and market access. Stakeholder theory considers organisations as “a constellation of cooperative and competitive interests possessing intrinsic value” (Donaldson & Preston, 1995, p.66). These interests belong to different stakeholders who exert an influence on and are affected by the organisation (Freeman, 1984). Therefore, organisations must be oriented towards all their potential stakeholders, such as customers, suppliers, employees, shareholders and society, whose needs must be considered (Freeman et al., 2018). According to this approach, if firms consider the interests of stakeholders on the basis of mutual trust and cooperation, they will gain a competitive advantage over firms that do not (Jones, 1995; Jones & Wicks, 1999, p.208; Gibson, 2000, p.250). This cooperation enables the organisation to address emerging issues, identify changes in the environment, be warned of possible shocks and create the necessary levels of trust to exploit new opportunities (Harrison et al., 2010).

Furthermore, from resource-based theory, companies committed to sustainability practices are able to obtain consistent, flexible and firm-specific resources that are used in times of economic uncertainty (Chatzoudes et al., 2022; Ortiz-de-Mandojana & Bansal, 2016). This theory postulates that firms compete on the basis of their resources and capabilities (Barney, 1991; Wernerfelt, 1984). Resources are considered to be tangible or intangible assets that belong to the organisation, while capabilities are unobservable skills developed by the organisation (Miles, 2012). The mix of valuable, unique, inimitable and non-substitutable resources and capabilities leads firms to gain and maintain competitive advantages (Barney & Clark, 2007). Stakeholder relationships have been identified as an intangible resource that, through participation in decision-making processes, can stimulate the creativity and problem-solving skills needed to face economic shocks (Ortiz-de-Mandojana & Bansal, 2016). Moreover, sustainability practices would be a source of increased firm capabilities, implying greater resilience through rapid adaptation and realignment through differentiation strategies in the event of economic shocks (Albuquerque et al., 2019).

Consequently, companies that implement sustainable practices should be more resilient in the face of a negative shock. The integration of stakeholder needs and the associated competitive advantages should provide a financial buffer for difficult times. However, while the implementation of sustainable practices prioritises long-term benefits (Amini & Bienstock, 2014; Del Río et al., 2023; Lozano, 2015; Whelan & Fink, 2016), it can also generate vulnerabilities when the company faces a shock that affects its long-term value.

2.2. Resilience, firm value and sustainability disclosure

Although there is some consensus on the meaning and implications of the term resilience, the previous literature differs on its measurement (Abedifar et al., 2023). According to these authors, resilience can be assessed through two approaches: accounting-based measurements and market-based measurements. Albuquerque et al. (2020) consider that the accounting-based approach measures an organisation's ability to recover the levels of return on assets, operating profit and asset turnover prior to the exogenous shock, while a market-based approach considers the organisation's capacity to recover its share price. More recent studies, such as Dautaj (2023), Ji et al. (2023) and Fiordelisi, Ricci, and Santilli (2023), consider resilience to be the ability of a company to recover its firm value.

Firms that engage in sustainability practices should be better protected against declines in value, and consequently recover their value, than firms that do not engage in such practices (Nirino et al., 2022; Phang et al., 2023).¹ Evaluating resilience requires the assessment of both the speed of recovery and the minimisation of the intensity of exogenous shocks. Building on Bushee (2001) and Del Río and Santa-maria (2016), Del Río et al. (2023) propose an adaptation of the Feltham and Ohlson (1995) model to assess the short- and long-term value, demonstrating that those companies that implement sustainability practices achieve higher value in the long run. Corporate sustainability aims to maximise value creation for stakeholders, which requires the development of long-term commitments at the economic, social and environmental levels (Bofinger et al., 2022; Nguyen et al., 2020). Schoenmaker and Schramade (2019) explain this long-term commitment based on two factors: the costs needed to prepare the company for the transition to a more sustainable economic model, and the time needed to optimise the financial, social and environmental value of the organisation. On the one hand, firms engaged in sustainability practices invest economic resources in the implementation of such practices in the short term, while the results will be seen in the long term when the changes bear fruit (Zheng et al., 2023; Zumente & Bistрова, 2021). On the other hand, the implementation of these practices also requires the passage of time, which in turn strengthens the long-term effects of sustainability (Bansal & DesJardine, 2014). These long-term effects may work to increase the value of the firm. As we have stated previously, firms that implement sustainable practices are able to gain competitive advantages and capabilities that could make them more resilient when confronted with an exogenous shock.

In addition, if a company discloses these practices to financial markets, it may help to reduce the level of uncertainty in the future decisions of various economic and social actors. Signalling theory has been proposed as a theoretical explanation for these positive effects related to sustainability disclosure. According to this theory, a signal is any new information or additional information that adds to previous older

¹ In this study, we assume causality under the social impact hypothesis proposed by Preston and O'Bannon (1997). In accordance with this hypothesis, if a firm satisfies its stakeholder claims, stakeholders will reciprocate by making firm-specific investments that will increase the value of the firm and enhance its global reputation and image. This approach has recently been adopted by other authors, such as Hernández et al. (2020), Lajnef and Ellouz (2022), Wei et al. (2024) and Li et al. (2024).

information that is known by the firm but not yet known by the investor (Spence, 1973). Sustainability disclosure allows companies to reveal new information and is, in fact, a signal that compiles and completes asymmetric information about sustainability strategies and their impacts (Spence, 2002). It reduces the informational gap between organisations and markets that exists despite the proliferation of non-financial information (Bergh & Gibbons, 2011; Connelly et al., 2011; Miller & Triana, 2009). As a signalling tool, sustainability disclosure also provides a discriminating element that can guide the decisions of economic and social agents, generating reputation and prestige among investors (Danvila et al., 2019; López-Arceiz et al., 2020), and reducing uncertainty about firm value over the long term.

Recent literature also suggests that both mandatory and voluntary sustainability disclosure itself can have significant economic, financial and environmental implications that enhance long-term firm value and resilience. First, mandatory disclosure and sustainability reporting has been shown to improve firms' cost of capital, investment efficiency, and stakeholder trust by reducing information asymmetry and increasing comparability among firms (Christensen et al., 2021; Haji et al., 2023). Gibbons (2023) finds that even sustainability disclosure that may fall outside traditional definitions of materiality have meaningful effects on investment and financing decisions, particularly for institutional investors. Similarly, Grewal et al. (2021), Kimbrough et al. (2024) and Tsang et al. (2023) extend these results evidencing that voluntary disclosure of material sustainability information improves stock price informativeness, which improves investor confidence and market-based resilience. Moreover, sustainability practices and their disclosure can help firms anticipate and adapt to environmental regulations. Cao et al. (2025) find that centralized environmental monitoring reduces greenwashing, incentivises the achievement of environmental and market opportunities and promotes the avoidance of legal penalties. These strategic capabilities directly relate to long-term value preservation and resilience. Driss et al. (2024) also observe that the presence of internal sustainability committees, as part of sustainability disclosure, becomes especially relevant in contexts of weak external environmental governance, enhancing the quality of environmental disclosure and reinforcing firm-level accountability. In parallel, recent evidence shows that certain organisational cultures committed towards sustainability disclosure can mitigate opportunistic behaviours, such as greenwashing, by lowering agency costs and increasing sensitivity to reputational and regulatory risks (Zhang et al., 2024). These dynamics strengthen the credibility of sustainable disclosure and contribute to long-term stakeholder trust and value protection.

Consequently, firms that engage in sustainability disclosure are expected to be more resilient to exogenous shocks due to their long-term focus and reduced information asymmetries. Indeed, aware of these effects, investors who choose to participate in these organisations are likely to be highly committed to sustainability and to prioritise long-term value creation (Del Río et al., 2023). However, while the long-term orientation of these firms generally enhances their capacity to absorb and recover from shocks, the nature of the shock itself may play a crucial role in determining the extent and characteristics of their resilience. Thus, the results will differ if the shock's impact is more prominent in the long-term component or in the short-term component of the firms' value.

2.3. Hypotheses

Previous literature has considered some factors that may explain the reactions of companies facing an exogenous shock. In relation to the industry, Izzeldin et al. (2021) suggest that technology firms are more resilient over the long term due to their adaptability and digital infrastructure, while manufacturing sectors face greater disruptions. Benkraiem et al. (2022) find that geographical location also matters, with American firms exhibiting stronger short-term overreactions compared to Asian counterparts. Abbasi et al. (2023) emphasize organisational

size, noting that multinational firms are more vulnerable to type 2 shocks. However, the role of sustainability disclosure in explaining corporate resilience remains underexplored. According to stakeholder and resource-based theories, firms implementing sustainability practices are expected to address stakeholder needs and leveraging the resulting competitive advantages, which would mean greater resilience when confronted with negative shocks (Corvino et al., 2024; Nader et al., 2022). However, the preference for the long-term, characteristic of these companies, could introduce a different behaviour when a company confronts some exogenous shocks.

Recently, Izzeldin et al. (2023) compare the response of financial markets to the COVID-19 pandemic and the Russo-Ukrainian War. The authors conclude that investors may have misinterpreted both events, leading to different reactions. In the case of the COVID-19 pandemic shock (type 1), investors may have overreacted in the short term by having a more severe response. This type of short-term shock would be characterised by its rapid and global nature, with extreme monetary and fiscal policies, restrictions on the population, and high financial contagion across markets (Yarovaya et al., 2022; Yahya, 2023). In addition, type 1 shocks often lead to immediate operational disruptions, such as supply chain interruptions and shifts in consumer demand, creating acute financial strain due to sudden market volatility (Cardillo et al., 2023; Eisenkopf et al., 2023; Garel & Petit-Romec, 2021). In such scenarios, firms with strong sustainability practices that leverage long-term investments in stakeholder relationships and adaptive capabilities are expected to exhibit higher resilience. This higher resilience could be attributed to a greater emphasis on long-term value over short-term value, which would act as a financial buffer. To test this asseveration, we propose the following working hypothesis:

H1: Sustainable companies are more resilient to a type 1 exogenous shock.

The resilience of sustainable companies might differ when faced with more gradual, long-term shocks. The Russo-Ukrainian War shock (type 2) was characterised by a slower onset and a more prolonged impact (Yarovaya et al., 2022). In this case, investors may have overreacted in the long term, leading to a less intense but longer-lasting response (Mnif et al., 2022). For this second type of shock, the reaction was different across markets and industries, the economic policy implemented was more restrictive, especially in terms of monetary policy decisions, and there were no restrictions on the population (Ferriani & Gazzani, 2023; Grebe et al., 2024; Sulong et al., 2023). Type 2 shocks typically lead to prolonged operational adjustments and sustained financial pressures, as companies face ongoing strategic realignments over a longer period (Saharti et al., 2024; Shen et al., 2023). In these scenarios, companies committed to long-term sustainability practices may experience reduced resilience, as their focus on long-term value could hinder their ability to adapt quickly to sustained pressures. Despite the relevance of sustainability practices, no previous studies have examined the resilience attributes of such companies when confronted with gradual, long-term shocks. Therefore, we propose the following hypothesis:

H2: Sustainable companies are less resilient to a type 2 exogenous shock.

The non-rejection of H_1 would mean that sustainability disclosure is able to improve the adaptive capacity of a firm facing an intense shock in the short term (type 1). This would contrast with the non-rejection of H_2 , which would imply that these companies are not particularly resilient when faced with a more gradual shock (type 2). This divergence in the resilience would be caused by the effect of investor preferences for long-term benefits in those companies that implement sustainable practices.

3. Methodology

3.1. Sample

We test our hypotheses using a sample of 471 European companies from the S&P Global Sustainability Yearbook, based on the Corporate Sustainability Assessment (CSA) methodology. This is a survey that provides quantitative information to classify companies into a publicly available qualitative index (RobecoSAM, 2023). The S&P Yearbook classifies companies into four classes in a medal display table: Gold, Silver, Bronze and Industry Mover.² The use of companies included in the S&P Yearbook allows us to consider a homogeneous sample in terms of total assets, market capitalisation and presence of different industries (RobecoSAM, 2023). Historical price data together with earnings expectations for the sample companies were drawn from the Refinitiv Eikon database. The sample period is from 1 January 2019 to 31 December 2022 and takes into account two different exogenous shocks: COVID-19 and the Russo-Ukrainian War. The final sample consists of 491,724 observations. Table 1 shows the composition of the sample.

We observe that the companies that belong to the S&P Global Sustainability Yearbook are large in terms of total assets and market capitalisation. Approximately 25 % of these companies studied were part of the medal display table during the period analysed, while the rest of the companies in the sample were considered for inclusion in the Yearbook but failed to make it due to the low score they obtained in the CSA process. These companies are unevenly distributed across European countries, with the UK, France, Norway, Spain and Germany leading the way. Industrials, consumer cyclicals and basic materials dominate the sectoral composition of the sample.

3.2. Main variables

3.2.1. Sustainable disclosure

Sustainability disclosure refers to the quality of voluntary non-financial information that a company shares with its stakeholders about the implemented sustainability practices (Giannarakis et al., 2018). To test our working hypotheses, we divided the sample of firms into high sustainability disclosers (HighSDs) and low sustainability disclosers (LowSDs) (Eccles et al., 2014; Ferrer et al., 2020; Leleux & Van der Kaaij, 2019; Nicolăescu et al., 2015). To distinguish between the two categories, we consulted the S&P Sustainability Yearbook, which ranks companies according to their level of sustainability. In particular, the Yearbook provides “an evaluation of the quality of a company's reporting on environmental, social and governance issues”, (RobecoSAM, 2019, p.7). Some recent studies have used the Yearbook as a sustainability disclosure indicator (Del Río et al., 2023; Durand et al., 2019; Ferrer et al., 2020; López-Arceiz et al., 2022; Van der Waal & Thijssens, 2020). Therefore, we created a binary variable (HighSD_i) that takes the value 1 for High_SD firms and 0 otherwise. The High_SD category includes companies that are listed in the medal display table of the Yearbook in the year of observation, while the Low_SD category comprises those that have gone through the CSA process but are absent from this rating list during a specific year.

² The Gold Class contains companies achieving a CSA score within 1 % of the industry's top-performing company's score, with a minimum score of 60. The Silver Class includes companies achieving a CSA score within a range of 1 % to 5 % of the top-performing company's score in their industry, with a minimum score of 57. The Bronze Class includes companies achieving a CSA score within a range of 5 % to 10 % of the top-performing company's score in their industry, and a minimum score of 54. Finally, the Industry Mover (mention) distinction includes companies within the top 15 % of each industry that participated in the CSA the previous year and the current year, achieved an improvement in their CSA score of at least 5 %, and achieved the strongest improvement in their industry.

Table 1

Sample characteristics.

Characteristic	n	%
Total Assets		
Lower than \$4230 mill.	117	24.90
Between \$4230 and \$32640 mill.	235	50.00
More than \$32640 mill.	118	25.10
Market Capitalisation		
Lower than \$2514 mill.	117	24.90
Between \$2514 and \$21115 mill.	235	50.00
More than \$21115 mill.	118	25.10
Yearbook		
Medal display table	114	24.30
Non-medal display table	356	75.70
Industries		
Energy	50	10.64
Basic Materials	66	14.04
Industrials	98	20.85
Consumer Cyclicals	79	16.81
Consumer Non-Cyclicals	50	10.64
Financials	3	0.64
Healthcare	34	7.23
Technology	21	4.47
Telecommunication Services	27	5.74
Utilities	42	8.94
Location		
Germany	29	6.17
Austria	24	5.11
Belgium	23	4.89
Denmark	20	4.26
Finland	28	5.96
France	41	8.72
Italy	25	5.32
Luxembourg	5	1.06
Netherlands	25	5.32
Norway	38	8.09
Portugal	25	5.32
United Kingdom	117	24.89
Spain	34	7.23
Sweden	21	4.47
Switzerland	15	3.19

This table shows the sample composition, with all percentages calculated on the total number of companies. The categories Total Assets and Market Capitalisation are divided into three ranges for better classification according to the median and interquartile range. The Yearbook characteristic distinguishes companies that are featured in the medal display table from those that are not. Industries are categorised based on the Refinitiv Business Classification (TRBC). The location characteristic lists the countries where the companies are based, with the number and percentage of companies from each country.

3.2.2. Short-term and long-term exogenous shocks: COVID-19 and the Russo-Ukrainian War

Weterings (2022, p.20) defines an exogenous shock as “an unexpected event that affects all the participants in a financial market”. In this study, following Izzeldin et al. (2023), we identify two exogenous shocks: COVID-19 (type 1) and the Russo-Ukrainian War (type 2). Fig. 1 shows the average evolution of the price series of the components of the S&P Sustainability Yearbook during the sample period.

Looking at the evolution shown in the above figure, we observe two periods. For the COVID-19 shock (type 1), it began on 20 February 2020 and finished on 20 March 2020. In European markets, the choice of this time period is explained by the start of the Italian lockdown on 9 March 2020 (Izzeldin et al., 2023). We have included a window of two weeks on either side of the event. The type 2 shock, the Russo-Ukrainian War, began on 1 January 2022 and ended on 31 March 2022. In this case, 22 February 2022 is the key date when Russia invaded Ukraine. The selection of the starting date is explained by the concentration of Russian troops near the Ukrainian border during the first week of January (BBC, 2022).

3.2.3. Firm value

Following Albuquerque et al. (2020), we measure resilience using a market-based approach. In particular, Dautaj (2023), Ji et al. (2023) and

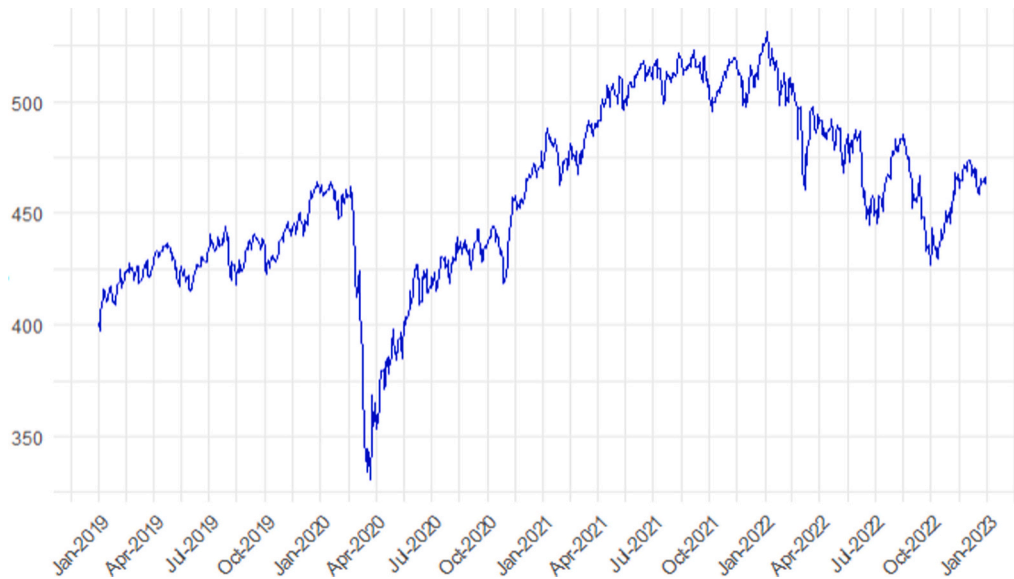


Fig. 1. Average evolution of prices of the components of the S&P Sustainability Yearbook.

Figure 1 shows the average evolution of prices of the components of the S&P Sustainability Yearbook from 2019 to 2022. The x-axis represents the quarters of each year, while the y-axis shows the price levels. The chart illustrates price fluctuations over time, highlighting significant market events such as the sharp decline in early 2020, likely due to the onset of the COVID-19 pandemic, followed by a recovery and subsequent fluctuations. Another notable dip occurs in early 2022, coinciding with the onset of the Russo-Ukrainian War, reflecting the market's response to geopolitical tensions. These trends underscore the sensitivity of sustainable assets to global economic and political events.

Fiordelisi, Galloppo, and Paimanova (2023) consider that resilience is the ability of a company to recover its firm value, understood as the smallest difference between its market value and its book value. In order to determine the firm value, the model proposed by Abarbanell and Bernard (2000), Bushee (2001), and Del Río and Santamaria (2016) is used, which is an adaptation of the Feltham and Ohlson (1995) model. Considering the two components associated with the short-term (Short_TC) and long-term (Long_TC) values, the model may be specified as follows [1]:

$$\text{Value}_{i,t} = b_{i,t} + \left[\frac{E_t(x_{i,t+1} - r_i \cdot b_{i,t})}{(1 + r_i)} \right] + \left[\sum_{s=2}^T \frac{E_t(x_{i,t+s} - r_i \cdot b_{i,t+s-1})}{(1 + r_i)^s} + \frac{E_t(P_{i,t+T} - b_{i,t+T})}{(1 + r_i)^T} \right] \quad (1)$$

where $\text{Value}_{i,t}$ represents the value of the i -th firm in the period t . This value is obtained as the sum of the book value of the i -th firm in the period t , the short-term component ($\text{Short_TC}_{i,t+1}$) and the long-term component ($\text{Long_TC}_{i,t+T}$). The short-term component is given by the expression $\left[(1 + r_i)^{-1} E_t(x_{i,t+1} - r_i \cdot b_{i,t}) \right]$, while the long-term component is represented by $\left[\sum_{s=2}^T (1 + r_i)^{-s} E_t(x_{i,t+s} - r_i \cdot b_{i,t+s-1}) + (1 + r_i)^{-T} E_t(P_{i,t+T} - b_{i,t+T}) \right]$. In these expressions, abnormal earnings are defined as forecast earnings ($E(x_{i,t+s})$) minus the expected book value times a rate of return ($r_i \cdot b_{i,t+s-1}$), where r_i is the cost of capital. The rate of return applied is equal to the estimated cost of equity capital based on the Capital Asset Pricing Model (CAPM).³ The term $P_{i,t+T}$ was obtained following the proposal of Liu and Thomas (2000). The firm value ($\text{Value}_{i,t}$) is the sum of the short-term ($\text{Short_TC}_{i,t+1}$) and the long-term ($\text{Long_TC}_{i,t+T}$) components for each of the following horizons: $T = 1; 2; 3$ (Abarbanell & Bernard, 2000; Bushee, 2001; Del Río et al., 2023). Consequently, the firm value can be specified as follows [2]:

$$\text{Value}_{i,t} = b_{i,t} + \text{Short_TC}_{i,t+1} + \text{Long_TC}_{i,t+T} \quad (2)$$

3.2.4. Control variables

We incorporate certain control variables to account for factors that might influence the firm value. These control variables include the total assets, the return on assets (ROA), the leverage, the clean/dirty activity sector and the country. The total assets represent the size of a firm. Larger firms often have more resources and diversified operations, which can impact their value (López-Arceiz et al., 2018). The ROA provides an indicator about the company's profitability relative to its total assets, indicating how efficiently management uses assets to generate earnings (Yadav, 2022). The leverage, measured by the debt-to-equity ratio, reflects the extent to which a firm utilizes debt financing, which can influence its value (Pratt et al., 2023). Additionally, we also control for the clean/dirty sector activity variable. It distinguishes between firms operating in environmentally friendly ("clean") industries versus those in more polluting ("dirty") sectors based on the EU Taxonomy for Sustainable Activities. Industry classification helps account for these sector-specific effects. Finally, we include the country where the company is settled down. Country-specific factors, such as economic conditions, regulatory frameworks, and market maturity, can significantly impact firm value (Ghoul et al., 2017).

3.3. Empirical analysis

First, we conduct a descriptive analysis of the value of the firm ($\text{Value}_{i,t}$), its book value ($b_{i,t}$) and the short-term ($\text{Short_TC}_{i,t+1}$) and long-term ($\text{Long_TC}_{i,t+T}$) components of firm value. The short-term component captures the immediate impact on firm value within one year, and the long-term component represents the cumulative impact over a longer period ($T = 1, \dots, 3$ years). We have also computed the daily market return ($R_{i,t}$). Using a t -test for independent samples, we evaluate the differences between High_SD and Low_SD firms. The t -test allows us to statistically compare the mean values of firm value, book value, the short-term and long-term components, and market return. This allows us to determine whether there are significant differences in these variables between the two groups. This analysis is performed for the full sample and separately for the two types of shocks: the type 1 shock (COVID-19)

³ According to the Capital Asset Pricing Model, the monthly rate of return (r) is estimated as $r = R_f + \beta_{\text{assets}}(R_m - R_f)$, where $(R_m - R_f)$ for developed European markets was obtained from https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

and the type 2 shock (Russo-Ukrainian War). Significant differences indicated by the *t*-test would suggest that the level of sustainability disclosure influences the value of the firm and its components.

After presenting the descriptive statistics, we analyse the level of resilience of the studied companies. Following Tang et al. (2022), we first examine the ability of the firm to minimise the intensity of the shock in terms of the size effect. This size effect considers the recovery of firm value prior to the shock. To measure this, we perform a series of *t*-tests for independent samples to compare: a) the firm value ($Value_{i,t}$) and its components ($Long_TC_{i,t+T}$ and $Short_TC_{i,t+1}$) before (ex-ante) and during (ex-durante) the shock, b) the reaction of High_SD and Low_SD companies, and c) the recovery of the firm value and its components for High_SD companies affected by the shock relative to Low_SD companies. The *t*-tests assess mean differences between the firm value and its components estimated according to expressions [1] and [2]. If there is no difference between the means, the coefficients indicate resilience. Conversely, significant differences indicate vulnerability. By distinguishing between High_SD and Low_SD companies, we can interpret the interaction effects of sustainability disclosure on resilience. Specifically, we expect High_SD firms to recover the ex-ante values, reflecting their better resilience in minimising the intensity of the shock. Fig. 2 shows the periods considered for both shocks: COVID-19 and the Russo-Ukrainian War.

The event window (ex-durante period) includes the event day (*t*) and a specified window period as shown in Fig. 1. We have defined different windows of two, four, six, eight, sixteen and thirty-one days to obtain the firm value before the shock (ex-ante period). Specifically, Table 2 shows the different periods by shock. The COVID-19 shock covers both the event window (ex-durante period) and the days prior to the shock (ex-ante period), discounting a period of three months before the shock.

In particular, in the case of the COVID-19 period, we consider the event day to be 9 March 2020, with a three-month period prior to the shock and an estimation window of 270 days (20 January 2019 to 20 October 2019).⁴ Similarly, for the Russo-Ukrainian War, we consider the event day to be 22 February 2022, with the ex-ante period starting on 1 October 2021, leaving a three-month period between the first window of the ex-ante period and the event window.⁵ We consider a company to have recovered its pre-shock value if there are no significant differences between the average firm value in the ex-durante and ex-ante periods. We repeat this process to estimate the short-term ($Short_TC_{i,t+1}$) and long-term ($Long_TC_{i,t+T}$) components of firm value before (ex-ante) and during (ex-durante) the shock, distinguishing between High_SD and Low_SD companies.

Once the firm value and its components are estimated, we employ a Difference-in-Differences (DiD) approach to assess the impact of the COVID-19 pandemic (type 1 shock) and the Russo-Ukrainian War (type 2 shock) on firm value and its long- and short-term components. This approach allows us to compare the changes in firm value as a result of each shock, between firms with high sustainability disclosure (High_SD) and those with low sustainability disclosure (Low_SD). The exogenous nature of these shocks allows us to isolate the causal impact of sustainability practices on firm resilience, thereby mitigating potential endogeneity. The DiD model has been specified as follows [3–8]:

$$Value_{i,t} = \beta_1 \cdot COVID19_t + \beta_2 \cdot High_SD_i + \beta_3 \cdot COVID19_t \cdot High_SD_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$Value_{i,t} = \beta_1 \cdot RUwar_t + \beta_2 \cdot High_SD_i + \beta_3 \cdot RUwar_t \cdot High_SD_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (4)$$

⁴ In the case of COVID-19, we leave this period of time because there were indications of the virus spreading in October–November, 2019 (BBC, 2020).

⁵ We leave this period of time because the concentration of Russian troops near the Ukrainian border was first reported by some media in October–November 2021 (BBC, 2023).

$$Long_TC_{i,t+T} = \beta_1 \cdot COVID19_t + \beta_2 \cdot High_SD_i + \beta_3 \cdot COVID19_t \cdot High_SD_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (5)$$

$$Long_TC_{i,t+T} = \beta_1 \cdot RUwar_t + \beta_2 \cdot High_SD_i + \beta_3 \cdot RUwar_t \cdot High_SD_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (6)$$

$$Short_TC_{i,t+1} = \beta_1 \cdot COVID19_t + \beta_2 \cdot High_SD_i + \beta_3 \cdot COVID19_t \cdot High_SD_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (7)$$

$$Short_TC_{i,t+1} = \beta_1 \cdot RUwar_t + \beta_2 \cdot High_SD_i + \beta_3 \cdot RUwar_t \cdot High_SD_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (8)$$

where $Value_{i,t}$, $Long_TC_{i,t+T}$ and $Short_TC_{i,t+1}$ represent the firm value, the long-term component and the short-term component for the *i*-th firm at time *t*, respectively. The variables $COVID19_t$ and $RUwar_t$ are binary variables that take the value 1 during the shock period (COVID-19 or Russo-Ukrainian War) and 0 otherwise. The term $High_SD_i$ constitutes a binary variable indicating whether the *i*-th firm has been classified as a high sustainable discloser (1 for High_SD, 0 for Low_SD). The interaction terms capture the joint effect of both shocks and $High_SD_i$. $X_{i,t}$ represents a vector of control variables that may affect firm value.⁶ Parameters β_1 , β_2 and β_3 capture the average effect of the shock on firm value and its long- and short-term components (β_1); the difference in firm value and the long- and short-term components between High_SD and Low_SD firms (β_2); and the differential impact of the shock on High_SD firms compared to Low_SD firms (β_3), respectively. Finally, γ is a vector of coefficients for the control variables and $\varepsilon_{i,t}$ is the error term. To ensure the robustness of our results, we account for potential heteroskedasticity in the error terms $\varepsilon_{i,t}$. Specifically, we use heteroskedasticity-robust standard errors, which ensure the validity of our statistical inference. In addition, we perform a J-test to control for the possible presence of omitted variables.⁷

Having examined the firm's ability to minimise the intensity of the shock in terms of the size effect, we need to consider the speed of recovery when the firm faces an exogenous shock. To do this, we have specified a vector autoregressive (VAR) model, differentiating between High_SD and Low_SD firms. The proposed specification, based on the proposal of Curtis (2012), is given by expressions [9–11] as follows:

$$Value_{i,t} = \gamma_0 + \gamma_1 \cdot b_{i,t} + \gamma_2 \cdot Value_{i,t-1} + \gamma_3 \cdot Value_{i,t-2} + u_{i,t} \quad (9)$$

$$Short_TC_{i,t+1} = \theta_0 + \theta_1 \cdot b_{i,t} + \theta_2 \cdot Short_TC_{i,t} + \theta_3 \cdot Short_TC_{i,t-1} + u_{i,t} \quad (10)$$

$$Long_TC_{i,t+T} = \omega_0 + \omega_1 \cdot b_{i,t} + \omega_2 \cdot Long_TC_{i,t+T-1} + \omega_3 \cdot Long_TC_{i,t+T-2} + u_{i,t} \quad (11)$$

where $Value_{i,t}$, $b_{i,t}$, $Short_TC_{i,t+1}$ and $Long_TC_{i,t+T}$ represent the firm value, the book value, the short-term component and the long-term component of the *i*-th firm on the *t*-th day, taking into account expressions [1] and [2]. In expressions [9–11], the coefficients γ_1 , θ_1 , and ω_1 capture the relationship between book value and the respective

⁶ In particular, we include alternative combinations of specific country-year (δ_{kt}), industry-year (φ_{jt}) and country-industry-year (γ_{kjt}) effects to capture the correlations between different firms in the same country over time. By incorporating firm and time fixed effects, we control for unobserved heterogeneity and time-specific shocks and ensure that the results are not driven by pre-existing differences between firms or by other concurrent events.

⁷ This test is used to compare two models to determine which one is better at explaining the variation in the data. To do this, we estimate our full models following expressions [3–8] and save the estimated residuals. We then estimate a set of basic models including only the control variables and save the estimated residuals. Finally, we introduce these latter residuals into the expressions [3–8]. The non-significance of the parameters associated with the estimated residuals enable us to justify the inclusion of the studied variables in the proposed model.

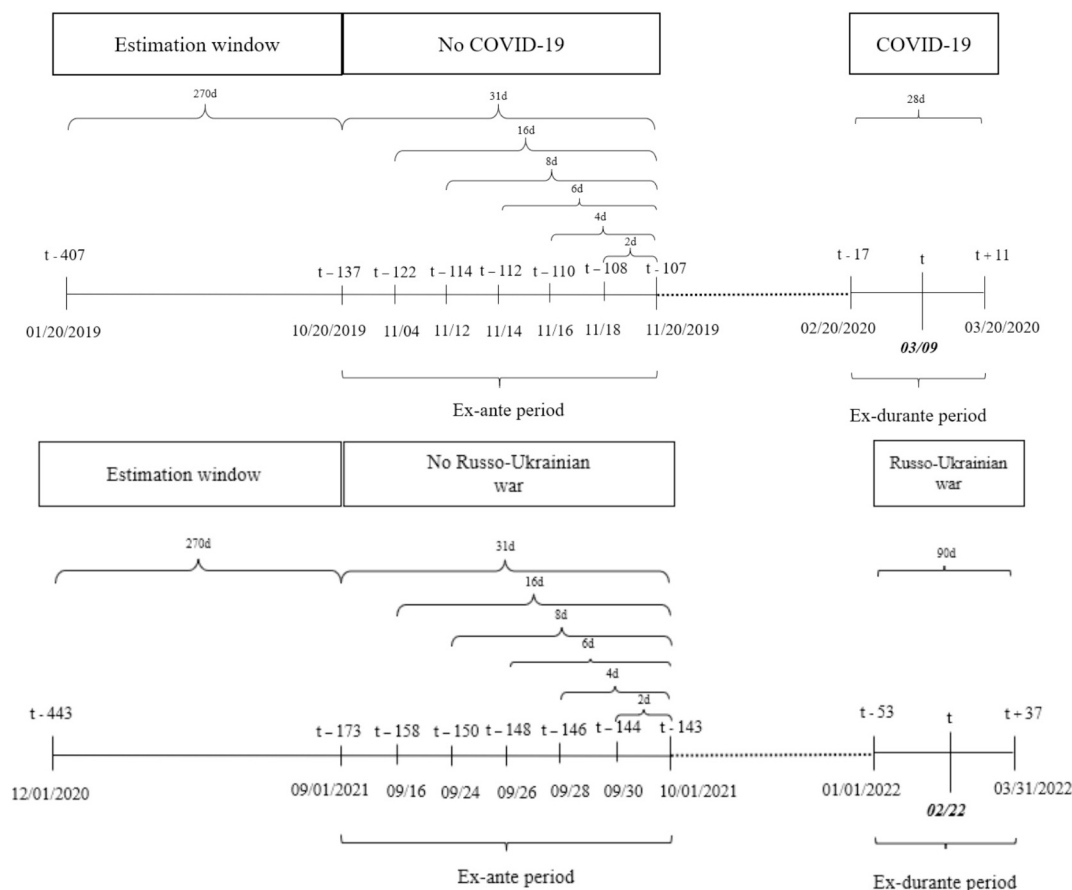


Fig. 2. Event and estimation windows.

Figure 2 illustrates the event day, estimation windows, and the ex-ante and ex-durante periods for two significant shocks: the COVID-19 pandemic (type 1 shock) and the Russo-Ukrainian War (type 2 shock). For each shock, the figure details the specific event date and the duration of each period. The estimation window signifies the timeframe used to calculate baseline parameters. The ex-ante period includes multiple sub-periods leading up to the event day, each with different lengths to capture various pre-event dynamics. The ex-durante period denotes the immediate aftermath of the event, allowing for the analysis of its direct impact.

dependent variable, while γ_2 , γ_3 , θ_2 , θ_3 , ω_2 , and ω_3 account for the influence of past values on current values, reflecting the firm's momentum and mean reversion tendencies. Positive coefficients indicate persistence in the firm value and its components over time, while negative coefficients suggest a correction mechanism. In all cases, we have included a lag of two periods, based on the autocorrelation (ACF) and partial autocorrelation (PACF) functions of the residuals, to ensure that the model accurately captures the temporal dependencies. Autocorrelation in the residuals is tested using the VAR residual Portmanteau (Q) tests for autocorrelations.⁸

To further understand the dynamic response of firm value and its components to shocks, we also use impulse-response (IR) functions. IR functions trace the effect of a one-time shock to one of the responses on current and future values of the endogenous variables in the VAR model. Specifically, these functions allow us to see how a shock to the firm's value, book value, short-term component, or long-term component propagates over time and affects these variables in subsequent periods. The parameters of the VAR model directly influence the shape and

duration of the IR functions. For instance, a high value in the parameters (γ_2 or γ_3) would suggest that a shock has a prolonged effect on firm value, indicating a slower recovery. Conversely, lower values would indicate a faster return to equilibrium. The use of IR functions thus complements our analysis by providing a dynamic view of how shocks affect firm value and its components over time, and how sustainability disclosure (High_SD vs. Low_SD) modifies these responses.

The proposed statistical techniques allow us to test the two dimensions of resilience: the intensity of the impact and the time taken to recover firm value following an exogenous shock. By examining these coefficients, we can infer how effectively and quickly High_SD and Low_SD firms respond to and recover from shocks, providing insights into their resilience mechanisms.

4. Results

Table 3 shows the mean and standard deviation for companies classified as High_SD and Low_SD. Panel A contains the statistics for the whole period, while Panels B and C are restricted to the COVID-19 and Russo-Ukrainian War shocks, respectively.

High_SD companies exhibit a lower average return (-0.0008%) compared to Low_SD companies (-0.0003%) over the whole period, although the difference is not significant. On the contrary, High_SD firms have a higher mean firm value (515.5769) than Low_SD firms (439.9044), with significant differences indicated by the ANOVA test. High_SD companies have consistently higher long-term values across the three time horizons considered, suggesting greater long-term resilience.

⁸ The Q test checks for autocorrelation up to a specified lag. It aggregates the autocorrelations of the residuals across multiple lags. It involves examining the cumulative sum of squared residual autocorrelations and comparing it to the chi-square distribution to determine if the residuals are white noise. We observe that the p -values associated with the Q test are higher than 0.100, indicating the absence of autocorrelation in the models studied. Consequently, the inclusion of two lags in our regression models helps control for potential autocorrelation and dynamic endogeneity.

Table 2

Event day, estimation windows and ex-ante/ex-durante periods.

Shock	COVID-19		Russo-Ukrainian War	
	t	Days	t	Days
Event day	03/09/2020	–	02/22/2022	–
Estimation window	01/20/2019–10/20/2019	270	12/01/2020–09/01/2021	270
Ex-ante period	10/20/2019–11/20/2019	31	09/01/2021–10/01/2021	31
	11/04/2019–11/20/2019	16	09/16/2021–10/01/2021	16
	11/12/2019–11/20/2019	8	09/24/2021–10/01/2021	8
	11/14/2019–11/20/2019	6	09/26/2021–10/01/2021	6
	11/16/2019–11/20/2019	4	09/28/2021–10/01/2021	4
	11/18/2019–11/20/2019	2	09/30/2021–10/01/2021	2
Ex-durante period	02/20/2020–03/20/2020	28	01/01/2022–03/31/2022	28

This table presents the event day, estimation windows, and ex-ante and ex-durante periods for two major shocks: the COVID-19 pandemic (type 1 shock) and the Russo-Ukrainian War (type 2 shock). For each shock, the specific event date and the number of days for each period are provided. The estimation window indicates the period used to estimate the baseline parameters. The ex-ante period consists of several sub-periods leading up to the event day, with varying lengths to capture different pre-event dynamics. The ex-durante period reflects the immediate aftermath of the event, allowing for the analysis of the immediate impact.

In contrast, there are no significant differences in book value and the short-term component between High_SD and Low_SD firms over the entire period, indicating similar short-term financial characteristics (p -value > 0.100). During the COVID-19 shock, High_SD firms maintain higher mean firm values (436.9548) and long-term components (336.6658 to 344.3343) compared to Low_SD firms (Value_t: 385.5285; Long_TC_{t,t+T}: 258.0573 to 271.2851), coupled with significant differences in returns and book values, suggesting that High_SD firms are better equipped to deal with short-term disruptions. The trend of higher mean values for High_SD firms persists during the Russo-Ukrainian War shock, where returns are slightly negative for both High_SD and Low_SD firms, but High_SD firms still show superior performance in terms of firm value (High_SD: 676.1915 vs. Low_SD: 480.6572) and long-term components (High_SD: 552.0723 to 560.5954 vs. Low_SD: 396.1786 to 408.4028). These results suggest that High_SD companies react differently when faced with an exogenous shock, providing preliminary evidence that High_SD companies are more resilient, as the long-term component could give them additional strength when they are hit by an exogenous shock. However, further analysis is needed to understand the weight and intensity of the short- and long-term value components in these deviations under the different types of shocks.

To this end, we examine whether this apparent resilience of High_SDs is observed not only in the ex-durante period, but also in the days preceding the shock (ex-ante period). Table 4 shows the evolution of firm value (Value_t) and its components (Short_TC_{t,t+1} and Long_TC_{t,t+T}), considering window periods of two, four, six, eight, sixteen and thirty-one days, respectively. These windows are constructed for the COVID-19 and Russo-Ukrainian War shocks, distinguishing between High_SD and Low_SD firms.

In general, we find that High_SDs tend to be more resilient than Low_SDs during the COVID-19 shock, with statistically significant higher firm values observed consistently across all window periods (p -value < 0.010). For example, over a 31-day window, High_SD firms have an average value of 494.6124 compared to 446.0326 for Low_SD firms ($T = 1$). During the COVID-19 shock, companies classified as High_SD tend to recover both the long-term and short-term components in the event window (p -value > 0.100). Low_SDs suffer a more severe impact, as they are not able to recover the long-term firm values (p -value < 0.010). In addition, the long-term component for High_SD firms is consistently higher, with values such as 346.9895 versus 326.4827 for Low_SD firms over a 31-day window ($T = 1$). Similarly, the short-term component for High_SD firms shows smaller, yet statistically significant differences, with values like 8.3375 versus 8.0722 for Low_SD firms over the same period (p -value < 0.010). Therefore, during this shock (type 1), the long-term component related to the implementation of sustainability practices protects High_SD companies.

Conversely, the pattern is reversed during the Russo-Ukrainian War

shock. High_SD firms have a lower firm value. For example, over a 31-day window, the average Value_t for High_SD firms is 548.7491, compared to 576.7029 for Low_SD firms ($T = 1$), highlighting the differential impact of the shock type. In addition, we note that High_SD firms experience significant declines in both long-term and short-term components over time (p -value < 0.010), whereas Low_SD firms manage to maintain or recover their long-term values (p -value > 0.100). For instance, over the same period, the long-term component for High_SD firms ($T = 1$) is 448.7561 when the starting point during the shock was 552.0723 (p -value < 0.010). This pattern is reversed for Low_SD firms (426.4801 vs. 396.1786, $T = 1$). The short-term evolution of the components is similar, with Low_SD firms able to recover their value. Therefore, when confronted with this second type of shock, High_SD companies tend to be penalised, failing to recover their long- and short-term firm values. Similar interpretations emerge when shorter time horizons are considered.

These findings suggest that sustainability practices that contribute to the long-term component of firm value provide a buffer during type 1 shocks (such as the COVID-19 pandemic). This aligns with previous literature highlighting the protective role of sustainability during economic downturns (Abbasi et al., 2023; Albuquerque et al., 2020; Tang et al., 2022). However, during type 2 shocks, which we associate with geopolitical conflicts, the immediate market reactions overshadow the benefits of sustainability practices, penalising High_SD firms. Thus, sustainable practices are a double-edged sword that can support the company during a type 1 shock, but can undermine its resilience during a type 2 shock. The economically significant sizes of the effect underscore the importance of considering the nature of shocks when evaluating firm resilience. More specifically, to elaborate on these conclusions, Table 5 presents the results for the DiD model specified in the previous section. This table presents the evolution of firm value (Value_t) and its components (Short_TC_{t,t+1} and Long_TC_{t,t+T}), considering the extreme windows of two and 31 days, respectively.⁹ The table shows the results for the two shocks, COVID-19 and the Russo-Ukrainian War, distinguishing between High_SD and Low_SD firms.

The results show that for both shocks, the main effect (β_1) is positive and highly significant across all time horizons (2, 4, 6, 8, 16 and 31 days). This finding aligns with previous studies, such as Izzeldin et al. (2023), which suggests that firm value is notably affected by external shocks. Nevertheless, the parameters associated with the COVID-19 shock (2 days: 0.112; 31 days: 0.242 to 0.246, p -value < 0.010) are larger than those associated with the Russo-Ukrainian War (2 days: 0.054; 31 days: 0.140 to 0.141, p -value < 0.010), indicating a more

⁹ The results for the shorter windows of four, six, eight and sixteen days do not show a different pattern and are available on request.

Table 3
Descriptive statistics.

Panel A 2019–2022						
Variable	High_SD		Low_SD		Test	
	Mean	Std. Dev.	Mean	Std. Dev.	ANOVA	Levene
R_t	−0.0008	0.1934	−0.0003	0.0842	—	—
$Value_t$	515.5769	1263.5089	439.9044	1320.4667	***	***
b_t	103.4415	328.9761	103.4897	407.3652	—	**
$Short_TC_{i,t+1}$	8.5393	32.9706	8.6363	56.9063	—	***
$Long_TC_{i,t+2}$	392.2981	1134.2709	338.7314	1133.6391	***	***
$Long_TC_{i,t+3}$	393.1201	1134.7698	342.2903	1145.3663	***	***
$Long_TC_{i,t+4}$	395.8738	1138.3907	356.4201	1170.5217	***	***

Panel B. Shock: COVID-19						
Variable	High_SD		Low_SD		Test	
	Mean	Std. Dev.	Mean	Std. Dev.	ANOVA	Levene
R_t	0.0017	0.0301	0.0002	0.0126	***	***
$Value_t$	436.9548	1114.3174	382.5285	996.3331	**	***
b_t	119.5448	399.1156	97.2800	361.4827	**	***
$Short_TC_{i,t+1}$	8.3367	27.4881	8.7936	35.9567	—	**
$Long_TC_{i,t+2}$	336.6658	977.5669	258.0573	755.2773	***	***
$Long_TC_{i,t+3}$	337.1477	978.5645	260.6934	761.8675	***	***
$Long_TC_{i,t+4}$	344.3343	986.8826	271.2851	780.9192	***	***

Panel C. Shock: Russo-Ukrainian War						
Variable	High_SD		Low_SD		Test	
	Mean	Std. Dev.	Mean	Std. Dev.	ANOVA	Levene
R_t	−0.0004	0.0195	−0.0003	0.0281	***	***
$Value_t$	676.1915	1500.3176	480.6572	1597.5691	***	***
b_t	125.1726	389.0261	98.0810	415.5161	***	***
$Short_TC_{i,t+1}$	11.1453	37.1539	11.5356	61.4771	—	**
$Long_TC_{i,t+2}$	552.0723	1396.5649	396.1786	1516.2024	***	***
$Long_TC_{i,t+3}$	553.7519	1397.7783	403.4384	1535.0048	***	***
$Long_TC_{i,t+4}$	560.5954	1405.4994	408.4028	1548.0769	***	***

This table presents the descriptive statistics for the variables analysed. The variable R_t represents the daily market return in percentage, indicating the change in the market index value from one day to the next. The term $Value_t$ denotes the firm value, measured as the market capitalisation of the firm, reflecting the total market value of a company's outstanding shares. The book-to-market ratio, symbolised by b_t , compares a firm's book value to its market value, providing insights into the firm's valuation. The term $Short_TC_{i,t+1}$ represents the short-term component of the value and measures the immediate value expected within the next period. The long-term components are denoted by $Long_TC_{i,t+2}$, $Long_TC_{i,t+3}$ and $Long_TC_{i,t+4}$ for $T = 1$, $T = 2$ and $T = 3$ years ahead, respectively, indicating the expected firm value over these longer horizons. The last two columns provide the ANOVA and Levene test results for the equality of means and variances, respectively.

intense impact from the type 1 shock. In addition, the coefficients for the High_SD variable (β_2) are positive and significant (2 days: 0.183 to 0.184; 31 days: 0.111 to 0.114, p -value<0.010), suggesting that, on average, High_SD firms are more exposed in terms of value compared to Low_SD firms, irrespective of the shocks. The interaction term (β_3) is positive and significant for both shocks and across all time horizons, but its intensity is not the same. During the COVID-19 pandemic, High_SD firms are more resilient to this type of exogenous shock than their Low_SD counterparts (2 days: 0.252 to 0.254; 31 days: 0.201 to 0.204, p -value<0.010). In contrast, during the Russo-Ukrainian War, High_SD firms react positively, but their exposure is higher (2 days: 0.284 to 0.288; 31 days: 0.215 to 0.216, p -value<0.010). This result reveals a higher exposure for High_SD firms during a type 2 shock, which is in line with the results presented in Table 4.

Regarding the results for the long-term and short-term components of firm value, our results show distinct impacts of the COVID-19 pandemic and the Russo-Ukrainian War on both components. For the long-term component, the coefficients for the exogenous shocks (β_1) are positive and highly significant across all time horizons (2 days: 0.048 to 0.105; 31 days: 0.127 to 0.228, p -value<0.010), revealing the exposure of the components of the firm value of all companies facing both shocks. The coefficients for the High_SD firms (β_2) are also positive and

significant (2 days: 0.143 to 0.169; 31 days: 0.098 to 0.110, p -value<0.010), suggesting that High_SD firms have a higher exposure in terms of firm value compared to Low_SD firms. However, the parameter changes depending on the type of shock, which introduces some nuances in the interaction term. The interaction term (β_3) is lower during the COVID-19 pandemic (2 days: 0.224 to 0.226 vs. 0.242 to 0.247; 31 days: 0.169 to 0.193 vs. 0.192 to 0.194, p -value<0.100), implying that High_SD firms are less exposed and more resilient in terms of long-term value. This is consistent with previous studies that have demonstrated that firms with high levels of sustainability disclosure are more resilient in the face of some exogenous shocks, such as the 2008 subprime crisis (Martínez-Ferrero et al., 2016), the enforcement of new regulations (Bilyay-Erdogan, 2022), and the COVID-19 pandemic (Hamrouni et al., 2022; Rehman et al., 2022). However, these authors do not examine the relevance of the long- and short-term components, nor do they compare shocks of different types. For the short-term component, the interaction term (β_3) is also positive and significant, highlighting a stronger exposure in the short-term value of High_SD firms (2 days: 0.173; 31 days: 0.135, p -value<0.010). However, this effect is more pronounced during the Russo-Ukrainian War, indicating a more intense impact on the short-term component (2 days: 0.197; 31 days: 0.153, p -value<0.010). This provides evidence in favour of the proposed hypotheses, as companies

Table 4Evolution of the firm value ($Value_{i,t}$) and its components (Long- $TC_{i,t+T}$ and Short- $TC_{i,t+1}$).

		Panel A. COVID-19 High_SD	Panel B. COVID-19 Low_SD	Sig.	Panel C. Russo-Ukrainian War High_SD	Panel D. Russo-Ukrainian War Low_SD	Sig.
		$Value_{i,t}$	$Value_{i,t}$		$Value_{i,t}$	$Value_{i,t}$	
Shock	T = 1	470.1798	387.9803		691.8467	531.3906	
	T = 2	470.6617	390.6164		693.5263	539.2522	
	T = 3	479.3744	405.4134		701.4418	545.0488	
2d	T = 1	497.2614	449.6591	***	538.8082	553.8462	***
	T = 2	497.8498	451.1353	***	540.5724	556.0256	***
	T = 3	504.0435	458.4167	***	543.2377	559.7591	***
Sig.	T = 1	—	—	***	—	—	***
	T = 2	—	—	**	—	—	***
	T = 3	—	—	**	—	—	***
4d	T = 1	500.3641	451.3527	***	541.9609	557.8878	***
	T = 2	500.9544	452.8249	***	543.7286	559.9899	***
	T = 3	504.1469	460.1161	***	546.3969	563.6934	***
Sig.	T = 1	—	**	***	**	—	***
	T = 2	—	*	**	**	—	***
	T = 3	—	*	**	**	—	***
6d	T = 1	499.8431	450.1011	***	540.5824	560.5862	***
	T = 2	500.4337	451.5792	***	542.3543	562.6889	***
	T = 3	503.6253	458.8739	***	545.0271	566.4008	***
Sig.	T = 1	—	**	***	**	—	***
	T = 2	—	**	***	**	—	***
	T = 3	—	**	**	**	—	***
8d	T = 1	499.6065	450.1313	***	542.0627	565.7189	***
	T = 2	500.3804	451.5716	***	543.8376	567.7886	***
	T = 3	503.2922	463.2135	***	546.5145	571.5099	***
Sig.	T = 1	—	**	***	***	—	***
	T = 2	—	**	***	***	—	***
	T = 3	—	**	**	***	—	***
16d	T = 1	498.8583	450.0789	***	541.2905	569.3436	***
	T = 2	499.8781	451.4655	***	543.0847	571.7968	***
	T = 3	502.4188	469.0263	***	545.7859	575.4904	***
Sig.	T = 1	—	***	***	***	—	***
	T = 2	—	***	***	***	—	***
	T = 3	—	***	***	***	—	***
31d	T = 1	494.6124	446.0326	***	544.2147	570.1296	***
	T = 2	495.7185	447.1013	***	546.0261	573.0422	***
	T = 3	498.1328	466.8291	***	548.7491	576.7029	***
Sig.	T = 1	—	***	***	***	—	***
	T = 2	—	***	***	***	—	***
	T = 3	—	***	***	***	—	***

		Panel A. COVID-19 High_SD	Panel B. COVID-19 Low_SD	Sig.	Panel C. Russo-Ukrainian War High_SD	Panel D. Russo-Ukrainian War Low_SD	Sig.
		Long- $TC_{i,t+T}$	Long- $TC_{i,t+T}$		Long- $TC_{i,t+T}$	Long- $TC_{i,t+T}$	
Shock	T = 1	336.6658	258.0573		552.0723	396.1786	
	T = 2	337.1477	260.6934		553.7519	403.4383	
	T = 3	344.3342	271.2851		560.5954	408.4027	
2d	T = 1	349.3108	330.6850	***	443.4344	410.9381	***
	T = 2	350.1993	332.1613	***	445.1986	412.5482	***
	T = 3	353.3929	338.5755	***	447.8639	415.7086	***
Sig.	T = 1	—	*	***	—	—	***
	T = 2	—	*	***	—	—	***
	T = 3	—	*	***	—	—	***
4d	T = 1	352.6619	332.3358	***	446.5826	414.9255	***
	T = 2	353.2522	333.8081	***	448.3503	416.4581	***
	T = 3	256.4448	340.2333	***	451.0186	419.5874	***
Sig.	T = 1	—	***	***	*	—	***
	T = 2	—	**	***	*	—	***
	T = 3	—	**	***	*	—	***
6d	T = 1	352.1494	331.1138	***	445.1779	417.5859	***
	T = 2	352.7401	332.5918	***	446.9498	419.1189	***
	T = 3	355.9316	339.0217	***	449.6226	422.2563	***
Sig.	T = 1	—	***	***	*	—	***
	T = 2	—	***	***	*	—	***
	T = 3	—	***	***	*	—	***
8d	T = 1	351.9402	330.9582	***	446.6366	422.1242	***
	T = 2	352.7141	332.3985	***	448.4115	423.6225	***
	T = 3	355.6259	342.0409	***	451.0885	426.7676	***

(continued on next page)

Table 4 (continued)

		Panel A. COVID-19 High_SD	Panel B. COVID-19 Low_SD	Sig.	Panel C. Russo-Ukrainian War High_SD	Panel D. Russo-Ukrainian War Low_SD	Sig.
		Long-TC _{i,t+T}	Long-TC _{i,t+T}		Long-TC _{i,t+T}	Long-TC _{i,t+T}	
Sig.	T = 1	—	***	***	**	—	***
	T = 2	—	***	***	**	—	***
	T = 3	—	***	***	**	—	***
16d	T = 1	351.2096	330.5994	***	445.8372	425.3946	***
	T = 2	352.2292	331.9860	***	447.6314	427.1643	***
	T = 3	354.7701	345.9942	***	450.3326	430.2832	***
Sig.	T = 1	—	***	***	***	—	***
	T = 2	—	***	***	***	—	***
	T = 3	—	***	***	***	—	***
31d	T = 1	346.9895	326.4827	***	448.7561	426.4801	***
	T = 2	348.0957	327.8513	***	450.5674	428.5841	***
	T = 3	350.5099	343.1144	***	453.2904	431.6738	***
Sig.	T = 1	—	***	***	***	—	***
	T = 2	—	***	***	***	—	***
	T = 3	—	***	***	***	—	***

		Panel A. COVID-19 High_SD	Panel B. COVID-19 Low_SD	Sig.	Panel C. Russo-Ukrainian War High_SD	Panel D. Russo-Ukrainian War Low_SD	Sig.
		Short-TC _{i,t+1}	Short-TC _{i,t+1}		Short-TC _{i,t+1}	Short-TC _{i,t+1}	
Shock	T = 1	8.3367	8.7936		11.1453	11.5356	
2d	T = 1	8.2729	7.8407	***	8.3673	9.9527	***
Sig.	T = 1	—	—	—	—	—	—
4d	T = 1	8.3252	7.8656	***	8.3719	10.0065	***
Sig.	T = 1	—	—	—	*	—	—
6d	T = 1	8.3167	7.8326	***	8.3891	10.0443	***
Sig.	T = 1	—	—	—	**	—	—
8d	T = 1	8.3224	7.9211	***	8.4196	10.1553	***
Sig.	T = 1	—	—	—	**	—	—
16d	T = 1	8.3491	8.0344	***	8.4468	10.2389	***
Sig.	T = 1	—	—	—	**	—	—
31d	T = 1	8.3375	8.0722	***	8.4521	10.2027	***
Sig.	T = 1	—	—	—	***	—	—

This table provides a comparative analysis of the firm value ($Value_{i,t}$) and its components over three forecast horizons ($T = 1, 2$ and 3). The analysis covers two distinct periods: the ex-ante (before the shock) and ex-durante (during the shock) periods, as defined in Fig. 2. The comparison includes High Sustainability Disclosure (High_SD) and Low Sustainability Disclosure (Low_SD) firms under the impacts of the COVID-19 pandemic (type 1 shock) and the Russo-Ukrainian War (type 2 shock). The table details the firm value ($Value_{i,t}$) at different time points and the corresponding components, the short-term component ($Short_TC_{i,t+1}$) and the long-term component ($Long_TC_{i,t+T}$), where $T = 1, 2$ and 3 . The columns labelled Sig. indicate the statistical significance when comparing the firm value between High_SD and Low_SD companies for each forecast horizon. The rows labelled Sig. show the statistical significance of the differences in firm value between the ex-ante and ex-durante periods. The intersections provide the combined effects of both sustainability disclosure and the ex-ante/ex-durante periods. The analysis is conducted separately for the COVID-19 shock (Panels A and B) and the Russo-Ukrainian War shock (Panels C and D). The initial shock period is indicated, followed by results at 2, 4, 6, 8, 16 and 31 days prior to the shock. Statistical significance is denoted by asterisks: *** $p < 0.010$, ** $p < 0.050$, * $p < 0.100$.

that disclose their sustainability practices are more resilient in terms of shock size/intensity when faced with an exogenous shock that causes an overreaction in the short term. This pattern corroborates the results of Izzeldin et al. (2023), who found that sustainability practices can mitigate some impacts in financial markets, but may be insufficient during extreme geopolitical events.

The control variables evidence that larger firms exhibit a negative association with firm value, which could reflect market concerns about organisational inertia or lower growth prospects in large, mature companies during crises. Similarly, firms operating in clean sectors show a negative association with value, possibly due to investors' concerns about the higher costs of sustainability commitments during periods of economic stress. Conversely, leverage displays a positive effect on firm value during the Russo-Ukrainian War, consistent with the notion that leverage can act as a signal of resilience, as access to external financing can provide a liquidity buffer in times of market disruption. The inclusion of region-level fixed effects captures notable cross-country differences in market responses. As shown by the significant regional coefficients, there are clear variations in how national markets reacted

to these global shocks, reflecting differences in economic structures, government interventions, and investor sentiment. For example, the stronger negative response observed in countries such as Spain, Italy, and France may relate to their economic vulnerability during the COVID-19 crisis, while the relatively milder response in countries like Denmark or Switzerland may reflect more resilient financial systems or more proactive policy measures.

In relation to validity of the DiD model to test the proposed hypotheses, we have assessed the parallel trend assumption. Fig. 3 provides a graphical representation for the treated (High_SD) and control (Low_SD) over the pre-treatment and post-treatment periods.

It is possible to observe that in all cases the tendencies are parallel before the shock for both types of company while we observe differences after the shocks. Moreover, we note that the sense of these differences are opposite; so that during the COVID-19 shock, the sustainable companies can smooth their dwindling. In contrast, the Russian-Ukrainian War shock shows the contrary behaviour. Additionally, we carry on an event study specification, where we plot coefficients for leads and lags of the treatment variable, demonstrating whether the pre-trends are

Table 5

DiD results for the firm value ($Value_{i,t}$) and its components ($Long_TC_{i,t+T}$ and $Short_TC_{i,t+1}$).

Panel A: $Value_{i,t}$												
	2d						31d					
	T = 1		T = 2		T = 3		T = 1		T = 2		T = 3	
	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War
Shock _t (β_1)	0.112***	0.054***	0.112***	0.054***	0.112***	0.054***	0.242***	0.141***	0.242***	0.140***	0.246***	0.140***
High_SD _t (β_2)	0.184***	0.150***	0.183***	0.150***	0.184***	0.150***	0.114***	0.111***	0.114***	0.111***	0.112***	0.111***
Shock _t *High_SD _t (β_3)	0.252***	0.284***	0.253***	0.284***	0.254***	0.288***	0.201***	0.215***	0.202***	0.216***	0.204***	0.216***
Control												
Total asset	-0.029***	-0.016**	-0.029***	-0.017**	-0.032***	-0.017**	-0.044***	-0.018***	-0.044***	-0.018***	-0.047***	-0.018***
Return on assets	-0.016*	-0.005	-0.015*	-0.005	-0.015*	-0.005	-0.021***	-0.016**	-0.021***	-0.015**	-0.021***	-0.015**
Leverage	-0.006	0.046***	-0.006	0.045***	-0.005	0.045***	0.017**	0.032***	0.017**	0.032***	0.020**	0.032***
Clean sector	-0.280***	-0.186***	-0.281***	-0.183***	-0.282***	-0.182***	-0.252***	-0.171***	-0.253***	-0.169***	-0.260***	-0.168***
Germany	-0.313***	-0.251***	-0.313***	-0.251***	-0.314***	-0.250***	-0.279***	-0.225***	-0.279***	-0.225***	-0.281***	-0.225***
Austria	-0.245***	-0.202***	-0.246***	-0.202***	-0.240***	-0.197***	-0.214***	-0.180***	-0.215***	-0.180***	-0.213***	-0.177***
Belgium	-0.248***	-0.202***	-0.248***	-0.199***	-0.234***	-0.199***	-0.223***	-0.178***	-0.223***	-0.175***	-0.215***	-0.176***
Denmark	-0.090***	0.043***	-0.091***	0.044***	-0.090***	0.044***	-0.064***	0.059***	-0.064***	0.060***	-0.064***	0.060***
Finland	-0.302***	-0.234***	-0.302***	-0.234***	-0.304***	-0.234***	-0.272***	-0.210***	-0.273***	-0.210***	-0.275***	-0.210***
France	-0.354***	-0.273***	-0.354***	-0.273***	-0.353***	-0.272***	-0.328***	-0.244***	-0.328***	-0.244***	-0.329***	-0.244***
Italy	-0.222***	-0.203***	-0.222***	-0.203***	-0.223***	-0.203***	-0.197***	-0.187***	-0.197***	-0.187***	-0.198***	-0.187***
Luxembourg	-0.088***	-0.072***	-0.088***	-0.072***	-0.088***	-0.072***	-0.076***	-0.062***	-0.076***	-0.062***	-0.077***	-0.062***
Netherlands	-0.230***	-0.178***	-0.230***	-0.178***	-0.229***	-0.177***	-0.195***	-0.169***	-0.195***	-0.169***	-0.196***	-0.168***
Norway	-0.272***	-0.233***	-0.272***	-0.225***	-0.256***	-0.223***	-0.228***	-0.209***	-0.228***	-0.203***	-0.222***	-0.203***
Portugal	-0.267***	-0.187***	-0.268***	-0.187***	-0.260***	-0.187***	-0.234***	-0.173***	-0.234***	-0.173***	-0.205***	-0.173***
Spain	-0.321***	-0.257***	-0.321***	-0.257***	-0.315***	-0.257***	-0.288***	-0.227***	-0.289***	-0.227***	-0.289***	-0.227***
Sweden	-0.231***	-0.187***	-0.231***	-0.187***	-0.233***	-0.185***	-0.198***	-0.164***	-0.198***	-0.164***	-0.200***	-0.163***
Switzerland	-0.138***	-0.106***	-0.138***	-0.107***	-0.139***	-0.107***	-0.116***	-0.084***	-0.116***	-0.084***	-0.117***	-0.084***
F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.133	0.091	0.133	0.092	0.136	0.092	0.131	0.088	0.131	0.088	0.134	0.089
DW	2.084	2.032	2.084	2.034	2.085	2.036	2.085	2.075	2.125	2.075	2.128	2.076
J	0.470	0.240	0.450	0.250	0.430	0.260	0.400	0.250	0.440	0.270	0.290	0.370

Panel B: $Long_TC_{i,t+T}$												
	2d						31d					
	T = 1		T = 2		T = 3		T = 1		T = 2		T = 3	
	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War
Shock _t (β_1)	0.105***	0.048***	0.105***	0.048***	0.105***	0.048***	0.224***	0.127***	0.224***	0.126***	0.228***	0.126***
High_SD _t (β_2)	0.144***	0.168***	0.145***	0.167***	0.144***	0.169***	0.100***	0.110***	0.100***	0.110***	0.098***	0.110***
Shock _t *High_SD _t (β_3)	0.224***	0.242***	0.226***	0.243***	0.226***	0.247***	0.169***	0.192***	0.170***	0.193***	0.173***	0.194***
Control												
Total asset	-0.016*	-0.018**	-0.017*	-0.019**	-0.019*	-0.019**	-0.030***	-0.018***	-0.030***	-0.018***	-0.033***	-0.018***
Return on assets	-0.021**	-0.008	-0.021**	-0.007	-0.021**	-0.007	-0.032***	-0.014**	-0.032***	-0.012**	-0.031***	-0.013**
Leverage	0.019*	0.053***	0.018*	0.053***	0.019**	0.052***	0.025***	0.034***	0.025***	0.034***	0.028***	0.034***
Clean sector	-0.241***	-0.152***	-0.242***	-0.150***	-0.245***	-0.149***	-0.219***	-0.142***	-0.220***	-0.140***	-0.228***	-0.140***
Germany	-0.283***	-0.227***	-0.283***	-0.228***	-0.285***	-0.227***	-0.255***	-0.207***	-0.255***	-0.207***	-0.258***	-0.207***
Austria	-0.217***	-0.179***	-0.218***	-0.179***	-0.214***	-0.175***	-0.194***	-0.162***	-0.194***	-0.162***	-0.193***	-0.159***
Belgium	-0.220***	-0.178***	-0.221***	-0.177***	-0.209***	-0.177***	-0.201***	-0.159***	-0.201***	-0.158***	-0.195***	-0.158***
Denmark	-0.059***	0.079***	-0.060***	0.079***	-0.059***	0.079***	-0.036***	0.091***	-0.036***	0.091***	-0.037***	0.091***
Finland	-0.265***	-0.206***	-0.266***	-0.206***	-0.268***	-0.207***	-0.242***	-0.188***	-0.242***	-0.188***	-0.245***	-0.189***

(continued on next page)

Table 5 (continued)

Panel B. Long_TC _{i,t+T}											
2d						31d					
T = 1		T = 2		T = 3		T = 1		T = 2		T = 3	
COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War
France	−0.319***	−0.243***	−0.320***	−0.243***	−0.318***	−0.243***	−0.297***	−0.220***	−0.297***	−0.220***	−0.299***
Italy	−0.196***	−0.181***	−0.197***	−0.181***	−0.198***	−0.182***	−0.176***	−0.168***	−0.176***	−0.168***	−0.168***
Luxembourg	−0.077***	−0.064***	−0.077***	−0.065***	−0.078***	−0.065***	−0.069***	−0.056***	−0.069***	−0.056***	−0.056***
Netherlands	−0.204***	−0.156***	−0.204***	−0.157***	−0.204***	−0.155***	−0.174***	−0.151***	−0.174***	−0.151***	−0.175***
Norway	−0.245***	−0.207***	−0.246***	−0.199***	−0.234***	−0.198***	−0.204***	−0.188***	−0.205***	−0.182***	−0.201***
Portugal	−0.237***	−0.164***	−0.238***	−0.164***	−0.232***	−0.164***	−0.209***	−0.154***	−0.210***	−0.154***	−0.183***
Spain	−0.286***	−0.230***	−0.286***	−0.230***	−0.282***	−0.230***	−0.259***	−0.206***	−0.259***	−0.206***	−0.260***
Sweden	−0.206***	−0.166***	−0.207***	−0.167***	−0.208***	−0.166***	−0.179***	−0.147***	−0.179***	−0.148***	−0.181***
Switzerland	−0.115***	−0.089***	−0.115***	−0.089***	−0.117***	−0.089***	−0.098***	−0.071***	−0.099***	−0.071***	−0.100***
F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.104	0.075	0.104	0.076	0.106	0.076	0.104	0.074	0.104	0.074	0.107
DW	2.059	2.045	2.060	2.045	2.058	2.044	2.095	2.053	2.095	2.054	2.095
J	0.390	0.290	0.380	0.300	0.380	0.310	0.350	0.300	0.360	0.320	0.350

Panel C. Short_TC _{i,t+1}			
2d		31d	
	COVID-19		Russo-Ukrainian War
Shock _i (β ₁)	0.059***		0.031***
High_SD _i (β ₂)	0.100***		0.076***
Shock _i *High_SD _i (β ₃)	0.173***		0.197***
Control			
Total asset	−0.075***		0.010
Return on assets	0.000		0.064***
Leverage	0.026**		−0.010
Clean sector	−0.249***		−0.039***
Germany	−0.221***		−0.115***
Austria	−0.183***		−0.102***
Belgium	−0.181***		−0.098***
Denmark	−0.142***		0.119***
Finland	−0.222***		−0.117***
France	−0.245***		−0.132***
Italy	−0.155***		−0.097***
Luxembourg	−0.096***		−0.055***
Netherlands	−0.164***		−0.087***
Norway	−0.272***		−0.071***
Portugal	−0.204***		−0.097***
Spain	−0.230***		−0.133***
Sweden	−0.169***		−0.085***
Switzerland	−0.086***		−0.057***
F	0.000		0.000
R-squared	0.054		0.037
DW	2.009		2.015
J	0.320		0.370

This table presents the Difference-in-Differences (DiD) results for firm value (Value_{i,t}) and its components, long-term (Long_TC_{i,t+T}) and short-term (Short_TC_{i,t+1}) components, across three forecast horizons (T = 1, 2 and 3). The analysis examines the impacts of two significant exogenous shocks: the COVID-19 pandemic and the Russo-Ukrainian War, on firms with high sustainability disclosure (High_SD) compared to those with low sustainability disclosure (Low_SD). Panel A displays the DiD results for firm value (Value_{i,t}). Panel B shows the results for the long-term component (Long_TC_{i,t+T}), and Panel C reports the short-term component (Short_TC_{i,t+1}). The coefficients for the shock variable (β₁), the High_SD variable (β₂), and the interaction term (β₃) are reported. Control variables including total assets, return on assets, leverage, clean/dirty activity sector and countries are included in all regressions. The UK was considered the control group for the country variable. The F-statistic tests the overall significance of the model, and R² indicates the proportion of variance explained by the model. The Durbin-Watson (DW) statistic tests for first-order autocorrelation in the residuals, with values around 2 suggesting no significant autocorrelation. The J-statistic tests for the validity of the instrument used, with p-values provided for each model. Statistical significance is indicated by asterisks: ***p < 0.010, **p < 0.050, *p < 0.100.

parallel. Specifically, we included event-time dummies interacted with the treatment indicator (β_3) and plotted the estimated coefficients along with their confidence intervals. The coefficients on pre-treatment periods (leads) serve as a statistical test for the parallel trends assumption: if they are not significantly different from zero, it suggests that there were no differential trends between the two groups before the treatment. The results indicate that pre-treatment coefficients are close to zero and statistically insignificant, supporting the parallel trend assumption.

Nevertheless, resilience involves not only the ability of the firm to minimise the impact of the shock, but also the ability to recover firm value in a short period of time. Fig. 4 shows the impulse-response (IR) functions associated with the exogenous shocks considered in the context of the estimations for the specified VAR model. For both shocks, we take into account the speed of the recovery of firm value during the ex-ante period.

In all cases, the speed of recovery is significantly faster for High_SD companies than for Low_SD companies. This trend is particularly evident during the COVID-19 shock, where the effects dissipate within a short period of time (High_SDs: 2 days; Low_SDs: 5 days). Similarly, during the Russo-Ukrainian War shock, High_SD companies also show faster recovery times (High_SDs: 5 days; Low_SDs: 10 days), albeit with somewhat less robust results. These findings suggest that High_SD companies possess inherent advantages, particularly in terms of recovery speed, when confronted with exogenous shocks. The shorter recovery times observed can be attributed to the implementation of sustainable practices, which include proactive risk management strategies, improved decision-making processes and greater adaptability to changing market conditions. Our findings align with previous studies that highlight the role of sustainability in enhancing corporate resilience. For example, Ortiz-de-Mandojana and Bansal (2016) demonstrate that companies with robust sustainability practices tend to have better operational performance and stock returns during periods of economic distress. Annex I presents the estimation of the VAR model. The results under the VAR specification show that Low_SD firms tend to value the short-term expectation more than their High_SD counterparts (0.8953; p -value < 0.010), while the valuation of the long-term component shows no differences (High_SD: 0.9651; Low_SD: 0.9949). This tendency is reversed during the COVID-19 shock, when High_SD firms have a higher weight on the long-term component (1.0101; p -value < 0.010) and a lower weight on the short-term component (0.8105; p -value < 0.010) compared to Low_SD companies.

Therefore, we cannot reject H_1 because sustainable companies are more resilient when faced with an exogenous shock that causes an overreaction in the short term (type 1). In addition, we cannot reject H_2 because sustainable companies are less resilient when faced with an exogenous shock that causes an overreaction in the long term (type 2). Nevertheless, in the latter case, we draw attention to the recovery of value in terms of speed in High_SD firms. The explanation for this different reaction lies in the long-term component of firm value, which strengthens sustainable companies during the first type of shock, but introduces some weaknesses during the second type of shock. These results support the argument of Ortiz-de-Mandojana and Bansal (2016), Albuquerque et al. (2020), and Chatzoudes et al. (2022) that long-term strategic planning and sustainability initiatives can buffer firms against some adverse economic conditions, as is the case with type 1 shocks. In contrast, during the Russo-Ukrainian War, the values of the long- and short-term components in High_SDs and Low_SDs suggest that the nature of the shock influences the effectiveness of sustainability practices in increasing resilience to a type 2 shock. However, these conclusions should be made robust through additional analysis.

4.1. Robustness

In this section, we propose four robustness checks. First, we calculate the estimated firm value using the valuation model proposed by Abarbanell and Bernard (2000), Bushee (2001), and Del Río and Santamaría

(2016), which allows us to examine the difference with the real firm value ($\Delta\text{Value}_{i,t}$). This indicator considers the difference between the two values and provides additional evidence of the firm's ability to minimise the impact of the shock, introducing the expectations that were present in financial markets during the period under study. We include a DiD approach of the $\Delta\text{Value}_{i,t}$ indicators to complete this analysis. Second, we propose a VAR model that, in this case, measures the speed of recovery based on the differences between the real and the estimated value ($\Delta\text{Value}_{i,t}$). Third, we divide the sample according to the level of sustainability disclosure achieved by the companies in the medal display table. To do this, following the classification provided by the S&P Yearbook, we compare the companies in the Gold category with those in the Industry Mover (mention) category. We expect that the companies that best implement sustainability practices will be more resilient to a type 1 shock than a type 2 shock, which would strengthen the conclusions related to H_1 and H_2 . Finally, we have included the results of two placebo tests. In these tests, we have considered both a placebo treatment timing using an artificial treatment date prior to the COVID-19 shock and a placebo treatment group assigning a random treatment among the companies that make up the sample.

4.1.1. Differences between the estimated and the real firm value

First, in order to estimate the difference between firm value and the expected value of the company ($\Delta\text{Value}_{i,t}$), we specify the valuation model that allows us to show how companies perform in the expected short- and long-term components. To do this, we consider the model proposed by the authors mentioned above, which is specified as follows [12]:

$$\widehat{\text{Value}}_{i,t} = \widehat{b}_{i,t} + \widehat{\text{Short_TC}}_{i,t+1} + \widehat{\text{Long_TC}}_{i,t+T} + u_{i,t} \quad (12)$$

where $\widehat{\text{Value}}_{i,t}$ denotes the estimated firm value, $\widehat{b}_{i,t}$ denotes the estimated book value ($\alpha_1 \cdot b_{i,t}$), $\widehat{\text{Short_TC}}_{i,t+1}$ is the one-year "near-term" forecasting horizon ($T = 1$) computed as $\alpha_2 \cdot [(1 + r_1)^{-1} E_t(x_{i,t+1} - r_1 \cdot b_{i,t})]$, and $\widehat{\text{Long_TC}}_{i,t+T}$ is the long-term value component calculated as $\alpha_3 \cdot [\sum_{s=2}^T (1 + r_1)^{-s} E_t(x_{i,t+s} - r_1 \cdot b_{i,t+s-1}) + (1 + r_1)^{-T} E_t(P_{i,t+T} - b_{i,t+T})]$, with the term T denoting the end of the forecasting horizon. The term $u_{i,t}$ contains the random error. Note that all the model variables are scaled by P_{t-1} . A fixed effect robust estimator, including three alternative combinations of specific country-year (δ_{kt}), industry-year (φ_{jt}) and country-industry-year (γ_{kjt}) effects, was used to capture the correlations between different firms in the same country over time. The parameters α_2 and α_3 measure the significance of the short- and long-term components in relation to the total expected value of the firm.¹⁰ The significance of the long-term component would strengthen the resilience of these companies in the face of an exogenous shock. The differences between firm value and the estimated value of the firm have been estimated using the following expressions [13–15]:

$$\Delta\text{Value}_{i,t} = \text{Value}_{i,t} - \widehat{b}_{i,t} + \widehat{\text{Short_TC}}_{i,t+1} + \widehat{\text{Long_TC}}_{i,t+T} \quad (13)$$

$$\Delta\text{Value_Short}_{i,t} = \text{Short_TC}_{i,t} - \widehat{\text{Short_TC}}_{i,t} \quad (14)$$

$$\Delta\text{Value_Long}_{i,t} = \text{Long_TC}_{i,t} - \widehat{\text{Long_TC}}_{i,t} \quad (15)$$

where $\text{Value}_{i,t}$ represents the firm value and the terms $\widehat{b}_{i,t}$, $\widehat{\text{Short_TC}}_{i,t+1}$ and $\widehat{\text{Long_TC}}_{i,t+T}$ represent the estimated book value, the estimated

¹⁰ We expect $\alpha_2 < 1$ and $\alpha_3 > 1$ in the context of High_SDs, which would imply an overestimation of long-term earnings and an underestimation of short-term earnings according to their sustainable practices. This means that $\alpha_2 < \alpha_3$, as long-term earnings are not underestimated relative to short-term earnings.

Panel A. COVID-19 shock

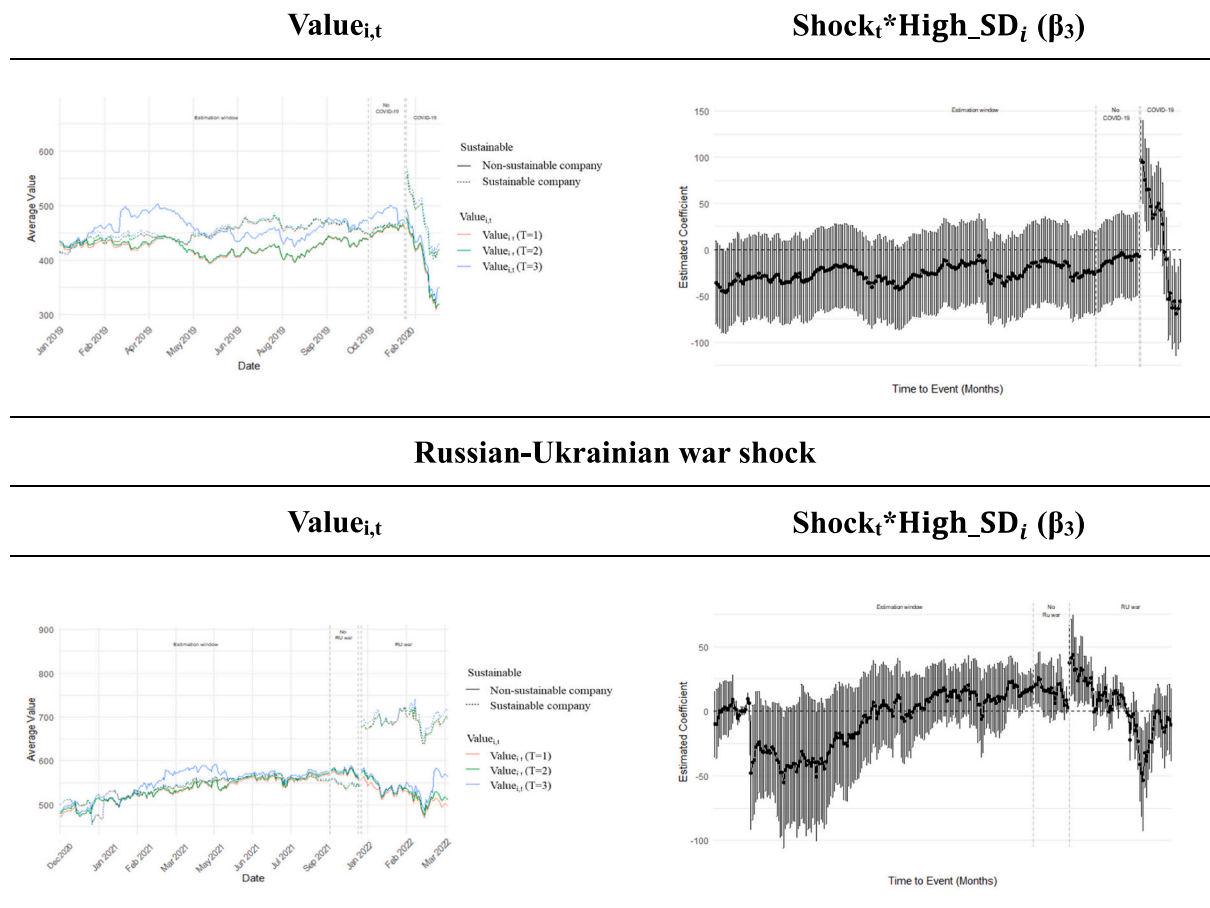


Fig. 3. Parallel trend hypothesis.

Figure 3 presents two types of charts to assess the parallel trend hypothesis. In the first type, we present the evolution of the $Value_{i,t}$ during the estimation window, the non-shock and the shock periods for $T = 1, 2$ and 3 for the 2 days estimation. The second type contains the dynamic evolution of the $Shock_t * High_SD_i (\beta_3)$ parameter during the same period of time. In both cases, the charts are referred to the COVID-19 and the Russian-Ukrainian War shocks.

short-term component and the estimated long-term component, respectively. The sum of these three values is equal to the estimated firm value $\widehat{Value}_{i,t}$. The terms $\widehat{Short_TC}_{i,t}$ and $\widehat{Long_TC}_{i,t}$ retain the meaning expressed in [expression \[2\]](#). The computation of the estimated firm value took into account the estimation window shown in [Fig. 2](#). These values were used to calculate the $\Delta Value$ corresponding to the ex-ante and ex-durante periods. It is expected that the intensity of the exogenous shock will be lower if the firm value and its expected value tend to converge in a shorter period of time.

[Table 6](#) shows the main results of the model proposed in [expression \[12\]](#). The table is divided into three panels: Panel A contains the estimation for the whole period, Panel B is based on the COVID-19 period and Panel C shows the results for the Russo-Ukrainian War.¹¹

A different pattern of behaviour can be observed between High_SD and Low_SD companies. In the first case, High_SDs tend to prioritise the long-term component ($\alpha_2 > \alpha_{3,T}$, $p\text{-value} > 0.100$), whereas Low_SDs show the opposite behaviour ($\alpha_2 > \alpha_{3,T}$, $p\text{-value} < 0.010$). In addition, the evidence suggests that the long-term component (0.9761 to 0.9921) is more important than the short-term component (0.1929 to 0.3993) in High_SD companies ($p\text{-value} < 0.010$). The same pattern is maintained

during the COVID-19 shock, when the long-term component is the most representative component of the expected firm value for High_SDs (0.9981 to 0.9987). This result is consistent with the findings of [Del Río et al. \(2023\)](#), who demonstrate that companies with high sustainability disclosure, as measured by participation in a sustainability rating, exhibit a higher value for the long-term component. In contrast, during the Russo-Ukrainian War shock, this combination is reversed for High_SDs, with the long-term component being less representative ($\alpha_2 > \alpha_{3,T}$, $p\text{-value} < 0.010$). This result reveals that companies that disclose their sustainability practices are affected differently by the two types of exogenous shock.

This model enables us to compute the $\Delta Value$ defined in [expressions \[13–15\]](#). [Table 7](#) contains the estimations of the $\Delta Value$ for the different window periods considered in this study (two, four, six, eight, sixteen and thirty-one days). We show the values for the COVID-19 and Russo-Ukrainian War shocks for both High_SD and Low_SD firms.

[Table 7](#) shows that during the COVID-19 shock, High_SD companies recover their pre-shock values faster than Low_SD companies ($p\text{-value} > 0.100$). This result is explained by the long-term component ($\Delta Value_Long$: 1.2761 during the shock and 31-day window $\Delta Value_Long (T = 3)$: 1.3191; $p\text{-value} > 0.100$), which penalises Low_SD companies ($\Delta Value_Long$: -0.9763 during the shock and 31-day window $\Delta Value_Long (T = 3)$: -1.2201; $p\text{-value} < 0.010$). Consequently, despite the fact that expected values were lower than actual values,

¹¹ In all panels, we have tested whether $\alpha_2 < 1$ and $\alpha_3 > 1$ in relation to the short- and long-term components together with the inequality $\alpha_2 < \alpha_3$.

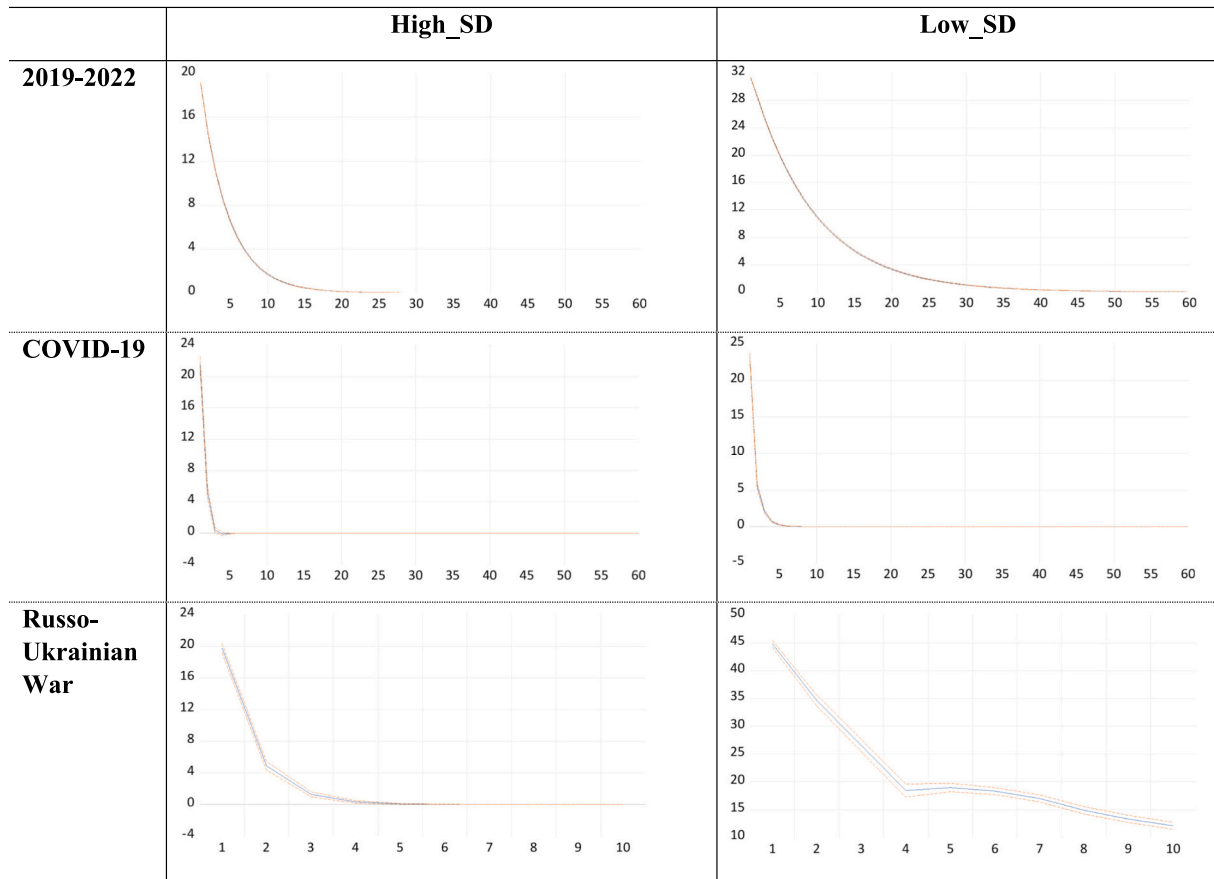


Fig. 4. Impulse-response (IR) function.

Figure 4 presents the impulse-response (IR) function for high sustainability disclosure (High_SD) and low sustainability disclosure (Low_SD) firms over the period 2019 to 2022. The chart also includes the IR functions for the two major shocks: the COVID-19 pandemic and the Russo-Ukrainian War. In all cases, the chart reflects the response of the firm value to firm value impulse using Cholesky (d.f. adjusted) one standard deviation with ± 2 standard error bands. The analysis demonstrates the system's response to these shocks, highlighting how the impacts propagate through time across different data sensitivities, capturing the dynamic effects on the variables under study. The x-axis represents the time horizon following the impulse, while the y-axis shows the magnitude of the response.

High_SD companies adopted a long-term perspective by implementing sustainability practices during this shock. This set of practices resulted in a notable increase in resilience among these firms, which was a key factor in their ability to withstand the impact of this shock. This result is consistent with the positive effects associated with the implementation of sustainability practices, which enable companies to identify changes in the environment and detect new business opportunities (Harrison et al., 2010) and access flexible and firm-specific resources (Chatzoudes et al., 2022; Ortiz-de-Mandojana & Bansal, 2016). In contrast, the effect was reversed during the Russo-Ukrainian War, with expectations for High_SD companies exceeding true values in the long term ($\Delta\text{Value_Long}$: -2.7289 during the shock and 31-day window $\Delta\text{Value_Long}$ ($T = 3$): -2.2066 ; $p\text{-value} < 0.010$). This result serves to reinforce our conclusions, confirming that sustainable companies with a long-term orientation are more resilient in terms of intensity when faced with an exogenous shock (type 1) that causes an overreaction in the short term (H_1). However, this effect dissipates when they encounter the second type of shock, which provokes an overreaction in the long term (H_2). The adoption of sustainable practices can account for these differences, showing that the long-term component serves to offset the short-term component.

To make this conclusion more robust, we have also proposed a DiD model for the ΔValue indicator and its components in both the long-term

($\Delta\text{Value_Long}$) and short-term ($\Delta\text{Value_Short}$). The regressions are specified in the following expressions [16–21]:

$$\Delta\text{Value}_{i,t} = \beta_1 \cdot \text{COVID19}_t + \beta_2 \cdot \text{High_SD}_i + \beta_3 \cdot \text{COVID19}_t \cdot \text{High_SD}_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (16)$$

$$\Delta\text{Value}_{i,t} = \beta_1 \cdot \text{RUwar}_t + \beta_2 \cdot \text{High_SD}_i + \beta_3 \cdot \text{RUwar}_t \cdot \text{High_SD}_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (17)$$

$$\Delta\text{Value_Long}_{i,t+T} = \beta_1 \cdot \text{COVID19}_t + \beta_2 \cdot \text{High_SD}_i + \beta_3 \cdot \text{COVID19}_t \cdot \text{High_SD}_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (18)$$

$$\Delta\text{Value_Long}_{i,t+T} = \beta_1 \cdot \text{RUwar}_t + \beta_2 \cdot \text{High_SD}_i + \beta_3 \cdot \text{RUwar}_t \cdot \text{High_SD}_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (19)$$

$$\Delta\text{Value_Short}_{i,t+1} = \beta_1 \cdot \text{COVID19}_t + \beta_2 \cdot \text{High_SD}_i + \beta_3 \cdot \text{COVID19}_t \cdot \text{High_SD}_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (20)$$

Table 6

Robustness: Market myopia effect. High_SD vs Low_SD.

Panel A 2019–2022						
	High_SD			Low_SD		
	T = 1	T = 2	T = 3	T = 1	T = 2	T = 3
α_0	59.6637***	67.9935***	77.4383***	67.0789***	71.0149***	73.7201***
α_1	0.5237***	0.4394***	0.3804***	0.4851***	0.4743***	0.4645***
α_2	0.1929***	0.6208***	0.3993***	1.2644***	1.1334***	1.1940***
$\alpha_{3,T}$	0.9921***	0.9832***	0.9761***	0.9979***	0.9862***	0.9797***
F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.9995	0.9993	0.9991	0.998	0.997	0.997
$\alpha_2 > 1$	—	—	—	***	***	***
$\alpha_{3,T} < 1$	***	***	***	***	***	***
$\alpha_2 > \alpha_{3,T}$	—	—	—	***	***	***

Panel B. Shock: COVID-19						
	High_SD			Low_SD		
	T = 1	T = 2	T = 3	T = 1	T = 2	T = 3
α_0	18.5157***	17.3468***	6.0896***	9.9919***	69.6851***	56.4562***
α_1	0.7738***	0.7899***	0.9456***	1.0006***	0.3767***	0.4435***
α_2	0.7937***	0.6977***	0.8119***	1.7785***	2.5113***	3.2254***
$\alpha_{3,T}$	0.9987***	0.9971***	0.9975***	0.9623***	0.9778***	0.9646***
F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.9999	0.9999	0.9999	0.9957	0.9999	0.9999
$\alpha_2 > 1$	—	—	—	***	***	***
$\alpha_{3,T} < 1$	***	***	***	***	***	***
$\alpha_2 > \alpha_{3,T}$	—	—	—	***	***	***

Panel C. Shock: Russo-Ukrainian War						
	High_SD			Low_SD		
	T = 1	T = 2	T = 3	T = 1	T = 2	T = 3
α_0	57.9832***	72.3799***	115.2709***	3.3578	33.6932***	9.6696**
α_1	0.1621***	0.1144***	0.0477***	0.9435***	0.6914***	0.9877***
α_2	4.8695***	4.1167***	1.3142***	2.6559***	1.7709***	2.4709***
$\alpha_{3,T}$	1.0084***	1.0055***	0.9977***	0.9458***	0.9712***	0.9659***
F test	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.9999	0.9999	0.9999	0.9996	0.9999	0.9996
$\alpha_2 > 1$	***	***	***	***	***	***
$\alpha_{3,T} < 1$	—	—	—	***	***	***
$\alpha_2 > \alpha_{3,T}$	***	***	***	***	***	***

This table presents the results of the model specified in [expression \[12\]](#), evaluating the estimated firm value ($\widehat{Value_{i,t}}$) at the end of three forecast horizons ($T = 1, 2$ and 3) for firms with High Sustainability Disclosure (High_SD) and Low Sustainability Disclosure (Low_SD). The analysis is conducted for the overall period (2019–2022) in Panel A, as well as for the specific shocks of COVID-19 and the Russo-Ukrainian War in Panels B and C, respectively. The parameter α_0 is the constant term, α_1 represents the effect of the accounting book value, α_2 measures the impact of the short-term value component ($Short_TC_{i,t+1}$), and α_3 evaluates the effect of the long-term value component ($Long_TC_{i,t+T}$). The table also reports the F-test results and the R-squared (R^2) value, indicating the overall fit of the model. The inequalities $\alpha_2 > 1$, $\alpha_3 < 1$, and $\alpha_2 > \alpha_3$ compare the differences among the parameters. Statistical significance is denoted by asterisks: *** $p < 0.010$, ** $p < 0.050$, * $p < 0.100$.

$$\Delta Value_Short_{i,t+1} = \beta_1 \cdot RUwar_t + \beta_2 \cdot High_SD_i + \beta_3 \cdot RUwar_t \cdot High_SD_i + \gamma \cdot X_{i,t} + \varepsilon_{i,t} \quad (21)$$

where $\Delta Value_{i,t}$, $\Delta Value_Long_{i,t+T}$ and $\Delta Value_Short_{i,t+1}$ represent the indicators for the differences in firm value, the long-term component and the short-term component for the i -th firm at time t , respectively. The variables $COVID19_t$ and $RUwar_t$ are binary variables that take the value 1 during the shock period (either COVID-19 or the Russo-Ukrainian War) and 0 otherwise. The term $High_SD_i$ constitutes a binary variable that indicates whether the i -th firm has been classified as a high sustainability discloser or not (1 for High_SD, 0 for Low_SD). The interaction terms cover the combined impact of both shocks and High_SD. $X_{i,t}$ represents a vector of control variables that may affect firm value. The parameters β_1 , β_2 and β_3 capture the average effect of the shock on firm value and its long- and short-term components (β_1); the difference in firm value and the long- and short-term components

between High_SD and Low_SD firms (β_2); and the differential impact of the shock on High_SD firms compared to Low_SD firms (β_3), respectively. Finally, γ is a vector of coefficients for the control variables and $\varepsilon_{i,t}$ is the error term.¹²

Table 8 contains the results for the DiD model. As in the previous section, this table presents the evolution of firm value ($\Delta Value_t$) and its components ($\Delta Short_TC_{i,t+1}$ and $\Delta Long_TC_{i,t+T}$), considering the

¹² As in the previous case, to ensure the robustness of our results, we account for potential heteroskedasticity in the error terms $\varepsilon_{i,t}$. Specifically, we use heteroskedasticity-robust standard errors, thereby ensuring the validity of our statistical inference. We also note that the DW tests have a value close to 2 and the J tests have a p -value > 0.100 . We also checked the parallel trend hypothesis observing that there are no significant differences between High_SD and Low_SD during the pretreatment periods.

Table 7Robustness: Evolution $\Delta\text{Value}_{i,t}$ indicator and the $\Delta\text{Value_Long}_{i,t+T}$ and $\Delta\text{Value_Short}_{i,t+1}$ components.

		Panel A. COVID-19 High_SD			Panel B. COVID-19 Low_SD			Panel A. COVID-19 High_SD			Panel B. COVID-19 Low_SD		
		$\Delta\text{Value}_{i,t}$	$\Delta\text{Value}_{i,t}$	Sig.	$\Delta\text{Value_Long}_{i,t+T}$	$\Delta\text{Value_Long}_{i,t+T}$	Sig.	$\Delta\text{Value_Short}_{i,t+1}$	$\Delta\text{Value_Short}_{i,t+1}$	Sig.	$\Delta\text{Value_Short}_{i,t+1}$	$\Delta\text{Value_Short}_{i,t+1}$	Sig.
Shock	T = 1	4.8291	0.5876	***	1.0062	-2.1837	***	-3.6669	7.0601	***			
	T = 2	4.4534	0.5659	***	0.3883	-2.2083	***	-0.8326	7.0602	***			
	T = 3	6.3332	3.1029	***	1.2761	-0.9763	***	-0.0283	7.1314	***			
2d	T = 1	5.6024	1.4539	***	1.0449	-2.8012	***	-3.6389	6.2949	***			
	T = 2	4.9411	-0.6525	***	0.4034	-2.8137	***	-0.8262	6.2951	***			
	T = 3	6.6165	2.1118	***	1.3096	-1.2185	***	-0.0281	6.3896	***			
	Sig.	—	—	***	—	—	***	—	—	***			
	Sig.	—	—	***	—	—	***	—	—	***			
	Sig.	—	—	***	—	—	***	—	—	***			
4d	T = 1	5.5862	-0.6323	***	1.0541	-2.8152	***	-3.6619	6.3149	***			
	T = 2	4.9385	-0.6441	***	0.4069	-2.8276	***	-0.8315	6.3150	***			
	T = 3	6.6248	2.1272	***	1.3209	-2.2083	***	-0.0282	6.3787	***			
	Sig.	—	—	***	—	***	***	—	—	***			
	Sig.	—	—	***	—	***	***	—	—	***			
	Sig.	—	—	***	—	**	***	—	—	***			
6d	T = 1	5.5889	-0.6476	***	1.0525	-2.8048	***	-3.6581	6.2886	***			
	T = 2	4.9389	-0.6596	***	0.4063	-2.8173	***	-0.8306	6.2885	***			
	T = 3	6.6235	2.1044	***	1.3191	-1.2201	***	-0.0282	6.3520	***			
	Sig.	—	*	***	—	***	***	—	—	***			
	Sig.	—	*	***	—	***	***	—	—	***			
	Sig.	—	*	***	—	***	***	—	—	***			
8d	T = 1	5.5834	-0.5745	***	1.0519	-2.8035	***	-3.6607	6.3595	***			
	T = 2	4.9371	-0.5861	***	0.4063	-2.8157	***	-0.8312	6.3596	***			
	T = 3	6.6207	2.2063	***	1.3179	-1.2310	***	-0.0283	6.4237	***			
	Sig.	—	*	***	—	***	***	—	—	***			
	Sig.	—	*	***	—	***	***	—	—	***			
	Sig.	—	*	***	—	***	***	—	—	***			
16d	T = 1	5.5862	-0.6323	***	1.0541	-2.8152	***	-3.6619	6.3149	***			
	T = 2	4.9385	-0.6442	***	0.4069	-2.8276	***	-0.8315	6.3150	***			
	T = 3	6.6248	2.1272	***	1.3209	-1.2245	***	-0.0282	6.3787	***			
	Sig.	—	*	***	—	***	***	—	—	***			
	Sig.	—	*	***	—	***	***	—	—	***			
	Sig.	—	*	***	—	***	***	—	—	***			
31d	T = 1	5.5889	-0.6476	***	1.0526	-2.8049	***	-3.6582	6.2885	***			
	T = 2	4.9389	-0.6596	***	0.4063	-2.8174	***	-0.8307	6.2886	***			
	T = 3	6.6236	2.1044	***	1.3191	-1.2201	***	-0.0283	6.3521	***			
	Sig.	—	*	***	—	***	***	—	—	***			
	Sig.	—	*	***	—	***	***	—	—	***			
	Sig.	—	*	***	—	***	***	—	—	***			

This table presents a comprehensive comparison of the $\Delta\text{Value}_{i,t}$ indicator and its components, namely the long-term value component ($\Delta\text{Value_Long}_{i,t+T}$) and the short-term value component ($\Delta\text{Value_Short}_{i,t+1}$), between firms with High Sustainability Disclosure (High_SD) and Low Sustainability Disclosure (Low_SD) at the end of three forecast horizons (T = 1, 2 and 3). The comparison incorporates both the ex-durante (shock) and ex-ante periods as defined in Fig. 2. The analysis is performed in three distinct ways: in the columns labelled Sig., High_SD and Low_SD companies are compared at the specified forecast horizons; in the rows labelled Sig., the Δ Value indicator and its components are compared between the ex-durante and ex-ante periods; and at the intersections, the combined effects of sustainability disclosure and the ex-durante/ex-ante periods are evaluated. This analysis is conducted for the shocks induced by the COVID-19 pandemic and the Russo-Ukrainian War. The table is divided into panels, with Panel A displaying results for High_SD firms during COVID-19, Panel B for Low_SD firms during COVID-19, Panel C for High_SD firms during the Russo-Ukrainian War, and Panel D for Low_SD firms during the Russo-Ukrainian War. Each panel includes detailed results for the $\Delta\text{Value}_{i,t}$ indicator and its components at each forecast horizon. The initial shock period is indicated, followed by results at 2, 4, 6, 8, 16 and 31 days before the shock. Statistical significance is indicated by asterisks, where *** denotes $p < 0.010$, ** denotes $p < 0.050$, and * denotes $p < 0.100$.

Table 7

Robustness: Evolution $\Delta\text{Value}_{i,t,T}$ indicator and the $\Delta\text{Value_Long}_{i,t+T}$ and $\Delta\text{Value_Short}_{i,t+1}$ components (Cont.)

		Panel C. Russo-Ukrainian War High_SD	Panel D. Russo-Ukrainian War Low_SD		Panel C. Russo-Ukrainian War High_SD	Panel D. Russo-Ukrainian War Low_SD		Panel C. Russo-Ukrainian War High_SD	Panel D. Russo-Ukrainian War Low_SD	
		$\Delta\text{Value}_{i,t}$	$\Delta\text{Value}_{i,t}$	Sig.	$\Delta\text{Value_Long}_{i,t+T}$	$\Delta\text{Value_Long}_{i,t+T}$	Sig.	$\Delta\text{Value_Short}_{i,t+1}$	$\Delta\text{Value_Short}_{i,t+1}$	Sig.
Shock	T = 1	2.7045	-4.3723	***	-2.5108	0.6251	***	0.2337	0.8387	***
	T = 2	2.8431	-2.7124	***	-3.2549	0.3779	***	0.3723	1.7472	***
	T = 3	4.3934	0.3064	***	-2.7289	0.2054	***	1.5141	4.4912	***
2d	T = 1	0.8011	-5.4496	***	-2.0167	0.5393	***	0.1755	0.8699	***
	T = 2	0.5726	-3.5508	***	-2.6168	0.3261	***	0.2795	1.7867	***
	T = 3	2.0064	-0.4274	***	-2.1802	0.1772	***	1.1367	4.5715	***
	Sig.	—	—	***	—	—	***	—	—	***
	Sig.	—	—	***	—	—	***	—	—	***
	Sig.	—	—	***	—	—	***	—	—	***
4d	T = 1	0.7869	-5.4382	***	-2.0311	0.8783	***	0.1755	0.5422	***
	T = 2	0.5542	-3.5321	***	-2.6354	1.8036	***	0.2796	0.3278	***
	T = 3	1.9916	-0.3837	***	-2.1955	4.6142	***	1.1374	0.1782	***
	Sig.	**	—	***	*	—	***	*	—	***
	Sig.	**	—	***	*	—	***	*	—	***
	Sig.	**	—	***	*	—	***	*	—	***
6d	T = 1	0.7938	-5.4304	***	-2.0247	0.8840	***	0.1761	0.5442	***
	T = 2	0.5633	-3.5193	***	2.6271	1.8152	***	0.2805	0.3291	***
	T = 3	2.0021	-0.3537	***	2.1887	4.6435	***	1.1409	0.1789	***
	Sig.	***	—	***	*	—	***	**	—	***
	Sig.	***	—	***	*	—	***	**	—	***
	Sig.	***	—	***	**	—	***	**	—	***
8d	T = 1	0.7877	-5.4767	***	-2.0313	0.8936	***	0.1765	0.5503	***
	T = 2	0.5554	-3.5492	***	-2.6357	1.8347	***	0.2812	0.3327	***
	T = 3	1.9978	-0.3551	***	-2.1959	4.6931	***	1.1438	0.1809	***
	Sig.	***	—	***	*	—	***	**	—	***
	Sig.	***	—	***	*	—	***	**	—	***
	Sig.	***	—	***	**	—	***	**	—	***
16d	T = 1	0.7919	-5.5135	***	-2.0276	0.9006	***	0.1771	0.5548	***
	T = 2	0.5609	-3.5731	***	-2.6311	1.8501	***	0.2821	0.6251	***
	T = 3	2.0052	-0.3565	***	-2.1922	4.7318	***	1.1476	0.3355	***
	Sig.	***	—	***	***	—	***	**	—	***
	Sig.	***	—	***	***	—	***	**	—	***
	Sig.	***	—	***	***	—	***	**	—	***
31d	T = 1	0.7787	-5.4949	***	-2.0409	0.9029	***	0.1772	0.5528	***
	T = 2	0.5438	-3.5531	***	-2.6484	1.8562	***	0.2823	0.3343	***
	T = 3	1.9915	-0.3264	***	-2.2066	4.7471	***	1.1482	0.1817	***
	Sig.	***	—	***	***	—	***	***	—	***
	Sig.	***	—	***	***	—	***	***	—	***
	Sig.	***	—	***	***	—	***	***	—	***

This table presents a comprehensive comparison of the $\Delta\text{Value}_{i,t}$ indicator and its components, namely the long-term value component ($\Delta\text{Value_Long}_{i,t+T}$) and the short-term value component ($\Delta\text{Value_Short}_{i,t+1}$), between firms with High Sustainability Disclosure (High_SD) and Low Sustainability Disclosure (Low_SD) at the end of three forecast horizons ($T = 1, 2$ and 3). The comparison incorporates both the ex-durante (shock) and ex-ante periods as defined in Fig. 2. The analysis is performed in three distinct ways: in the columns labelled Sig., High_SD and Low_SD companies are compared at the specified forecast horizons; in the rows labelled Sig., the ΔValue indicator and its components are compared between the ex-durante and ex-ante periods; and at the intersections, the combined effects of sustainability disclosure and the ex-durante/ex-ante periods are evaluated. This analysis is conducted for the shocks induced by the COVID-19 pandemic and the Russo-Ukrainian War. The table is divided into panels, with Panel A displaying results for High_SD firms during COVID-19, Panel B for Low_SD firms during COVID-19, Panel C for High_SD firms during the Russo-Ukrainian War, and Panel D for Low_SD firms during the Russo-Ukrainian War. Each panel includes detailed results for the $\Delta\text{Value}_{i,t}$ indicator and its components at each forecast horizon. The initial shock period is indicated, followed by results at 2, 4, 6, 8, 16 and 31 days before the shock. Statistical significance is indicated by asterisks, where *** denotes $p < 0.010$, ** denotes $p < 0.050$, and * denotes $p < 0.100$.

extreme windows of 2 and 31 days.¹³ The table shows the results for the two shocks (COVID-19 and the Russo-Ukrainian War) distinguishing between High_SD and Low_SD firms.

The results demonstrate that High_SD companies recover their pre-shock values faster than Low_SD companies, particularly for the COVID-19 shock. This is evidenced by the non-significant interaction terms (Shock-High_SD) for the ΔValue indicators (2 days: 0.018; 31 days: 0.013, $p\text{-value} > 0.050$), indicating that High_SD firms are less affected by this type of shock, and are thus more resilient. In contrast, during the Russo-Ukrainian War, while High_SD firms still show

resilience, they cannot easily adapt to the new context (2 days: 0.022 to 0.094; 31 days: 0.019 to 0.079, $p\text{-value} < 0.010$), which is in line with the assertion that sustainable practices are more effective in mitigating short-term shocks (type 1) than long-term ones (type 2). These results are inconsistent with Nader et al. (2022) and Corvino et al. (2024), who suggest that sustainable companies can adapt to both immediate and prolonged disruptions. Our results indicate that High_SD firms have advantages when facing immediate shocks, but some weaknesses when confronted with more prolonged impacts.

For the $\Delta\text{Value_Long}_{i,t+T}$ and $\Delta\text{Value_Short}_{i,t+1}$ indicators, the results highlight the differential impacts of both shocks on High_SD and Low_SD companies. In the long term, both shocks consistently have a significant impact on the $\Delta\text{Value_Long}$ component of the ΔValue (2 days: -0.056 to -0.125; 31 days: -0.138 to -0.265, $p\text{-value} < 0.010$). High_SD firms

¹³ The results for the shorter windows of two, four, six, eight and sixteen days do not exhibit a different pattern and are available upon request.

show a mitigating effect on this impact, but the interaction term (Shock*High_SD) remains significantly negative (2 days: -0.225 to -0.294 ; 31 days: -0.171 to -0.197 , p -value <0.010), indicating that High_SD firms are still penalised in the long run, especially during the Russian-Ukrainian War (2 days: -0.244 to -0.294 ; 31 days: -0.193 to -0.212 , p -value <0.010). In the short term, both shocks initially have a significant impact on the short-term component of firm value (2 days: 0.035 to 0.079 ; 31 days: 0.092 to 0.136 , p -value <0.010), deviating it from its true value. This deviation is particularly significant during the Russo-Ukrainian War for High_SD firms (2 days: 0.207 to 0.228 ; 31 days: 0.157 to 0.159 , p -value <0.010). These results confirm that High_SD companies exhibit higher resilience when faced with a type 1 shock (H_1). However, in the case of a type 2 shock, High_SD firms face significant challenges due to the impact on both the long- and short-term components (H_2). This differential impact underscores the importance of sustainability practices for enhancing short-term resilience, while also highlighting the persistent long-term challenges that firms face during exogenous shocks.¹⁴

4.1.2. Value-at-risk specification: Δ Value indicator

In a second analysis, we have specified a VAR model to measure the speed of recovery. This model focuses on the Δ Value indicator, which quantifies the difference between a firm's actual value and its expected value. The analysis distinguishes between High_SDs and Low_SDs in order to identify variations in recovery dynamics. The proposed specification is given by the following expressions [22–24]:

$$\Delta\text{Value}_{i,t} = \gamma_0 + \gamma_1 \cdot \Delta\text{Value}_{i,t-1} + \gamma_2 \cdot \Delta\text{Value}_{i,t-2} + u_{i,t} \quad (22)$$

$$\Delta\text{Value_Short}_{i,t+1} = \vartheta_0 + \vartheta_1 \cdot \Delta\text{Value_Short}_{i,t} + \vartheta_2 \cdot \Delta\text{Value_Short}_{i,t-1} + u_{i,t} \quad (23)$$

$$\Delta\text{Value_Long}_{i,t+T} = \omega_0 + \omega_1 \cdot \Delta\text{Value_Long}_{i,t+T-1} + \omega_2 \cdot \Delta\text{Value_Long}_{i,t+T-2} + u_{i,t} \quad (24)$$

where $\Delta\text{Value}_{i,t}$, $\Delta\text{Value_Short}_{i,t+1}$ and $\Delta\text{Value_Long}_{i,t+T}$ represent the differences between firm value and its expected value, the short-term components and the long-term components of the i -th firm, respectively. In all cases, we have considered a lag of two periods, taking into account the autocorrelation (ACF) and partial autocorrelation (PACF) functions of the residuals. Fig. 5 shows the impulse-response (IR) functions associated with the exogenous shocks considered in the context of the estimates for the specified VAR model specified. For both shocks, we consider the speed of recovery of the firm value during the ex-ante period. The details of the estimation of the VAR model can be found in Annex II.¹⁵

In all scenarios, High_SD companies exhibit a faster recovery rate than Low_SD companies. In particular, this accelerated recovery is most pronounced for the COVID-19 shock, which is characterised by a rapid dissipation of its effects (H_1). A parallel pattern is observed in the case of the Russo-Ukrainian War shock, where High_SDs have a faster recovery, albeit with a slightly diminished outcome (H_2). These results confirm that High_SDs possess distinct advantages in coping with exogenous shocks, especially in terms of speed of recovery. Although we have not found any previous studies that analyse the speed of recovery, the result

we have obtained would reflect the “build back better” philosophy promoted by some international bodies such as the [Organization for Co-operation and Economic Development \(2020\)](#). This strategy is based on an economic recovery from the COVID-19 crisis that is more sustainable and resilient, taking into account climate change and biodiversity, as well as the social and economic harm caused by firms. The consideration of these aspects by High_SD firms may have introduced some strengths that help explain the shorter recovery time.

4.1.3. Medal display table of the S&P Yearbook

Table 9 presents a comparison between companies that are classified as Gold and Industry Movers (mention) in the medal display table of the S&P Yearbook. The medal display table categories provide a robust and alternative measure of sustainability disclosure, capturing different aspects and dimensions of sustainability practices that may not be fully encompassed by the primary measure. By incorporating this second proxy, we increase the robustness of our analysis and address potential biases related to measuring errors in sustainability disclosure. The table considers the Δ Value indicator for both categories together with the results of an ANOVA test.

The results in Table 9 reveal that companies that develop sustainable practices more intensively, and belong to the top category of the medal display table, exhibit a smaller difference between actual and expected values during the COVID-19 shock (-3.3450 to -3.6502). A similar result has been obtained by other authors, such as [Lins et al. \(2017\)](#), who found that firms with strong sustainability practices exhibited greater resilience during the 2008 financial crisis. In contrast, this trend is reversed during the Russo-Ukrainian War, when the effect of this shock is stronger for such firms (-46.2499 to -50.0783). Our results thus support the conclusion that companies engaged in sustainable practices are more resilient to type 1 shocks (H_1), which cause overreactions in the short term (p -value <0.010). However, these practices introduce vulnerabilities that reduce resilience to type 2 shocks (H_2), leading to greater overreactions over a longer period.

4.1.4. Placebo tests

Finally, we present a summary of the two placebo tests performed in relation to the estimated DiD models: a) Placebo treatment timing and, b) Placebo treatment group.¹⁶ In relation to the placebo treatment timing, we have implemented a structured placebo approach by shifting the treatment period backward in time. Specifically, we created four placebo treatment variables by applying time lags of 5, 10, 15, and 20 months before the actual treatment period for both shock-related indicators (COVID-19 and Russian-Ukrainian War). This process involved grouping the data by firm identifiers to maintain the panel structure and applying the lags to shift the treatment variables accordingly. Once the new indicators were defined, we estimated the DiD models where each placebo variable was used as an independent variable, in combination with the interaction term involving sustainability. The absence of significant coefficients for β_1 (p -value >0.100) and β_3 (p -value >0.100) across different placebo treatment periods suggests that the observed effects in the primary analysis are not driven by arbitrary timing choices. The persistence of the significance of β_2 (p -value <0.010) also highlights that the structural differences between firms with varying sustainability disclosure levels remain stable and are not driven by exogenous shocks. These findings reinforce the validity of the original treatment specification and indicate that the impact of actual shocks is distinguishable from random timing effects.

The placebo treatment group was implemented specifying a simulation-based approach using 1000 iterations to ensure the robustness of our Difference-in-Differences (DiD) analysis. We began by defining the key variables, including the dependent variables ($\text{Value}_{i,t}(T=1)$, $\text{Value}_{i,t}(T=2)$, $\text{Value}_{i,t}(T=3)$, $\text{LTC}_{i,t}(T=1)$, $\text{LTC}_{i,t}(T=2)$, $\text{LTC}_{i,t}$,

¹⁴ The impact of control variables on the difference between real and expected firm values varies by shock type and time horizon. During COVID-19, larger firms and those in clean sectors faced negative effects, while leverage had a positive impact. In contrast, during the Russo-Ukrainian War, profitability (ROA) played a more significant role, clean sector firms were rewarded, and regional effects were mixed, with Denmark benefiting and countries like Germany, Austria, Belgium, and France experiencing persistent negative effects.

¹⁵ The p -values associated with the Q test are higher than 0.100, revealing the non-presence of autocorrelation in the studied models.

¹⁶ The specific results are available under request.

Table 8

DiD results for the $\Delta Value_{i,t}$ indicator and the $\Delta Value_Long_{i,t+T}$ and $\Delta Value_Short_{i,t+1}$ components.

Panel A: $\Delta Value_{i,t}$												
	2d						31d					
	T = 1		T = 2		T = 3		T = 1		T = 2		T = 3	
	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War
Shock _i (β_1)	-0.005	-0.004	-0.006	-0.003	0.023**	0.012	-0.007	-0.007	-0.008	-0.006	0.052***	0.035***
High_SD _i (β_2)	0.090***	0.051***	0.089***	0.055***	0.111***	0.075***	0.087***	0.050***	0.083***	0.055***	0.087***	0.064***
Shock _i *High_SD _i (β_3)	0.018*	0.031***	0.019*	0.022***	0.090***	0.094***	0.013	0.028***	0.013	0.019***	0.013	0.079***
Control												
Total asset	-0.044***	0.012	-0.053***	0.020**	-0.059***	0.015*	-0.045***	0.014**	-0.048***	0.020***	-0.056***	0.015**
Return on assets	0.013	0.073***	0.010	0.080***	0.007	0.073***	0.021***	0.043***	0.020**	0.046***	0.016**	0.039***
Leverage	0.041***	-0.009	0.044***	-0.005	0.047***	0.002	0.077***	-0.014**	0.078***	-0.011*	0.082***	-0.005***
Clean sector	-0.190***	0.047***	-0.190***	0.042***	-0.224***	0.041***	-0.184***	0.053***	-0.182***	0.051***	-0.214***	0.052***
Germany	-0.138***	-0.019**	-0.134***	-0.015*	-0.182***	-0.065***	-0.116***	-0.015*	-0.110***	-0.011	-0.151***	-0.057***
Austria	-0.106***	-0.019**	-0.105***	-0.018**	-0.139***	-0.056***	-0.086***	-0.011	-0.084***	-0.009	-0.114***	-0.045***
Belgium	-0.109***	-0.021**	-0.107***	-0.019**	-0.133***	-0.059***	-0.091***	-0.015**	-0.088***	-0.012*	-0.115***	-0.048***
Denmark	-0.148***	0.139***	-0.146***	0.151***	-0.149***	0.147***	-0.140***	0.135***	-0.137***	0.143***	-0.137***	0.145***
Finland	-0.135***	-0.022**	-0.132***	-0.019**	-0.179***	-0.066***	-0.115***	-0.020**	-0.110***	-0.017**	-0.151***	-0.060***
France	-0.158***	-0.024**	-0.151***	-0.021**	-0.204***	-0.075***	-0.141***	-0.019**	-0.133***	-0.017**	-0.181***	-0.066***
Italy	-0.097***	-0.019**	-0.093***	-0.018**	-0.127***	-0.058***	-0.081***	-0.017**	-0.077***	-0.015**	-0.106***	-0.053***
Luxembourg	-0.039***	-0.011	-0.039***	-0.011	-0.053***	-0.025***	-0.033***	-0.010	-0.033***	-0.010	-0.044***	-0.022***
Netherlands	-0.103***	-0.013	-0.099***	-0.011	-0.133***	-0.047***	-0.082***	-0.010	-0.079***	-0.008	-0.107***	-0.043***
Norway	-0.204***	0.036***	-0.208***	0.006	-0.237***	-0.042***	-0.212***	0.038***	-0.215***	0.017**	-0.240***	-0.028***
Portugal	-0.118***	-0.014	-0.117***	-0.012	-0.153***	-0.049***	-0.096***	-0.011	-0.093***	-0.009	-0.116***	-0.045***
Spain	-0.142***	-0.034***	-0.138***	-0.033***	-0.184***	-0.083***	-0.121***	-0.027***	-0.114***	-0.025***	-0.157***	-0.070***
Sweden	-0.108***	-0.009	-0.105***	-0.007	-0.139***	-0.045***	-0.086***	-0.004	-0.082***	-0.002	-0.111***	-0.036***
Switzerland	-0.068***	-0.021**	-0.060***	-0.019**	-0.074***	-0.039***	-0.059***	-0.010	-0.051***	-0.007	-0.066***	-0.022***
F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.008	0.003	0.008	0.003	0.023	0.014	0.007	0.003	0.007	0.003	0.017	0.013
DW	2.057	2.048	2.057	2.049	2.065	2.044	2.067	2.041	2.068	2.035	2.066	2.034
J	0.390	0.250	0.400	0.260	0.410	0.240	0.420	0.280	0.400	0.300	0.330	0.220

Panel B. $\Delta Value_Long_{i,t+T}$												
	2d						31d					
	T = 1		T = 2		T = 3		T = 1		T = 2		T = 3	
	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War
Shock _t (β_1)	−0.123***	−0.058***	−0.125***	−0.058***	−0.102***	−0.056***	−0.259***	−0.147***	−0.265***	−0.146***	−0.225***	−0.138***
High_SD _t (β_2)	0.097***	0.066***	0.050***	0.031***	0.206***	0.163***	0.160***	0.104***	0.118***	0.068***	0.257***	0.197***
Shock _t *High_SD _t (β_3)	−0.243***	−0.286***	−0.247***	−0.294***	−0.225***	−0.244***	−0.197***	−0.209***	−0.202***	−0.212***	−0.171***	−0.193***
Control												
Total asset	0.033***	0.006	0.032***	0.009	0.032***	0.000	0.038***	0.008	0.038***	0.010	0.031***	0.003
Return on assets	−0.002	0.019**	0.002	0.016**	−0.012	0.023***	0.029***	0.020***	0.029***	0.018***	0.019**	0.020***
Leverage	−0.057***	−0.018**	−0.051***	−0.024***	−0.062***	0.002	−0.041***	−0.009	−0.041***	−0.013**	−0.043***	0.005
Clean sector	0.157***	0.088***	0.183***	0.100***	0.079***	0.044***	0.138***	0.076***	0.162***	0.088***	0.075***	0.033***
Germany	0.177***	0.137***	0.208***	0.157***	0.085***	0.078***	0.184***	0.120***	0.184***	0.138***	0.077***	0.064***
Austria	0.162***	0.136***	0.182***	0.147***	0.095***	0.097***	0.163***	0.121***	0.163***	0.132***	0.092***	0.086***
Belgium	0.163***	0.130***	0.184***	0.141***	0.093***	0.091***	0.163***	0.115***	0.163***	0.125***	0.083***	0.079***
Denmark	−0.015	−0.143***	0.000	−0.135***	−0.047***	−0.157***	−0.022***	−0.152***	−0.022***	−0.145***	−0.061***	−0.164***
Finland	0.172***	0.133***	0.200***	0.150***	0.088***	0.082***	0.175***	0.118***	0.175***	0.134***	0.073***	0.069***
France	0.199***	0.156***	0.235***	0.176***	0.094***	0.096***	0.206***	0.138***	0.206***	0.156***	0.075***	0.082***
Italy	0.111***	0.111***	0.134***	0.127***	0.044***	0.064***	0.129***	0.097***	0.129***	0.112***	0.056***	0.051***
Luxembourg	0.060***	0.048***	0.067***	0.052***	0.038***	0.035***	0.061***	0.042***	0.061***	0.046***	0.038***	0.031***

(continued on next page)

Table 8 (continued)

Panel B. $\Delta Value_Long_{i,t+T}$												
	2d						31d					
	T = 1		T = 2		T = 3		T = 1		T = 2		T = 3	
	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War
Netherlands	0.128***	0.110***	0.151***	0.121***	0.061***	0.074***	0.132***	0.100***	0.132***	0.112***	0.062***	0.063***
Norway	0.177***	0.159***	0.200***	0.164***	0.097***	0.110***	0.163***	0.142***	0.163***	0.149***	0.082***	0.099***
Portugal	0.169***	0.127***	0.192***	0.137***	0.094***	0.095***	0.170***	0.115***	0.170***	0.125***	0.071***	0.081***
Spain	0.172***	0.125***	0.204***	0.147***	0.079***	0.059***	0.180***	0.108***	0.180***	0.128***	0.069***	0.046***
Sweden	0.142***	0.119***	0.163***	0.130***	0.080***	0.081***	0.142***	0.103***	0.142***	0.114***	0.073***	0.069***
Switzerland	0.044***	0.026***	0.062***	0.038***	0.002	−0.007	0.051***	0.015**	0.051***	0.026***	0.000	−0.013**
F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.102	0.066	0.102	0.065	0.106	0.078	0.104	0.066	0.104	0.065	0.106	0.078
DW	2.039	2.022	2.038	2.022	2.037	2.029	2.043	2.031	2.042	2.031	2.047	2.031
J	0.310	0.290	0.330	0.280	0.240	0.350	0.320	0.360	0.340	0.270	0.350	0.310
Panel C. $\Delta Value_Short_{i,t+1}$												
	2d						31d					
	T = 1		T = 2		T = 3		T = 1		T = 2		T = 3	
	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War	COVID-19	Russo-Ukrainian War
Shock _t (β_1)	0.062***	0.036***	0.079***	0.063***	0.064***	0.035***	0.134***	0.092***	0.136***	0.092***	0.136***	0.091***
High_SD _t (β_2)	−0.073***	−0.051***	−0.033***	−0.025***	−0.011	−0.005	−0.101***	−0.074***	−0.058***	−0.039***	−0.046***	−0.029***
Shock _t *High_SD _t (β_3)	0.178***	0.207***	0.212***	0.228***	0.180***	0.212***	0.140***	0.157***	0.142***	0.159***	0.142***	0.159***
Control												
Total asset	−0.076***	0.011	−0.079***	0.011	−0.080***	0.011	−0.063***	0.009	−0.065***	0.010	−0.065***	0.010
Return on assets	−0.005	0.043***	−0.005	0.051***	−0.004	0.054***	0.012	0.017**	0.012	0.021***	0.011	0.022***
Leverage	0.005	0.003	0.009	−0.001	0.010	−0.002	0.068***	−0.006	0.069***	−0.008	0.069***	−0.008
Clean sector	−0.216***	0.001	−0.237***	−0.012	−0.241***	−0.015	−0.185***	0.008	−0.202***	0.010	−0.206***	−0.005
Germany	−0.171***	−0.062***	−0.197***	−0.079***	−0.204***	−0.084***	−0.122***	−0.052***	−0.142***	−0.068***	−0.148***	−0.072***
Austria	−0.162***	−0.076***	−0.178***	−0.086***	−0.182***	−0.088***	−0.114***	−0.063***	−0.126***	−0.071***	−0.129***	−0.073***
Belgium	−0.156***	−0.067***	−0.173***	−0.078***	−0.177***	−0.081***	−0.115***	−0.057***	−0.128***	−0.066***	−0.132***	−0.068***
Denmark	−0.120***	0.156***	−0.134***	0.148***	−0.137***	0.145***	−0.096***	0.156***	−0.107***	0.150***	−0.109***	0.148***
Finland	−0.172***	−0.070***	−0.198***	−0.086***	−0.204***	−0.090***	−0.125***	−0.062***	−0.145***	−0.076***	−0.151***	−0.079***
France	−0.184***	−0.081***	−0.214***	−0.098***	−0.221***	−0.103***	−0.141***	−0.070***	−0.166***	−0.085***	−0.173***	−0.089***
Italy	−0.108***	−0.059***	−0.130***	−0.071***	−0.135***	−0.075***	−0.088***	−0.050***	−0.103***	−0.063***	−0.106***	−0.066***
Luxembourg	−0.087***	−0.042***	−0.095***	−0.047***	−0.097***	−0.048***	−0.066***	−0.037***	−0.072***	−0.041***	−0.073***	−0.042***
Netherlands	−0.126***	−0.059***	−0.146***	−0.069***	−0.151***	−0.071***	−0.093***	−0.051***	−0.107***	−0.061***	−0.110***	−0.063***
Norway	−0.234***	−0.041***	−0.257***	−0.051***	−0.262***	−0.054***	−0.222***	−0.033***	−0.239***	−0.041***	−0.242***	−0.044***
Portugal	−0.169***	−0.072***	−0.191***	−0.081***	−0.196***	−0.084***	−0.124***	−0.064***	−0.139***	−0.072***	−0.143***	−0.075***
Spain	−0.170***	−0.069***	−0.199***	−0.090***	−0.206***	−0.096***	−0.124***	−0.056***	−0.146***	−0.075***	−0.152***	−0.080***
Sweden	−0.146***	−0.056***	−0.163***	−0.067***	−0.167***	−0.069***	−0.102***	−0.046***	−0.113***	−0.055***	−0.116***	−0.057***
Switzerland	−0.063***	−0.023***	−0.074***	−0.035***	−0.078***	−0.038***	−0.043***	−0.010	−0.052***	−0.018**	−0.054***	−0.020***
F	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R-squared	0.051	0.035	0.033	0.049	0.049	0.034	0.036	0.035	0.037	0.033	0.036	0.033
DW	2.029	2.060	2.030	2.067	2.031	2.064	2.063	2.038	2.063	2.039	2.063	2.039
J	0.370	0.240	0.350	0.350	0.310	0.220	0.380	0.250	0.380	0.290	0.370	0.260

This table presents the Difference-in-Differences (DiD) results for $\Delta Value_{i,t}$ and its components, $\Delta Value_Long_{i,t+T}$ and $\Delta Value_Short_{i,t+1}$ across three forecast horizons ($T = 1, 2$ and 3). The analysis examines the impacts of two significant exogenous shocks: the COVID-19 pandemic and the Russo-Ukrainian War, on firms with high sustainability disclosure (High_SD) compared to those with low sustainability disclosure (Low_SD). Panel A displays the DiD results for $\Delta Value_{i,t}$. Panel B shows the results for the long-term component ($\Delta Value_Long_{i,t+T}$), and Panel C reports the short-term component ($\Delta Value_Short_{i,t+1}$). The coefficients for the shock variable (β_1), the High_SD variable (β_2), and the interaction term (β_3) are reported. Control variables including total assets, return on assets, leverage, clean/dirty activity sector and countries are included in all regressions. The UK was considered the control group for the country variable. The F-statistic tests the overall significance of the model, and R^2 indicates the proportion of variance explained by the model. The Durbin-Watson (DW) statistic tests for first-order autocorrelation in the residuals, with values around 2 suggesting no significant autocorrelation. The J-statistic tests for the validity of the instrument used, with p-values provided for each model. Statistical significance is indicated by asterisks: *** $p < 0.010$, ** $p < 0.050$, * $p < 0.100$.

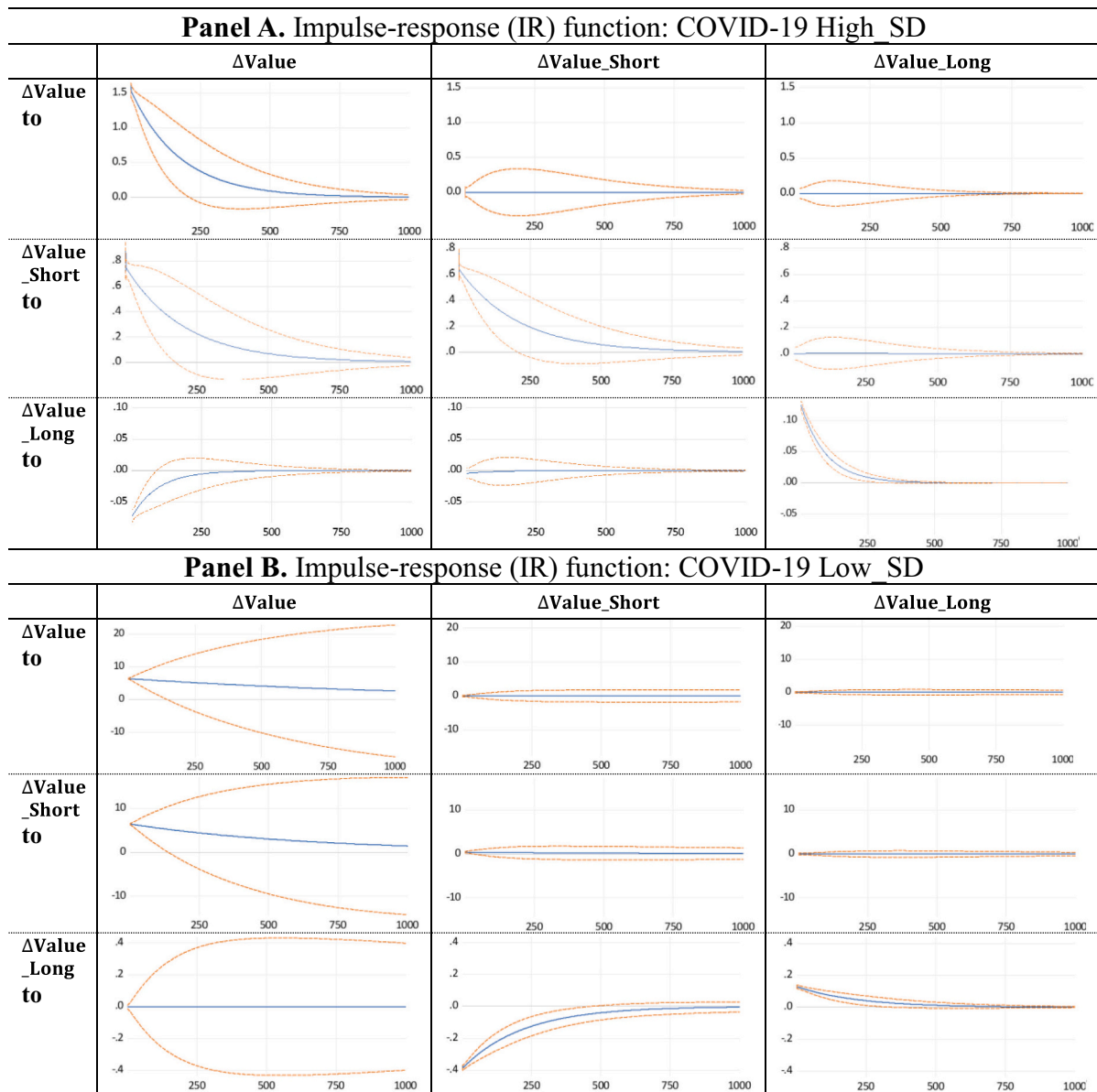


Fig. 5. Impulse-response (IR) function.

Figure 5 presents the impulse-response (IR) function for high sustainability disclosure (High_SD) and low sustainability disclosure (Low_SD) firms for the two major shocks: the COVID-19 pandemic (Panels A and B) and the Russo-Ukrainian War (Panels C and D). In all cases, the chart reflects the response of the ΔValue indicator to ΔValue impulse using Cholesky (d.f. adjusted) one standard deviation with ± 2 standard error bands. The responses of ΔValue to various components ($\Delta\text{Value_Short}$ and $\Delta\text{Value_Long}$) are plotted to analyse the impact over time. The x-axis represents the time horizon following the impulse, while the y-axis shows the magnitude of the response.

$\epsilon(T = 3)$ and $\text{STC}_{i,t}$), the exogenous shocks (COVID-19 and Russian-Ukrainian War), and the treatment variable (sustainability). In each iteration, we randomly assigned the placebo treatment (sustainability) to 50 % of the firms ensuring randomness through a seed function. For each combination of dependent and independent variables, we estimated linear regression models incorporating the placebo treatment and its interaction with the exogenous shock variables. The estimated coefficients for the placebo variables (β_3) are close to zero, and their 95 % confidence intervals always include zero. This lack of statistical significance suggests that the model does not produce spurious results when tested against irrelevant or false treatments. The results are consistent across all dependent variables and time windows.

5. Conclusions

The aim of this study has been to analyse how the value of companies that implement sustainable practices reacts to two different types of exogenous shocks (short-term/type 1 and long-term/type 2). We use the shocks arising from COVID-19 and the Russo-Ukrainian War as examples of each type, respectively. The type 1 shock is characterised by a short-term overreaction, while the type 2 shock is expected to have a longer-term impact and spread its effects over a longer period of time. Our results show that companies with sustainable practices are more resilient to a type 1 shock. The impact on firm value in the face of a shock with a short-term overreaction is lower for sustainable companies because the short-term component has less weight due to their long-term orientation. As a result, sustainable companies appear more resilient,

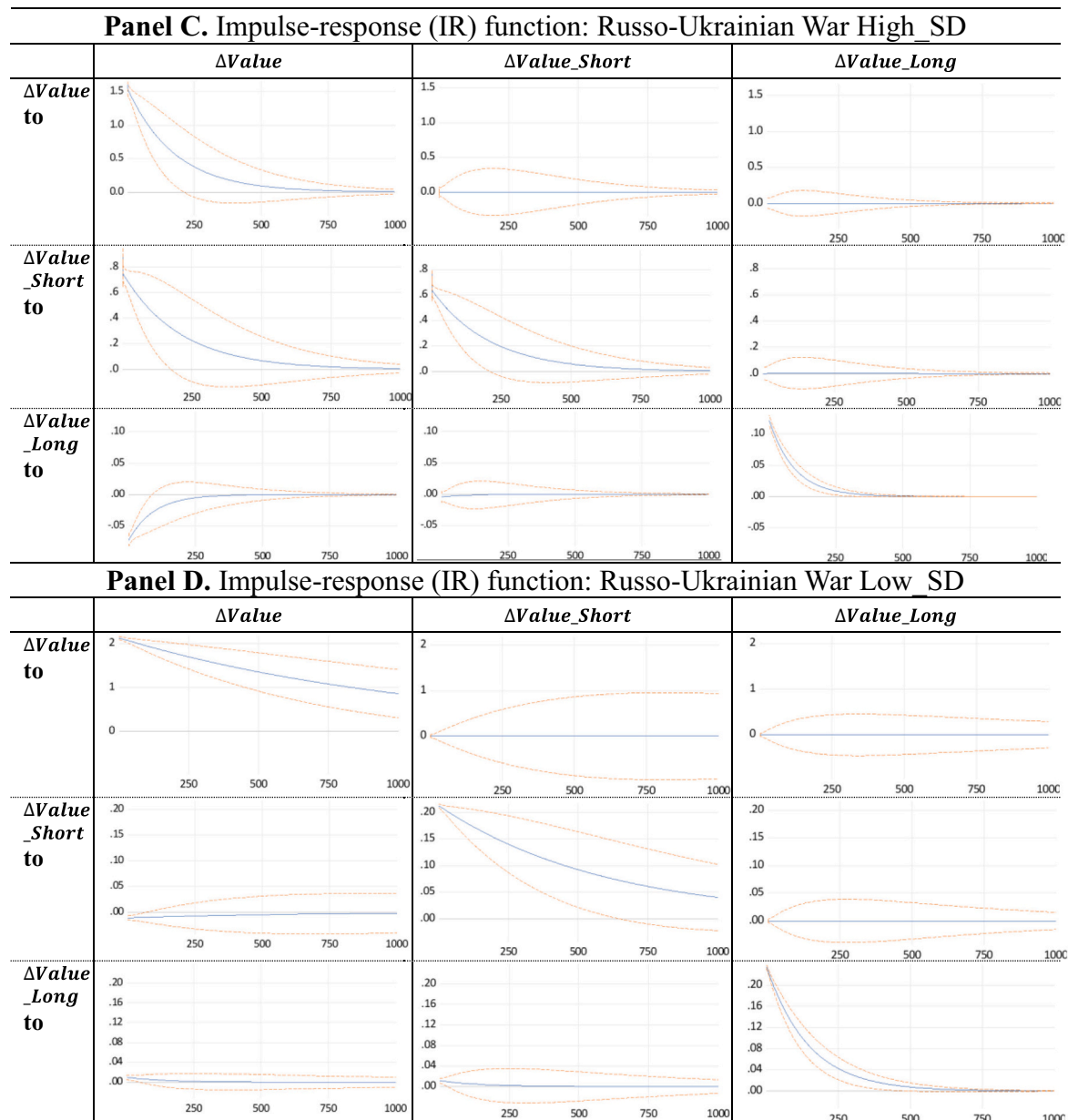


Fig. 5. (continued).

with a smaller drop in value and a faster recovery time. In contrast, when the market faces a long-term shock, the effect on these companies is the opposite. In this case, the long-term component introduces some weaknesses when a sustainable company confronts a type 2 shock.

Previous literature has examined how firms react in terms of returns when faced with exogenous shocks. In this regard, Izzeldin et al. (2023) found that investors overreacted in the short term during COVID-19, while they overreacted in the long term in the case of the Russo-Ukrainian War. The characteristics of these shocks, which were more persistent in the case of the war, may explain these different reactions (Abbasi et al., 2023; Yarovaya et al., 2022). These studies have contributed significantly to the analysis of the behaviour of organisations when confronted with an exogenous shock. However, they have some limitations that we have tried to overcome in this research. First, they do not analyse the resilience of companies in terms of value and expected value during both types of shocks. Second, these studies do not introduce sustainable practices as an explanatory factor that could influence companies' reactions. In our study, we not only introduce the location, industry and firm size as control variables, but also consider

the implementation of sustainable practices (Abbasi et al., 2023; Benkraiem et al., 2022; Izzeldin et al., 2021). Finally, we also evaluate two dimensions of resilience in this type of company. We then examine the size (intensity) of the shock and the time (speed) that a company takes to recover its previous value. Our results reveal that the intensity of the impact on sustainable companies is higher when they suffer a type 2 shock, although they tend to recover in a shorter period of time in both cases.

Our results have several implications from both an academic and practitioner perspective. Considering the three theories mentioned in the theoretical section, stakeholder (Freeman, 1984) and resource-based (Barney, 1991), sustainable practices promote trust and cooperation, which in the long run lead to a competitive advantage; at the same time, they provide the organisation with enhanced capabilities. In addition, the disclosure of sustainable practices to financial markets provides a signal of the impact that firms are having, in line with signalling theory (Spence, 1973). We show that these positive effects are also present when analysing organisational resilience. High sustainable firms show lower impacts on their values and shorter recovery times

Table 9Robustness: Evolution in the $\Delta\text{Value}_{i,t}$ indicator according to the medal display table.

Panel A. COVID-19													
		2d		4d		6d		8d		16d		31d	
		Mean	ANOVA	Mean	ANOVA	Mean	ANOVA	Mean	ANOVA	Mean	ANOVA	Mean	ANOVA
$\Delta\text{Value}_{i,1}$	Gold	−3.6502	***	−3.5937	***	−3.5565	***	−3.5120	***	−3.4332	***	−3.3450	***
	Mention	−17.9042		−17.9401		−18.0514		−18.1693		−18.2464		−18.2073	
$\Delta\text{Value}_{i,2}$	Gold	−4.2648	***	−4.2492	***	−4.2296	***	−4.1909	***	−4.1251	***	−4.0562	***
	Mention	−16.3509		−16.4039		−16.5133		−16.6318		−16.7163		−16.7275	
$\Delta\text{Value}_{i,3}$	Gold	−4.7290	***	−4.7360	***	−4.7226	***	−4.6776	***	−4.6057	***	−4.5364	—
	Mention	−18.2328		−18.2965		−18.4307		−18.5795		−18.7209		−18.8032	

Panel B. Russo-Ukrainian War													
		2d		4d		6d		8d		16d		31d	
		Mean	ANOVA	Mean	ANOVA	Mean	ANOVA	Mean	ANOVA	Mean	ANOVA	Mean	ANOVA
$\Delta\text{Value}_{i,1}$	Gold	−50.0718	***	−50.0783	***	−50.1181	***	−50.2007	***	−49.7593	***	−46.2499	***
	Mention	−3.5971		−3.5979		−3.6001		−3.6073		−3.6081		−3.5249	
$\Delta\text{Value}_{i,2}$	Gold	−59.0224	***	−59.0519	***	−59.0981	***	−59.2073	***	−58.9749	***	−56.5177	***
	Mention	−5.0059		−5.0093		−5.0123		−5.0231		−5.0298		−4.9636	
$\Delta\text{Value}_{i,3}$	Gold	−68.4751	***	−68.5186	***	−68.5702	***	−68.6961	***	−68.5423	***	−66.4738	***
	Mention	−6.4354		−6.4398		−6.4444		−6.4583		−6.4951		−6.5792	

The table shows the evolution and results of ANOVA tests for the ΔValue indicator ($\Delta\text{Value}_{i,t}$) across different categories of the medal display table, specifically comparing the Gold and Mention categories, at the end of three forecast horizons ($T = 1, 2$ and 3). The analysis takes into account the ex-ante periods as defined in Fig. 2. Panel A focuses on the COVID-19 shock, while Panel B examines the Russo-Ukrainian War shock. The table includes means and ANOVA test results for various time points before the initial shock (2, 4, 6, 8, 16 and 31 days). For each time point, the mean ΔValue indicator for both Gold and Mention categories is provided, along with the corresponding ANOVA results to test for statistical significance. The Gold category represents firms with high sustainability disclosure, while the Mention category includes firms with low levels of sustainable disclosure. Statistical significance is indicated by asterisks, where *** denotes $p < 0.010$, ** denotes $p < 0.050$, and * denotes $p < 0.100$.

when affected by a type 1 shock. However, for the case of type 2 shock, although the recovery speed is still higher among high sustainable firms, the initial impact on their firm value is higher than for low sustainable firms. This effect is due to the greater sensitivity of the long-term value component of these companies. We also highlight some findings of interest to practitioners. For CEOs and business leaders, this study underlines the critical importance of integrating sustainability into strategic planning, emphasizing its dual role as a short-term financial cushion and a long-term competitive advantage. While sustainable practices can provide immediate shock absorption, it is crucial for investors to recognise that sustainable companies are not always the most resilient, especially in the face of shocks characterised by overreactions over the long term. Risk managers need to adapt their strategies to incorporate sustainability considerations, recognising potential long-term vulnerabilities. Government policymakers could use this research to encourage sustainable practices while providing support mechanisms for companies facing prolonged shocks. Finally, industry associations and collaborative platforms have an opportunity to foster corporate sustainability practices and help companies collectively weather unforeseen shocks. Tailoring strategies to the unique characteristics of each industry is essential, ensuring a holistic approach that promotes resilience and sustainable value creation. Moreover, in line with recent literature (e.g. Christensen et al., 2021; Gibbons, 2023), our findings underscore that sustainability disclosure plays a central role in enhancing transparency, reducing information asymmetries, and strengthening investor trust. As shown by Kimbrough et al. (2024) even voluntary ESG reporting reduces the variability in ESG rating agency scores and thereby also reduces uncertainty in the capital markets for these companies. These disclosures not only influence market perceptions and financial decisions in the face of exogenous shocks but also

support the long-term strategic positioning and resilience of the firm.

Finally, we highlight some of the limitations of this study. First, we analyse the two types of shocks, short-term (type 1) and long-term (type 2), using COVID-19 and the Russo-Ukrainian War as our examples. While the selection of these shocks does allow for a nuanced analysis, it may limit the extrapolation of the results to other types of unanticipated events. Second, the measurement of sustainability disclosure in this study, based on the S&P sustainability rating, provides a robust foundation for the analysis. Nevertheless, future research could expand the scope of sustainability disclosure mechanisms to encompass a broader array of examples in order to provide a more comprehensive understanding of their impact on organisational resilience. Furthermore, despite controlling for certain variables such as location, industry and firm size, there may be other factors that influence firm resilience, such as corporate governance structure and organisational value. Finally, the study focuses primarily on financial market metrics, which may overlook other important dimensions of organisational resilience. Future research could address these limitations to provide a more comprehensive understanding of the interplay between sustainable practices and organisational responses to different shocks.

Acknowledgements

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Appendix A. Appendix

Annex I

Estimations of the VAR model.

	High_SD			Low_SD		
	Value _{i,t}	Short_TC _{i,t+1}	Long_TC _{i,t+T}	Value _{i,t}	Short_TC _{i,t+1}	Long_TC _{i,t+T}
Value _{i,t-1}	0.9629***			0.9937***		
Value _{i,t-2}	0.0369***			0.0056***		
Short_TC _{i,t}		0.8410***			0.8953***	
Short_TC _{i,t-1}		0.1594***			0.1031***	
Long_TC _{i,t+T-1}			0.9651***			0.9949***
Long_TC _{i,t+T-2}			0.0348***			0.0043***
γ_0	0.1434*	0.0017	0.1368*	0.1653***	0.0111***	0.1749***
$b_{i,t}$	0.0001	0.0001***	0.0001	0.0014***	0.0001***	0.0007***
R-squared	0.9996	0.9966	0.9995	0.9994	0.9962	0.9991

	COVID-19 High_SD			COVID-19 Low_SD		
	Value _{i,t}	Short_TC _{i,t+1}	Long_TC _{i,t+T}	Value _{i,t}	Short_TC _{i,t+1}	Long_TC _{i,t+T}
Value _{i,t-1}	0.9723***			0.9844***		
Value _{i,t-2}	0.0171			-0.0086		
Short_TC _{i,t}		0.8105***			0.8893***	
Short_TC _{i,t-1}		0.1993***			0.0666***	
Long_TC _{i,t+T-1}			1.0101***			1.0019***
Long_TC _{i,t+T-2}			-0.0197			-0.0258***
γ_0	-0.6783	-0.0703	-0.8718	0.2605	0.2795***	0.2151
$b_{i,t}$	-0.0091***	-0.0006***	-0.0151***	0.0121***	0.0004	-0.0114***
R-squared	0.9984	0.9911	0.9975	0.9978	0.9560	0.9961

	Russo-Ukrainian War - High_SD			Russo-Ukrainian War - Low_SD		
	Value _{i,t}	Short_TC _{i,t+1}	Long_TC _{i,t+T}	Value _{i,t}	Short_TC _{i,t+1}	Long_TC _{i,t+T}
Value _{i,t-1}	0.9318***			0.9549***		
Value _{i,t-2}	0.0679***			0.0437***		
Short_TC _{i,t}		0.9674***			0.9944***	
Short_TC _{i,t-1}		0.0337**			0.0022	
Long_TC _{i,t+T-1}			0.9335***			0.9535***
Long_TC _{i,t+T-2}			0.0662***			0.0446***
γ_0	-0.3297	-0.0047	-0.2777	0.0837	-0.0162	0.1666
$b_{i,t}$	0.0021	0.0001	0.0007	-0.0075***	0.0001*	-0.0085***
R-squared	0.9994	0.9996	0.9993	0.9992	0.9946	0.9990

The table presents the estimations for the proposed VAR model. The symbols Value_{i,t}, Short_TC_{i,t} and Long_TC_{i,t} represent the firm value, the short-term components and the long-term components, respectively. The model is estimated for the whole period and for the COVID-19 shock and the Russo-Ukrainian War shock, discriminating between high sustainability disclosure (High_SD) and low sustainability disclosure (Low_SD) firms. The terms γ_0 and $b_{i,t}$ are the constant and the book-to-market ratio. In all cases, we introduce two lags of the firm value, the short-term and the long-term component variables. The table provides detailed estimates for both High_SD and Low_SD firms during the entire period and the two specified shocks, highlighting the influence of past firm value and component values on the current firm value and component values. Statistical significance is indicated by asterisks, where *** denotes $p < 0.010$, ** denotes $p < 0.050$, and * denotes $p < 0.100$.

Annex II

Estimations of the VAR model for the $\Delta Value_{i,t}$ (indicator).

	COVID-19 High_SD			COVID-19 Low_SD		
	$\Delta Value_{i,t}$	$\Delta Value_Short_{i,t+1}$	$\Delta Value_Long_{i,t+T}$	$\Delta Value_{i,t}$	$\Delta Value_Short_{i,t+1}$	$\Delta Value_Long_{i,t+T}$
$\Delta Value_{i,t-1}$	0.9702***			1.0205***		
$\Delta Value_{i,t-2}$	0.0241			-0.0214***		
$\Delta Value_Short_{i,t}$		0.8074***			1.0196***	
$\Delta Value_Short_{i,t-1}$		0.1869***			-0.0211***	
$\Delta Value_Long_{i,t+T-1}$			1.0632***			1.0285***
$\Delta Value_Long_{i,t+T-2}$			-0.0733***			-0.0329***
γ_0	0.0062	0.0099	-0.0058	0.0273	-0.0183	0.0463***
R-squared	0.9955	0.9904	0.9974	0.9381	0.9528	0.9957

	Russo-Ukrainian War High_SD			Russo-Ukrainian War Low_SD		
	$\Delta Value_{i,t}$	$\Delta Value_Short_{i,t+1}$	$\Delta Value_Long_{i,t+T}$	$\Delta Value_{i,t}$	$\Delta Value_Short_{i,t+1}$	$\Delta Value_Long_{i,t+T}$
$\Delta Value_{i,t-1}$	0.8892***			1.0031***		
$\Delta Value_{i,t-2}$	0.0979***			-0.0041		
$\Delta Value_Short_{i,t}$		0.8782***			1.0021***	
$\Delta Value_Short_{i,t-1}$		0.1228***			-0.0036	
$\Delta Value_Long_{i,t+T-1}$			0.9664***			0.9972***
$\Delta Value_Long_{i,t+T-2}$			0.0343**			-0.0041
γ_0	0.1381	-0.0017	-0.0035	-0.0175	0.0007	0.0059***
R-squared	0.8801	0.9923	0.9987	0.9986	0.9962	0.9944

The table presents the estimations for the proposed VAR model. The symbols $\Delta Value_{i,t}$, $\Delta Value_Short_{i,t}$ and $\Delta Value_Long_{i,t}$ represent the $\Delta Value$ indicator and its components in the short-term and the long-term, respectively. The model is estimated for the COVID-19 shock and the Russo-Ukrainian War shock, discriminating between high sustainability disclosure (High_SD) and low sustainability disclosure (Low_SD) firms. The term γ_0 is the constant of the proposed models. In all cases, we introduce two lags of the $\Delta Value$ indicator and its short-term and long-term components. The table provides detailed estimates for both High_SD and Low_SD firms during the two specified shocks, highlighting the influence of past $\Delta Value$ indicator and component values on the current $\Delta Value$ indicator and component values. Statistical significance is indicated by asterisks, where *** denotes $p < 0.010$, ** denotes $p < 0.050$, and * denotes $p < 0.100$.

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