CIRCULAR ECONOMY AND M&A: HOW TARGET FIRMS' SUSTAINABLE ORIENTATION SHAPES DUE DILIGENCE DYNAMICS?

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Abstract

This article examines how the circular economy (CE) orientation of target firms influences the due diligence undertaken by acquirers in the mergers and acquisitions (M&A) market. Employing ordinary least squares (OLS) regressions on a unique sample of 3,159 European M&A operations, the findings reveal that due diligence activities are significantly faster when acquirers deal with more CE-oriented target firms. This result is consistent with the view that innovative sustainability approaches, such as CE, are used by investors to alleviate information asymmetry concerns in the market for corporate control. Moreover, additional analysis highlights that the association between circular targets and expedited due diligence has strengthened over time, reflecting a recent shift in investors' understanding of CE practices. Overall, the results underscore the growing importance of CE in the M&A market, offering valuable implications for managers, investors, and policymakers.

Keywords: Mergers and Acquisitions, M&A, Circular Economy, Due Diligence, Time Trend

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1. INTRODUCTION

The recent growing emphasis on sustainability has transformed the corporate landscape, prompting economic entities to adopt strategies that integrate environmental and social considerations into their daily operations and their business models. In this regard, the circular economy (CE) has emerged as a vital framework for addressing resource scarcity and fostering sustainable development (Geissdoerfer et al., 2017; Kirchherr et al., 2017). In contrast to the traditional linear economy that follows the "take-make-dispose" model, a CE-based business model promotes resource efficiency, waste reduction, and value creation through closed-loop systems (Lewandowski, 2016). By focusing on extending product lifecycles and maximizing resource utility, CE aligns with the principles of sustainable business models and innovation (Lahti et al., 2018).

Recent evidence highlights the growing appeal of CE practices to investors and stakeholders alike, particularly in mergers and acquisitions (M&A)

transactions, where the business models and sustainability practices of target firms increasingly influence deal dynamics (Esken et al., 2018; Ghisellini et al., 2016; Alkaraan, 2022; Cardillo & Harasheh, 2023). Indeed, M&A operations are among the most prominent inter-firm phenomena for achieving economic growth, competitive advantage objectives and sustainability strategies (Caiazza et al., 2021).

However, these transactions are complex, time-consuming and resource-intensive, requiring meticulous due diligence to assess financial, operational, and strategic fit (Dikova et al., 2010; Wangerin, 2019; Welch, 2020; Asante & Sun, 2024). There is scant but still existent literature suggesting that sustainability practices, particularly those related to environmental, social, and governance (ESG), can be incorporated into the due diligence process to alleviate information asymmetry problems (Cho et al., 2013; Kayser & Zülch, 2024). Some studies highlight the growing relevance of sustainability behaviours in the assessment of potential acquisitions, noting that integrating ESG factors can provide a more comprehensive understanding of the value and risk profile of the target firm (Cho et al., 2013; Gomes & Marsat, 2018; Cardillo & Harasheh, 2023). While this strand of literature has explored the role of sustainability and corporate culture in M&A financial outcomes, less attention has been paid to the influence of target firms' practices, particularly those concretely rooted in sustainability. Specifically, a notable gap remains in the literature, as no study has investigated how CE orientation, those that effectively operationalize sustainability practices, are incorporated into the due diligence activities. This oversight is especially critical, given the increasing importance of circularity in contemporary business strategies (Rennings et al., 2023).

The aim of this paper is to address this gap by investigating how the CE orientation of target firms influences the due diligence dynamics in a set of 3,159 European M&A deals announced between 2012 and 2023. Using multivariate regression models, the paper empirically examines whether the "circular" nature of target firms expedites the due diligence process, defined as the number of days between deal announcement and deal closing (Dikova et al., 2010; Skaife & Wangerin, 2013; Wangerin, 2019; Cardillo & Harasheh, 2023). The target is classified as "circular" or not based on qualitative information related to the acquired company (i.e., target firm) drawn from the *Deal Rationale*, *Deal Comments*, and the *Deal Overview* from Orbis M&A (Bureau Van Dijk).

The findings reveal that due diligence activities are significantly faster when target firms are particularly CE-oriented. This result highlights the growing recognition of CE practices as a signal of operational effectiveness and strategic alignment, which reduces information asymmetry and transaction uncertainty (Cho et al., 2013; Gomes, 2019; Wangerin, 2019). To further understand the dynamics associated with this relationship, the paper draws on a key additional analysis. That is, this relationship is found to have strengthened over time, reflecting a positive trend in investors' understanding of sustainability-oriented practices.

This paper makes several contributions to the M&A and CE literature. First, it extends previous research on corporate social responsibility (CSR) and ESG practices by demonstrating the unique impact of targets' circular orientation on M&A processes, thus helping to bridge the gap between sustainability research and corporate finance (Gomes & Marsat, 2018; Alkaraan, 2022; Rennings et al., 2023). Second, the study enriches the literature supporting the idea that sustainability practices, specifically those related to CE approaches, can help to reduce information asymmetries during M&A transactions (Cho et al., 2013; Hussaini et al., 2021, 2023; Kayser & Zülch, 2024). Third, the study highlights the dynamic nature of investor preferences, confirming existing evidence that market participants increasingly value sustainable practices as part of their strategic considerations (Caiazza et al., 2021; Alkaraan, 2022). Finally, this study provides important practical implications for managers, investors and M&A experts, emphasizing the importance of integrating CE principles into business strategies to attract investment and enhance transaction efficiency.

The remainder of the paper is structured as follows. Section 2 briefly reviews the literature and develops the hypothesis. Section 3 describes the research design employed in the study. Section 4 discusses the results, while Section 5 provides additional and robustness tests, respectively. Finally, Section 6 concludes and discusses the implications of the study.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

The growing emphasis on sustainability in corporate strategies has brought increased attention to its role in the M&A. Sustainability-related practices, such as those included in the ESG frameworks, are now recognized as an integral part of decision-making in M&A transactions (Cardillo & Harasheh, 2023; Kayser & Zülch, 2024). In particular, acquirers are progressively considering the sustainability profiles of target firms, which can influence financial outcomes, market perception, and post-deal integration (Tampakoudis & Anagnostopoulou, 2020). However, while the broader sustainability agenda has gained traction in the M&A literature, less attention has been devoted to the role of CE practices, which operationalize sustainability principles through closed-loop systems that emphasize resource efficiency, waste reduction, and product lifecycle optimization (Kirchherr et al., 2017; Geissdoerfer et al., 2017).

The approaches oriented to CE have emerged as a key innovation in sustainability, moving beyond abstract commitments to concrete practices that align economic growth with environmental stewardship (Lewandowski, 2016). In the context of M&A, CE-oriented targets offer acquirers access to innovative practices, technologies, and capabilities that can enhance their competitive advantage while responding to stakeholder demands for sustainability (Chiaudano & Shakil, 2024; Wang et al., 2022). These attributes make CE a valuable strategic consideration during the due diligence process, where acquirers assess the compatibility, risks, and potential synergies of a target firm. Despite its relevance, the specific role of CE in shaping due diligence dynamics remains understudied. Although research suggests that ESG-oriented practices can mitigate information asymmetries during M&A (Cho et al., 2013; Gomes &

Marsat, 2018), no study has systematically examined how CE integrating sustainability into operational processes impacts the effectiveness and efficiency of due diligence activities.

Due diligence is a critical phase of M&A, during which acquirers evaluate the financial, operational, and strategic fit of the target (Dikova et al., 2010; Wangerin, 2019). This process often requires significant time and resources to address information asymmetries, especially when targets operate in less transparent sectors or follow unconventional business practices (Healy & Palepu, 2001; Capron & Shen, 2007; Nwogugu, 2007). When information asymmetries are high, as Thompson and Kim (2020) have shown, due diligence tends to be more time-consuming as acquirers need to invest additional resources in verifying the accuracy and reliability of the target's information. Similarly, Wangerin (2019) highlights that comprehensive due diligence allows acquirers to identify potential risks, such as adverse events, that can prolong the duration of pre-deal assessments. These findings highlight the central role of reducing information asymmetries in accelerating the due diligence process. In this regard, CSR and sustainability practices, including those embedded in CE models, can provide acquirers with clearer signals of operational efficiency and strategic alignment, thereby reducing uncertainty and facilitating faster decision-making (Cho et al., 2013; Kayser & Zülch, 2024). For instance, CE initiatives such as advanced recycling systems, waste minimization strategies, and closed-loop supply chains, offer more tangible and concrete evidence of a target's commitment to sustainability and its potential for creating long-term value (Ghisellini et al., 2016; Esken et al., 2018). Indeed, companies that operate within a CE framework often have well-documented processes, measurable sustainability outcomes, and standardized reporting systems that also align with stakeholder expectations (Ritzén & Sandström, 2017; Alkaraan, 2022; Teti et al., 2022). These attributes not only reduce the uncertainty linked to operational practices but also provide acquirers with reliable metrics for evaluating potential synergies and risks, as highlighted by Veleva and Bodkin (2018) and Nußholz (2017). In addition, such characteristics mitigate the risks associated with information gaps, enabling acquirers to evaluate the target's operations more efficiently (Ritzén & Sandström, 2017; Alkaraan, 2022). Moreover, CE models reflect a level of operational maturity and strategic foresight that resonates with acquirers seeking to minimize integration challenges and maximize post-deal synergies (Lewandowski, 2016; Chiaudano & Shakil, 2024). Furthermore, research has shown that innovative and structured

business models serve as key determinants of deal attractiveness, influencing both valuation and integration strategies (Nußholz, 2017; Veleva & Bodkin, 2018; Rennings et al., 2023). In this regard, targets with robust and sustainable business models are perceived as lower-risk investments, as their practices are often more predictable and easier to integrate into the acquirer's existing operations (Wangerin, 2019; Rennings et al., 2023). Moreover, CE-oriented firms typically exhibit enhanced governance and operational structures, that are aligned with the broader goals of corporate sustainability strategies. These attributes resonate with findings by Ritzén and Sandström (2017), who argue that well-documented sustainability practices contribute to improved stakeholder engagement and overall operational efficiency. By extension, in M&A contests, this alignment would allow acquirers to expedite the evaluation of potential synergies and risks, thereby creating a smoother pathway to deal completion. In turn, embracing a CE approach can provide a clear operational framework that can enhance the credibility of divested companies, thereby reducing the time and complexity associated with due diligence activities.

Based on these considerations, it is reasonable to argue that acquirers may conduct due diligence more effectively when dealing with circular targets, since the efficient and robust nature of CE practices may mitigate information asymmetries and facilitate a smoother evaluation process. This leads to the following hypothesis:

H1: Ceteris paribus, due diligence is performed faster when the acquirer deals with more CE-oriented targets.

3. RESEARCH METHODOLOGY

3.1. Sample selection

The sample analysed in this study consists of M&A transactions structured as acquisitions involving non-financial companies located in the member states of the European Union (EU-27). These transactions, completed between 2012 and 2023, were identified using the Orbis M&A (Bureau Van Dijk) database. As shown in Table 1, which provides a comprehensive overview of the sampling process, transactions with a deal value below €1 million, transactions with missing information on the deal characteristics, and transactions involving companies for which financial data were not available on Orbis (Bureau Van Dijk) database were excluded. Following these exclusions, the final sample used for the analyses comprised 3,159 M&A deals.

Table 1. Sample selection

Transactions configured as acquisitions involving non-financial companies located in the European Union [EU-27], completed between 2012 and 2023 (Orbis M&A database)	8,415
Less:	
Deals with a deal value of less than €1 million	1,047
Operations without deal characteristics information	1,485
Transactions involving companies without a BvD ID number	881
Transactions involving companies with no corresponding available financial information from the Orbis database (Bureau Van Dijk)	1,843
Final sample	**3,159**

Tables 2a and 2b present the sample composition, detailing the distribution of M&A deals by announcement year and target industry. While

the transactions are generally evenly distributed across the analyzed years, the number of deals at the tails of the distribution (i.e., in 2010 and 2020)

is relatively lower. This pattern is consistent with the effects of the 2008–2009 financial crisis and the recent COVID-19 pandemic, which slowed down the M&A market activity (Magnanelli et al., 2022; Kyriazopoulos, 2024). The industry composition shows a relatively homogeneous distribution of transactions. However, the most represented sector

is wholesale and retail trade (17.80%), followed by manufacturing (17.07%) and business equipment (10.71%). Overall, this would be relevant for empirical analyses, given that these sectors offer substantial opportunities for innovation, including initiatives aimed at moving towards CE models (Mhatre et al., 2021).

Table 2a. Sample composition by year of deal announcement

Year	Frequencies	% events
2012	215	6.81%
2013	365	11.55%
2014	250	7.91%
2015	214	6.77%
2016	286	9.05%
2017	312	9.88%
2018	258	8.17%
2019	381	12.06%
2020	92	2.91%
2021	101	3.20%
2022	316	10.00%
2023	369	11.68%
Total	3,159	100.00%

Table 2b. Sample composition by targets' industry

Industry	Frequencies	% events
Consumer non-durables	117	4.07%
Consumer durables	343	11.92%
Manufacturing	491	17.07%
Energy, oil, and gas	91	3.16%
Chemicals	101	3.51%
Business equipment	477	16.58%
Communications	201	6.99%
Utilities	301	10.46%
Wholesale, retail, shops	512	17.80%
Healthcare	211	7.33%
Other	314	10.91%
Total	3,159	100.00%

3.2. Empirical model

To test the hypothesis that the circular nature of the target firm leads to a shorter due diligence period, the empirical model used an ordinary least squares (OLS) econometric regression model, which is widely used in quantitative studies of M&A transactions (Marquardt & Zur, 2015). The regression was constructed based on the following equation:

$$DUE\_DILIGENCE = \beta_0 + \beta_1 CE\_TARGET + \beta_2 DEAL\_VALUE + \beta_3 INTRA + \beta_4 LITIG + \beta_5 CASH + \beta_6 MULTIBID + \beta_7 AC\_SIZE_{t-1} + \beta_8 TARGET\_SIZE_{t-1} + \beta_9 TARGET\_LEVERAGE_{t-1} + \varepsilon_{i,t} \quad (1)$$

The dependent variable *DUE_DILIGENCE* is the natural log of the number of days between the announcement and completion dates (Dikova et al., 2010; Marquardt & Zur, 2015; Cardillo & Harasheh, 2023). As explained by Wangerin (2019), this range of time is likely to opportunely capture the effort made by acquirers to understand the target firm's value, corporate business models, and cultural arrangements during due diligence activities.

The key independent variable of interest is *CE_TARGET*, a dichotomous variable that takes the value of 1 if the target firm employs a "circular" approach based on information extracted from the deal, and 0 otherwise. Specifically, the *Deal Overview*, *Deal Rationale,* and *Deal Comments* sections of Orbis M&A were consulted. These sections provide key information about M&A agreements. In particular, the *Deal Overview* offers a broader description of the target company, highlighting its core business, business model, technologies, and corporate mission. In addition, the *Deal Rationale* section includes statements from managers or corporate representatives explaining the strategic motivations behind the transaction, often related to growth or innovation objectives. Lastly, *Deal Comments*, prepared by market analysts and aggregated from multiple data providers (e.g., Bureau Van Dijk), summarize the details of the agreement, such as the date, acquired stake, and descriptions of the parties involved.

A target was classified as circular oriented (i.e., *CE_TARGET* = 1) if the analysis[25] of these sections

clearly revealed that the transaction either involved a selling company operating under a CE-inspired business model or, alternatively, that the deal was explicitly aimed to achieve CE objectives.

Overall, β_1 is expected to be negative, meaning that when acquirers deal with more circular targets, they employ less effort (i.e., less time is required to complete the deal) to perform due diligence activities.

The control variables, detailed in Table 3, are derived from prior research exploring the deal, acquirer and target characteristics influencing M&A due diligence (Skaife & Wangerin, 2013; Amel-Zadeh & Zhang, 2015; Marquardt & Zur, 2015). Longer negotiation periods are expected for deals with higher values (*DEAL_VALUE*), transactions involving targets in industries with high litigation risks (*LITIG*), cash-only payment methods (*CASH*), or the presence of multiple bidders (*MULTIBID*). Conversely, shorter negotiations are expected for intra-industry transactions (*INTRA*). For other independent variables, no specific predictions are made due to mixed findings in the literature (Wangerin, 2019). Lastly, since macroeconomic phenomena could influence empirical analyses (Perafán-Peñá et al., 2022), the regressions incorporate fixed effects (FE) for year and targets' industry upon model specifications.

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[25] A keyword search was conducted within these sections in order to interpret their content. Specifically, the following keywords were searched: "circular

economy", "circularity", "circular", "recycling", "reuse", "waste minimization" and "waste". It should be noticed that the keywords search were used solely to identify potential deals involving circular targets. However, the final classification as a CE-based target was determined only after a detailed analysis of the content within the relevant sections.

Table 3. Variables description

Variables	Description	Source
Dependent variable		
DUE_DILIGENCE	The natural logarithm of the number of days between the M&A announcement date in year *t* and the completion date.	Orbis M&A (Bureau Van Dijk)
Independent variable		
CE_TARGET	A dichotomous variable that takes on the value of 1 if the transaction is classified as "circular" based on the information contained in the *Deal Comments*, *Deal Rationale* and *Deal Overview*, and 0 otherwise.	Orbis M&A (Bureau Van Dijk)
Control variables		
DEAL_VALUE	The natural logarithm of the value of the M&A transactions, in millions of euros.	Orbis M&A (Bureau Van Dijk)
INTRA	A dichotomous variable that takes value 1 if acquirer and target SIC codes are the same, 0 otherwise.	
LITIG	A dichotomous variable that takes the value 1 if the target firm is a member of an industry with high litigation risk as measured by Marquardt and Zur (2015), and 0 otherwise.	
CASH	A dichotomous variable that takes the value of 1 for transactions in which the only consideration offered is cash, 0 otherwise.	
MULTIBID	Dichotomous variable that takes the value of 1 if more than one bidder is involved in the deal process, and 0 otherwise.	
ACQ_SIZE	The natural logarithm of the acquirer's total assets in year *t - 1*.	Orbis (Bureau Van Dijk)
TARGET_SIZE	The natural logarithm of the target's total assets in year *t - 1*.	
TARGET_LEVERAGE	Target's ratio between total debt and total assets in year *t - 1*.	

4. RESULTS

4.1. Descriptive statistics

The correlation between the variables used in the study was verified. Specifically, Pearson correlation was calculated for two continuous variables, point-biserial correlation for a continuous variable and a dichotomous variable, and Chi-square coefficient for two dichotomous variables. Although significant correlations (at least at the 5% level) were found between some variables, variance inflation factors (VIFs) were also calculated. However, with all VIF values below 10, the results confirmed that multicollinearity was not a concern in the empirical analyses.

Table 4 presents the descriptive statistics of the study variables. For clarity, the descriptive data of *DUE_DILIGENCE* in days have also been tabulated. On average, transactional due diligence lasts around 226 days. The median of 93 days fits well with previous studies that show between three to four months as the usual time employed for due diligence activities after the deal is announced (Marquardt & Zur, 2015; Wangerin, 2019, Cardillo & Harasheh, 2023). Regarding the independent variable of interest, the mean value of *CE_TARGET* indicates that 14% of the deals included in the sample involve a target firm based in CE. Around 33% of deals are in the same industry, while auction-structured M&A deals (i.e., involving more than one bidder) are relatively few (about 6%). Also, as expected, in general, the buyers display a greater dimension than their targeted firms, while these latter generally exploit a high degree of leverage.

Table 4. Variables description

Variables	Observations	Mean	Median	SD	Minimum	Maximum
Dependent variable						
DUE_DILIGENCE	3,159	4.65	4.53	1.35	0.00	6.74
DUE_DILIGENCE (days)	3,159	226.49	93.00	240.72	1.00	831.00
Independent variable						
CE_TARGET	3,159	0.14	0.00	0.35	0.00	1.00
Deal characteristics						
DEAL_VALUE	3,159	3.78	3.75	1.88	0.00	7.80
INTRA	3,159	0.33	0.00	0.46	0.00	1.00
LITIG	3,159	0.08	0.00	0.27	0.00	1.00
CASH	3,159	0.26	0.00	0.44	0.00	1.00
MULTIBID	3,159	0.07	0.00	0.25	0.00	1.00
Acquiror characteristics						
ACQ_SIZE	3,159	13.75	13.90	3.11	2.85	18.24
Target characteristics						
TARGET_SIZE	3,159	10.76	10.74	1.87	6.06	14.73
TARGET_LEVERAGE	3,159	0.61	0.64	0.24	0.06	0.97

Note: All continuous variables are winsorized at 1% and 99%. Variables definitions are provided in Table 3.

4.2. Main analysis

Table 5 provides the results of the estimated OLS regressions related to Eq. (1). The findings indicate that the circular nature of target companies affects the terms of the M&A deal. Specifically, they indicate that when buyers deal with more circular targets, the due diligence activities are performed faster. Model 1 presents the result of the univariate analysis. The coefficient on *CE_TARGET* is negative and statistically significant [(-0.12) and p-value < 0.05]. Notably, the results are also in the multivariate test,

even demanding more FEs structure. In Model 2 the coefficient on *CE_TARGET* is (-0.08) and p-value < 0.01, while in Model 3 the coefficient is (-0.06) and p-value < 0.01. Overall, these findings are also highly economically significant. Indeed, considering Model 3, due diligence performed on CE-based targets is 6% (= $e^{0.06 - 1}$) more efficient than due diligence conducted on non-CE targets, which is equal to a save (in terms of time-consuming resource) of 14 working days (= 226.49 * 6%), on average.

Overall, these results support the study's hypothesis *H1*, highlighting that target firms'

CE practices significantly reduce the duration of due diligence in M&A transactions. On the one hand, these results are consistent with previous literature (Gomes & Marsat, 2018; Cho et al., 2013; Kayser & Zülch, 2024), which emphasizes that sustainable behaviours help to mitigate information asymmetries, which is a common factor in protracted negotiations. On the other hand, they extend previous evidence suggesting that CE-based target engagement is likely to optimize the acquirer's evaluation process, as the observed improvement in due diligence performance highlights their role in enhancing trust and reducing complexity in deal evaluation.

Regarding the control variables, larger deal values (*DEAL_VALUE*) are found to increase the complexity of due diligence, which is consistent with the idea that acquirers expend more effort when there are higher financial stakes at stake (Wangerin, 2019). Moreover, a negative and significant relationship is observed for *INTRA*, indicating that deals within the same industry encounter fewer barriers to completion (Skaife & Wangerin, 2013). Consistent with Marquardt and Zur (2015), positive coefficients are identified for *CASH*, *MULTIBID*, and *TARGET_SIZE*, suggesting that these factors contribute to extended due diligence efforts. Finally, higher leverage levels are shown to slow deal closure, aligning with the findings of Luypaert and De Maeseneire (2015).

Table 5. Regression results

| Variables | Dependent variable: DUE_DILIGENCE | | |
	Model 1	Model 2	Model 3
CE_TARGET	-0.12** (-2.25)	-0.08*** (-2.86)	-0.06*** (-2.72)
DEAL VALUE		0.10*** (4.15)	0.12*** (4.21)
INTRA		-0.04** (-2.01)	-0.03** (-2.00)
LITIG		0.17 (1.14)	0.11 (0.84)
CASH		0.04** (2.23)	0.03* (1.81)
MULTIBID		0.26* (1.84)	0.25* (1.84)
ACQ_SIZE		-0.03 (0.98)	-0.05 (1.24)
TARGET_SIZE		0.15*** (3.70)	0.15*** (3.60)
TARGET_LEVERAGE		0.09** (1.96)	0.11** (2.03)
Constant	4.63*** (87.70)	3.20*** (7.76)	4.20*** (5.86)
Year FE	No	No	Yes
Industry FE	No	No	Yes
Obs.	3,159	3,159	3,159
Adjusted R-squared	0.03	0.06	0.12
F-statistics	1.43**	3.15***	2.68***

*Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. T-statistics are in parentheses.*

5. ADDITIONAL AND ROBUSTNESS ANALYSES

5.1. Additional test

To further explore the dynamics of CE in M&A settings, an additional analysis is conducted. This test aims to provide a deeper insight into how the CE nature of target firms interacts with temporal and contextual factors in influencing due diligence efforts.

Specifically, I examine whether the relationship between CE-oriented targets and the due diligence effort evolves over time. The increasing focus on sustainability in recent years, driven by both regulatory pressures and shifting stakeholder expectations, has likely heightened the strategic relevance of CE practices in corporate transactions (Kirchherr et al., 2017; Hartley et al., 2024). This additional is conducted using an interaction model that relies on a time trend variable (*TIME*), keeping the statistical specifications of Eq. (1). *TIME* is a continuous variable coded as 1 for deals announced in 2012, sequentially incremented by 1 for each subsequent year in the sample until 12, for deal announced in 2023. It should be noticed that its use is different from the use of year FEs, since the former captures variability in a certain association across years (usually over time), rather than specifically to any year.

Table 6 displays the results of this analysis. The *TIME* variable alone is not significant at any conventional level, showing that the dynamics of deal timing are not driven by any time trends in general. However, the coefficient on interaction variable *CE_TARGET*TIME* is instead negative and significant [(-0.02) and p-value < 0.05]. This indicates that the negative relationship between due diligence effort and the degree of target circularity has become stronger over time. This result suggests that potential M&A investors may have accumulated more experience and a framework for effectively evaluating due diligence practices, which could amplify the observed reduction in due diligence efforts for CE targets. This is consistent with broader trends in sustainability adoption, where innovative practices become increasingly institutionalized and integrated into business strategies (Geissdoerfer et al., 2017; Cardillo & Harasheh, 2023; Rennings et al., 2023).

Table 6. Additional test: Time trend analysis

Variables	Model 1
Dependent variable: DUE_DILIGENCE	
CE_TARGET	-0.07** (-2.80)
TIME	-0.01 (0.49)
*CE_TARGET * TIME*	-0.02** (2.31)
Constant	3.32*** (7.00)
Control variables	Included
Year FE	No
Industry FE	No
Obs.	3,159
Adjusted R-squared	0.07
F-statistics	3.15***

*Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels (two-tailed), respectively. T-statistics are in parentheses.*

5.2. Robustness tests

To enhance the robustness of the main empirical analysis, further robustness checks were conducted.

First, FEs for the target firm's country of origin were considered as an alternative to year and industry

FEs. This adjustment reflects the understanding that M&A transactions are often influenced by macroeconomic factors explained by cross-country differences (Caiazza et al., 2021).

Second, with respect to the measurement of the main independent variable of interest (*CE_TARGET*), a deal was classified as "circular" based solely on the information contained in the target description of the *Deal Overview* section, as this section was deemed the most representative in capturing the circular nature of target firms beyond the strategic motivations of the deal.

Finally, an alternative proxy for due diligence was employed, measuring deal timing as the period between the first rumour date and the completion date. Unlike the dependent variable used in the main analysis, this measure captures due diligence activities occurring between the confidential agreement date and the announcement date. Following Alperovych et al. (2021), the confidential agreement date was used as a proxy for the deal rumour date reported by Orbis M&A. Despite the rumoured date is not a perfect substitute for the confidential agreement date, prior studies agree that it may serve as an indicator of the lack of information created by intermediaries involved in negotiating the confidential agreement (Boone & Mulherin, 2007; Alperovych et al., 2021).

Overall, the results of these robustness checks, which are not displayed in the tables for simplicity, qualitatively support the empirical results presented in Table 5, further confirming the role of targets' CE orientation in driving more efficient due diligence processes.

6. CONCLUSION

This study provides new insights into the relationship between target firms' CE orientation and the effectiveness of due diligence activities in M&A. The main findings show that transactions involving CE-oriented targets are associated with significantly faster due diligence processes. This result underscores the growing relevance of CE practices in reducing informational asymmetries and enhancing transaction efficiency. Additional analyses reveal that this association has strengthened over time and is particularly pronounced in intra-industry deals, where sector-specific knowledge facilitates the assessment of CE practices. This study makes several contributions to the existing literature. Indeed, while prior studies have explored the influence of CSR on M&A outcomes (Gomes & Marsat, 2018; Tampakoudis et al., 2021; Vastola & Russo, 2021; Teti et al., 2022; Cardillo & Harasheh, 2023), this study focuses specifically on CE practices as a tangible operationalization of sustainability principles, bridging the gap between sustainability research and M&A dynamics. Second, it provides empirical evidence on how temporal and contextual factors, such as time trends dynamics, shape the impact of CE practices in corporate transactions. Overall, the work enriches the growing body of evidence suggesting that sustainability-oriented business models and practices are increasingly valued and understood in the market for corporate control.

The findings have significant implications for managers, investors, and policymakers. For managers of target firms, adopting CE practices can enhance and make their companies more attractive to potential acquirers. For potential investors in the M&A market, these results suggest that the CE orientation of target firms can serve as a reliable signal of operational efficiency and risk mitigation. The study thus hints at the idea that investing in CE-oriented targets may not only yield financial benefits in terms of time-saving resources but also align with broader sustainability goals, which are increasingly prioritized by stakeholders. In an intra-industry context, the work suggests that investors can leverage their sectoral expertise to further capitalize on the strategic advantages offered by CE-oriented targets.

For policymakers, this study underscores the value of promoting CE adoption through incentives and regulations. Policies that encourage transparency and sustainability reporting can amplify the benefits of CE practices in M&A by reducing transaction inefficiencies and fostering sustainable economic growth. By incentivizing CE adoption, policymakers can facilitate a broader shift toward sustainable business practices, contributing to long-term environmental and economic resilience. This issue is particularly relevant in the current European context, as the Corporate Sustainability Reporting Directive (CSRD; https://shorturl.at/En4od) introduced by the European Union significantly expands mandatory ESG disclosure requirements to include smaller companies. This shift is poised to profoundly impact M&A processes, as acquirers will have access to a broader range of sustainability-related information, influencing target selection. In this context, the adoption of CE practices by target firms becomes even more critical, as enhanced transparency and sustainability reporting will likely increase the attractiveness of CE-oriented companies to potential acquirers. It is worth noticing that the findings from time trend analysis reveal that potential investors are currently anticipating these information environment switches, given that they are able to understand better the targets' CE practices during the due diligence activities.

Despite its contributions, this study has certain limitations that require consideration. First, the sample is restricted to European M&A transactions, which may limit the generalizability of the findings to other regions with different regulatory and cultural contexts. Second, the classification of CE-oriented targets relies on qualitative information from databases, which, while robust, may introduce a certain degree of subjectivity into the analyses. Third, while the study focuses on the duration of due diligence as a proxy for effort, other dimensions of due diligence quality and depth remain unexplored.

Future research could address these limitations by exploring the impact of CE practices in M&A transactions in non-European contexts, where regulatory and cultural differences may yield new insights. Additionally, longitudinal studies examining the post-acquisition integration of CE-oriented targets could provide a more comprehensive understanding of their long-term value creation. Further investigations could also consider the interaction between CE practices and other deal characteristics, such as payment methods or target ownership structures, to uncover additional dynamics influencing M&A processes. Finally, qualitative studies involving interviews with M&A professionals could offer deeper insights into the practical challenges and opportunities associated with integrating CE practices into corporate transactions.

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