**Institutional quality and firms’ recycling performance**

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**Abstract:**

The institutional environment can play a crucial part in the adoption of recycling practices by firms. Drawing on a sample of 1096 nonfinancial listed firms operating in 40 countries over the period 2012-2024, our study investigates the effects of institutional stability (political stability and confidence in the rule of law) and institutional conduciveness (free and fair corporate governance, a liberal market and an effective administrative infrastructure) on corporate recycling performance. Estimates reveal that listed firms tend to recycle a larger proportion of their waste in countries with a high level of political accountability that are also politically more stable. In such countries, the voting power of citizens can put pressure on politicians to monitor more effectively the waste management of large listed firms. Therefore, political actors can have a major role in increasing a firm’s level of recycled waste by providing a more predictable political agenda and by monitoring more effectively the ecological impact of firms.

**Keywords:** Institutions; Firm; Recycled waste; Circular Economy; Climate Change

**JEL codes:** Q54; G33

**1. Introduction**

The urgency of a transition to a net-zero and climate-resilient economy has never been more pronounced (Goworek et *al*. 2018; Agrawal et *al*., 2021). The awareness about this urgency has risen at an exponential rate across the world. For instance, the World Bank released its first report on circular economy (CE) in 2022 pointing out that the current business approach of “take-make-waste” is unsustainable because the virgin resources extracted between 2000 and 2015 represent more than half of the resources that were extracted in the last century (World Bank, 2022). According to the United Nations Environment Programme, circular economy solutions can enhance profitability and generate value not only for companies but also for their stakeholders and the financial sector, potentially unlocking up to USD 4.5 trillion in economic growth (UNEP, 2023). Additionally, the World Economic Forum (2025) reports that 65% of firms expect greater resilience through reduced dependence on scarce raw materials, extended product lifecycles, and simplified supply chains. Moreover, CE initiatives encourage the development of durable, repairable, and recyclable products. For example, the number of goods and services certified by the European Ecolabel rose from over 21,000 in 2010 to more than 83,500 in 2021, as reported by the European Environment Agency (EEA, 2023). A solution to overcome this global issue resides in initiatives that can encourage firms to embrace circular models that can permit the conservation of resources, the reduction of the carbon footprint, the creation of new jobs, and the maintenance of critical materials supply (European Investment Bank, 2023). In this regard, Ghisellini et *al*. (2016) argue that CE aims to improve resource use efficiency by promoting the implementation of closing-the-loop production patterns that can reestablish the balance between the economic system, ecological system, and society. As pointed out by Arranz, Sena & Kwong (2022a), the growing importance of CE models is evident in the increasing emphasis placed on their implementation within firms and organizations. This trend is widely recognized and supported by various institutions, policymakers, and public administrations, as highlighted in the works of Katz-Gerro and López Sintas (2019) and Millar et *al*. (2019).

Even if the CE has been identified as a reliable alternative to the current linear economic model, it is still an ambiguous paradigm in the field of sustainability (Geissdoerfer *et* *al*., 2017), in that multiple definitions and approaches have been suggested (Kirchherr *et* *al*., 2017). It has been described as an ‘umbrella concept’ (Blomsma and Brennan, 2017). Nevertheless, among the 114 definitions of CE (Kirchherr et al., 2017), two broad perspectives can be identified. First, the CE is necessarily technical or technologically oriented, as it involves inter-sectoral material and energy flows and regenerative technologies. This focus is consistent with the definition of CE provided by Geissdoerfer *et* *al*. (2017): “the CE is a regenerative system in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing material and energy loops. This can be achieved through long-lasting design, maintenance, repair, reuse, remanufacturing, refurbishing, and recycling”. This definition is essentially operational and technical. It emphasizes the different operations that are linked to a production process. Second, scholars have started to conceptualize the CE as a multi-actor concept (de Jesus and Mendonça, 2018), with economic and social actors at the core of the CE (Geissdoerfer *et* *al*., 2017). Here, a CE system is seen as gathering a variety of actors with diverse interests, preferences, and visions, in different geographical and economic spaces. These actors, as producers, consumers and social groups, have to join each other in a process of cooperation to achieve a CE (Gupta *et al*., 2019). In this regard, the CE not only involves a mapping of the circulation of material resources and energy, but should also be seen as a societal system, in which social agents are at the core, and mutual support and coordination between different stakeholders along the entire supply chain are highly important (Millar *et al*., 2019). Therefore, the transition from a linear to a circular economy implies that firms require new capabilities, i.e., new knowledge and skills to coordinate and deploy resources efficiently, by promoting a balance between economic, ecological, and social objectives. This requires new inter-organizational management, stakeholder cooperation and appropriate institutional frameworks (Korhonen *et al*., 2018; Vernier *et al*., 2022). Indeed, some studies argue that the institutional framework can pave the way for the transition to the CE. For example, Dai *et al*. (2015) and Dubey *et al.* (2016) suggested that the success of CE initiatives is closely influenced by institutional aspects such as norms and cultural factors. Fei *et al*. (2016) and Levänen (2015) state that the transition to more sustainable choices and the adoption of CE principles involve societal support, legislation, and financial subsidies. Ghisellini *et al.* (2016) and Murray *et al*. (2017) demonstrate that the legal framework, infrastructure development, tax incentives, and public education are all promoters of the CE. In the same vein, according to de Abreu and Ceglia (2018) and De Jesus *et al*. (2018), governments play a key role in promoting an environment that is conducive to CE development and in building institutional capacity that increases the knowledge and relational resources necessary for the CE. However, although research has shown that institutional factors are crucial determinants of the transition to the CE, there are several shortcomings in the literature. First, until now, the analysis of the institutional factors has been largely qualitative, and there is still a need for large, empirical quantitative studies. Second, De Jesus *et al*. (2018) and Arranz et al. (2022) call for more academic research to examine how institutional factors operate, because little is known about how these pressures arise and act to drive firms towards the adoption of practices based on the principles of the CE. Only a few researchers, such as Ranta *et al*. (2018), Arranz *et al*. 2022, and Calzolari *et al*. (2023), have applied institutional theory to the institutional pressures for firms’ adoption of CE practices. While these studies offer valuable insights, they have explored particular country cases and focused on a narrow set of institutional factors (regulation and norms). Third, a significant issue that remains unexplored in the literature is the influence of institutional development on firms’ adoption of CE practices. It is crucial to examine the quality of a country's economic, political, and social institutions (Hermelo and Vassolo, 2010) and how effectively they can establish an environment conducive to CE practices. This involves analyzing the extent to which institutional stability and what we term institutional conduciveness (a fair and favourable market and regulatory framework) promote the adoption of CE practices. Those two dimensions represent an important determinant for the transition to CE, as that transition implies a radical change in organizational structures, business models, operating systems, and procedures. Institutional stability is crucial in mitigating the uncertainty that surrounds CE activities by conferring a consistent and predictable business environment; institutional conduciveness is expected to be a key driver for the CE as it implies a transparent business environment and fair rules, improving the competition conditions for all firms.

The objective of our paper is to fill these gaps by going beyond the regulation pressures and considering a larger institutional framework to analyze how institutional quality, which encompasses both institutional stability and conduciveness factors, shapes the opportunities and barriers to implementing CE practices. We hypothesize that those dimensions represent an important determinant for the transition to CE, as it implies a radical change in organizational structures, business models, operating systems, and procedures. Indeed, institutional stability is crucial in mitigating the uncertainty that surrounds CE activities by providing a consistent and predictable foundation for the institutional environment. Also, institutional conduciveness, rooted in a free and fair institutional framework and supported by the quality of administrative infrastructure, plays a key role in advancing the circular economy. It contributes to creating a transparent environment and ensures fair rules, thereby improving competitive conditions for all businesses. In this perspective, we use the *World Governance Indicators* database of the *World Bank* and the fifteenth edition of the Legatum Prosperity Index, which offers annual time-variant measures of the institutional stability captured by the political stability and the confidence in the rule of law. Meanwhile, institutional conduciveness is assessed through factors such as free and fair corporate governance, a liberal market, and an effective administrative infrastructure.

As recycling plays a fundamental role in CE frameworks by promoting material recovery, minimizing waste, and lowering the demand for primary resources (Sarja et al., 2021), our study explores this concept by examining the impact of these institutional variables on recycled waste levels of 1096 firms listed in 40 countries, spanning the period from 2012 to 2024. Our empirical analysis based on static and dynamic panel approaches will benefit from the strong heterogeneity that exists among the listed firms in terms of recycled waste as a percentage of a firm’s total waste (a), the level of recycled water (b) and the amount of recycled paper (c). Therefore, the contribution of this paper is multifold. First, this paper emphasizes the intricate interplay between firms and their institutional environment. It provides a fresh lens to understand the barriers and enablers in the path toward a circular economy, enriching the ongoing discourse on environmental sustainability and firm capabilities. Furthermore, our research lays a foundational framework for policymakers, assisting them in devising informed policies and strategies to overcome obstacles in implementing CE initiatives and ensuring their successful execution.

Our study is organized as follows. Section 2 will discuss the relationship between institutions and CE capabilities highlighting our hypotheses. The data set and the variables will be statistically described in Section 3 while the empirical analysis and the robustness checks will be performed in Section 4. The last section concludes.

**2. Institutions and circular economy practices**

In their literature review, De Jesus and Mendonça (2018) identified two types of factors that could affect the performance of CE practices, namely the hard factors and soft factors. Hard drivers and barriers include technical factors, as the availability of technical solutions is crucial for the transition to the CE because it implies a new mode of production and new business templates. It also includes economic, financial, and market factors. For example, the transition to the CE can be deterred by high costs and market uncertainty related to new investments. Factors linked to the economic context, such as resource consumption, imperfect information, and price volatility, can promote or hinder the development of the CE.

On the other hand, De Jesus and Mandonça (2018) identify soft factors such as institutional, social, and cultural dimensions. For example, studies highlighted that cultural acceptance of the CE is considered to be increasing slowly, resulting in the slow diffusion of CE models. The mindset of CE as an emerging and desirable business is still limited in different regions in the world (Ranta et al., 2018). Also, a few studies started to question the role of the institutional framework in adopting CE practices. Ghisellini et *al*. (2016) and Murray et *al*. (2017) stress that the legal framework, infrastructure development, tax incentives, and public education are all promoters of the CE. For de Abreu and Ceglia (2018), the government plays a key role in promoting an environment that is conducive to CE development and in building institutional capacity that increases the knowledge and relational resources necessary for the CE. Flynn & Hacking (2019) suggest that public policy and private agent strategy can help to locate inflexible institutions and systems in order to undertake the gradual reconfiguration from linear to circular. The studies of Korhonen et *al*. (2018) and Vernier et al. (2022) consider that CE requires a new reconfiguration of inter-organizational management and appropriate institutional frameworks.

Theoretically, it has long been recognized in the environmental literature that, without institutional pressure, individuals and firms in a free market cannot address environmental challenges, due to market failure (Pigou, 1951; Randall et al., 1983); Jaffe, Newell & Stavins, 2005). In this regard, a recent research stream has used institutional theory to investigate the adoption of environmental activities. Institutional theory, which emerged in the early 1980s, represents a complex and large theory used in social science to explain the influence of institutions on political organization (March & Olsen, 1996; North, 1990; Miranda & Kim, 2006), as well as social, economic, and management organization (Meyer & Rowan, 1977; DiMaggio & Powell, 1983; Zucker, 1987). This theory (North, 1991; Metcalfe, 2001) argues that institutions, which are the ‘‘humanly devised constraints that structure political, economic and social interaction’’ (North, 1991 p.87), establish the “rule of games” for social and economic life and exert their influence through coercive, normative, and mimetic mechanisms (DiMaggio and Powell, 1983). Firms are embedded in their institutional contexts and dependent on the institutionalized framework applied locally. In particular, Scott (2008) highlights that three interconnected pillars, regulative, normative, and cultural-cognitive, influence how firms and individuals behave.

In this framework, some scholars investigate the influence of institutional factors on different sustainable practices. In sustainable innovation and technical change, Coenen and López (2010) analyze the effect of the three-pillar framework of regulatory, normative, and cultural cognitive institutions on sectoral systems of innovation (SSI), technological innovation systems (TIS), and socio-technical systems (STS) as approaches to innovation and technological change for sustainable and competitive economies. They show that institutions serve as guiding innovators. In the same way, Berrone et al. (2013) highlight that greater regulatory and normative pressures positively affect the propensity of the firm to engage in eco-innovation in the U.S. (United States). Pajunen *et* al. (2013) studied the institutional barriers in the development of innovative residue-based products in Finland. Other studies applied institutional theory to examine climate change strategies. For example, Delmas and Montes‐Sancho (2010) analyze different countries to explore the effect of institutional pressures on early or late participation in climate change programs of businesses. Shinkle & Spencer (2012) and Hahn et al. (2015) investigate voluntary corporate disclosures of climate change-related information and highlight that corporate disclosures are affected by institutional pressures. Similarly, Daddi *et al.* (2016) studied the effects of coercive, normative, and mimetic pressures on the climate change mitigation and adaptation strategies of 487 Italian firms. Moreover, studies emphasize the effect of institutional pressure on the environmental management system (Phan & Baird, 2015; Abreu et al. 2012) or environmental management accounting (Wang, et al., 2019; Alnaim & Metwally, 2024).

Regarding CE practices, only very few studies started to question the institutional theory to understand how institutional pressures act and arise to drive the changes in firms toward CE practices. Ranta et al. (2018) used several case studies in China, the U.S., and Europe to analyse the different institutional drivers and barriers to CE implementation. Arranz et al. (2022) draw on institutional entrepreneurship theory, which defines institutional entrepreneurs as actors that both support divergent change and actively engage in its implementation. These actors use their resources to reshape existing institutional frameworks by introducing innovative ideas that drive transformation. They combine traditional regression methods with machine learning techniques, specifically Artificial Neural Networks, using data from the European Union’s Public Consultation on the Circular Economy. This mixed-method approach enables them to offer a comprehensive understanding of the phenomenon by examining how three types of institutional pressures (coercive, normative, and mimetic) and their interactions influence the development of circular economy initiatives. Along the same line, Calzorali et al. (2023) provide new insights into the role of coercive, normative, and mimetic pressure in shaping the implementation of circular supply chains. Using Delphi like approach and 30 expert interviews they highlight that institutional pressure based on coercive market and regulatory pressures have a higher effect than the normative and mimetic pressures. Recently, Dagiliene et al 2024, examined the institutional logic of the transition to CE in manufacturing firms based on qualitative data.

Moreover, as stressed by scholars (Ranta et al. 2018, Jain et al 2020), institutional pressures alone is insufficient to enforce a systemic change. In this condition a significant issue remains unexplored: how institutional development influences firms CE capabilities. Indeed, beyond the regulatory and normative pressures, institutional conditions (which vary greatly across countries) influence the capacity of firms to minimize climate risks, facilitate low-carbon transitions and mobilize private finance for sustainable development. Weak institutions may exacerbate vulnerabilities or slow necessary economic transformations. In this context, institutional development, which encompasses the strength and effectiveness of governance structures, plays a key role in incentivizing firms to adopt CE. Therefore, this paper investigates whether an advanced level of development of a country's economic, political, and social institutions (Hermelo and Vassolo, 2010) provides a more conducive environment for recycling practices. Such activities play a fundamental role in CE frameworks by promoting material recovery, minimizing waste, and lowering the demand for primary resources.

In this perspective, we examine the role of the two crucial and interrelated guiding principles of institutional development which are stability and conduciveness (Chan et *al*., 2008; Hermelo and Vassolo, 2010). Institutional stability refers to the consistent and predictable foundation provided by the institutions (Chan et *al*., 2008). As stressed by public management, business environment, and political economy literature, institutional stability is essentially influenced by political stability (Herrera et al., 2020; Kauffaman and Laffare, 2021). In fact, political stability, which implies stable government and regulation, creates a legitimacy of institutions and a predictable and trustworthy environment. This allows firms to maintain continuity in their objectives and operate and plan with confidence. We assume that this factor is crucial because it mitigates the uncertainty that surrounds recycling activities. Indeed, several studies (Dejesus et al 2018; Ghisellini et al 2018, Antonioli et al., 2022) have highlighted that the transition from linear to CE can be associated with a high level of initial and transition costs and uncertain returns on profits. In this context, a predictable and stable institutional framework enables firms to make long-term investments and allocate resources efficiently to integrate CE practices into their operations and business models. Moreover, CE is not simply a circular flow of materials and the use of raw materials and energy through multiple phases; it involves a collaborative system between actors in an entire ecosystem. This new system implies a room for social agents with their strategies, their visions, their conflicts, and the cooperation they establish through the networks they build (Geissdoerfer et al., 2017; Köhler et al., 2022). In this collaborative system, the objective is no longer to capture value for sole profit, but rather to share it to ensure the long-term economic, social, and environmental health of the territory and the sector (Boldrini and Antheaume, 2021). Hence, institutional stability is expected to strengthen the trust between stakeholders, incentivizing firms to strengthen their recycling capabilities. Therefore, we hypothesize that:

*H1: Institutional stability positively influences a firm’s recycling performance.*

Regarding institutional conduciveness, this principle stresses the importance of a fair and favourable institutional framework (Hoskisson et *al*., 2013). Several interconnected attributes are related to the conduciveness of the institutions. Teece (2007) and Hoskisson et *al*. (2013) highlight that the presence of effective infrastructure, the liberal market and free and fair corporate governance provide a conducive framework for deploying, manifesting, utilizing, and valuing new firms' capabilities. Therefore, all these attributes could also play a key driver in the CE practices of firms. For example, in a high-conducive institutional environment, a firm would be aware that non-compliance with laws and regulations related to CE such as waste management, recycling, repairing reusing could lead to severe financial penalties and damages to its reputation. Thus, a firm should have strong incentives to resolve the management waste tensions to avoid those punishments. Also, beyond the existence of regulations, free and fair governance is a crucial factor for institutional conduciveness. Free governance contributes to the emergence of a transparent environment and fair rules, improving the competition conditions for all businesses. This is conducive to a market in which companies compete to innovate towards sustainability (Sivak et al., 2011; Ziegler, 2015). As highlighted by several scholars, the innovative behaviours of firms represent the core principles for the successful adoption of CE practices (Lüdeke‐Freund et al., 2019; Vernier et al., 2022). CE represents a new sustainable paradigm (de Jesus et al., 2018) that requires fundamental transformations in production and consumption patterns; thus, a radical change in the way material and energy flows and interactions between companies are managed (Korhonen et al., 2018). In this regard, the nature of the system of economic governance had a direct impact on the innovative capabilities of firms. As observed by Boschma and Capone (2015), coordinated market economies tend to support more evolutionary change, while free liberal markets are better suited to revolutionary changes in industrial and firm structures. CE is seen as a new socio-economic paradigm implying a radical innovation in managing resources and in creating economic, social and environmental value (Korhonen et *al*. (2018). In this context, such revolutionary changes may encourage firms to invest more in the development of practices that can minimize their environmental impact.

Accordingly, we assume that:

*H2: Free and fair governance should positively influence recycling practices.*

Finally, the quality of the administrative infrastructure and the degree of bureaucracy represent as well important dimensions of institutional conduciveness that can affect a firm’s CE practices. Indeed, as several scholars pointed out (Ranta et al; 2018; de Jesus and Mendonça, 2018), the adoption of CE practices could be hampered by complex and rigid administrative procedures and lack of competence of officials. Therefore, firms can be discouraged by cumbersome and inflexible bureaucratic procedures that are not adapted to more circular business models that require a more agile approach. In the light of this theoretical perspective, we constructed our last hypothesis (*H3*).

*H3: More effective administrative infrastructures should increase the performance of recycling practices.*

**3. Data and variables**

Our empirical study analyzes a sample of 1096 nonfinancial listed firms operating in 40 countries over the period 2012-2024. The initial sample was composed of 1751 listed firms that reported data on recycling activities in the database of the *Bloomberg Terminal*. The final size of our sample was determined by the availability of observations dealing with the firm’s financial features (a) and corporate governance (b). Furthermore, we assess a firm’s capacity to recycle using three measures, namely the amount of waste recycled as a percentage of the firm’s total waste (*Recycled Waste*), the volume of recycled water as a percentage of the total water used for the firm’s operational activities (*Recycled Water)*, and the amount of paper sent for recycling (*Recycled Paper*). Second, the *Worldwide Governance* database of the *World Bank* provides 6 time-variant proxies that capture institutional quality: corruption control (*Control of Corruption*), the performance of the government and public institutions (*Government Effectiveness*), the stability of the political environment (*Political Stability*), the public governance capacity to develop the private sector (*Regulatory Quality*), confidence in the law (*Rule of Law*), and citizens’ political voice (*Voice*). We will rely on these institutional dimensions of the *World Bank* to test our hypotheses related to institutional stability (*Political Stability*, *Rule of Law*) and institutional conduciveness (*Voice*, *Control of Corruption*, *Regulatory Quality*, *Government Effectiveness*). All six variables are given a score that can range from -2.5 to 2.5, with higher values implying a higher institutional quality.

We also employed an alternative set of institutional variables constructed by the *Legatum Institute* to explore the channels that might explain our empirical findings. Again, 6 variables capture institutional quality: executive constraints (*Executive Constraints*), political accountability (*Political Accountability*), rule of law (*Rule of Law (Legatum)*), the integrity of the government (*Government Integrity*), government effectiveness (*Government Effectiveness* *(Legatum)*) and regulatory quality (*Regulatory Quality (Legatum)*).

Third, the following firm financial features are gathered from the *Bloomberg Terminal*: level of debt (*Debt/Equity*, *Debt/Assets*), operational performance (*Sales Growth*, *EBITDA/Revenue*), degree of liquidity (*Cash Ratio*, *Quick Ratio*), firm size (*Assets*, *Capitalization*) and financial performance (*ROA* and *Tobin’s Q*). Fourth, we have included in our data set variables related to corporate governance, namely the duality of the firm’s chief executive officer (*CEO Duality*), the number of individuals that are serving on the board (*Board Size*), the weight of independent directors in the firm’s board (*Independent*) and the presence of a corporate social responsibility (CSR) committee. Fifth, the macro(economic) context is assessed through the change in national average temperature from a baseline climatology (*Temp*), gross domestic product per capita (*GDPc*), economic growth (*GDPg*) and the inflation rate (*Inflation*). Table 1 details the definitions of all the above variables and indicates the sources of the data.

{Table 1}

An overview of per-country listed firms’ recycling performance is shown in Table 2. The figures suggest that the recycling of firm waste is widely emphasized across countries. The highest average percentages of recycled waste are reported by the listed firms from Japan and Norway, which on average recycle more than 70% of the waste generated by their operations. Lower values of *Recycled Waste* are mainly associated with countries from South America such as Argentina, Chile and Colombia. A higher level of water reuse relates to Chinese, Irish and Philippine firms, which recycle on average more than 60% of the total water volume employed in operational activities, but 14 countries in our sample report average values of *Recycled Water* below 20%. Firms operating in Chile, Norway and the United Kingdom send larger quantities of paper for recycling.

{Table 2}

Tables 3 and 4 present the summary statistics of our sample and the correlation matrix based on the pairwise coefficient. Some noteworthy observations can be made. First, a strong heterogeneity exists between countries in terms of institutional quality, but also between firms in terms of financial features, as reflected in the values of the standard deviations. Second, *Political Stability* has the lowest median value among the institutional variables constructed by the *World Bank*, with around half of our firm observations subject to a period of political uncertainty. Table 3 also reports the significance of the *t*-test for the difference in means between the subsample of observations subject to a high-quality institutional environment and the subsample of observations dealing with a low-quality institutional environment. In this regard, a high-quality institutional environment was identified as an environment for which the value of the institutional variable (*Control of Corruption*, *Government Effectiveness*, *Political Stability*, *Regulatory Quality*, *Rule of Law*,or *Voice*) was higher than the median of the sample. The waste and water recycling performances are significantly different between environments with low- and high-quality institutions. Third, the mean annual temperature change per country is 1.493 degrees Celsius over the period 2012-2024, which is a marked environmental degradation. Fourth, the quality of the national institutional framework is positively and significantly correlated at a 1% level with *Recycled Waste* (Table 4). Moreover, high levels of operational performance (*Sales Growth* and *EBITDA/Revenue*) are also strongly correlated with the recycling of water. Interestingly, firms with a CSR committee seem to be associated with a higher degree of recycled water and a lower level of recycled waste. In the following section, we shall empirically examine the relationship between institutional quality and our measures of recycling performance.

{Table 3}

{Table 4}

**4. Estimates**

In this section, we shall present our econometric model based on a static panel approach (subsection 4.1) and the estimations of different robustness checks dealing with alternative financial control variables (subsection 4.2), subsamples (subsection 4.3), a dynamic panel approach (subsection 4.4), alternative proxies to assess the institutional framework (subsection 4.5) and Heckman selection model (subsection 4.6).

**4.1 Static panel approach**

We will estimate the following econometric equation to understand how the institutional environment shapes the recycling activity of listed firms:

*Recyclei,t = ψ(Institutioni,t-1)+ Φ(Financiali,t-1) + λ(Governancei,t-1) + τ (Macroi,t-1)+* *αi + βt + ξi,t* (1)

where *i* is the firm’s index, which ranges from 1 to 1096, and *t* the index of year; *αi* captures the firms’ fixed effects, *βt* the time effects, and *ξi,t* is the error term. *Recycle* is a vector that includes one of our dependent variables, namely *Recycled Waste*, *Recycled Water* and *Recycled Paper*. *Financial* is a vector composed of four financial features of firms lagged by 1 year (*Debt/Equity*, *Sales Growth*, *Cash Ratio*, the natural logarithm of *Assets* and *ROA*). *Governance* and *Macro* represent our vectors of variables that will control for the governance structure of the firm (*CEO Duality*, *Board Size*, *Independent* and *CSR Committee*), the ecological environment (*Temp*) and macroeconomic fluctuations (natural logarithm of *GDPc*, *GPDg* and *Inflation*). The national institutional framework is assessed through the vector *Institution* lagged by 1 year, which has our six dimensions gathered from the database of the *World Bank*. In this regard, hypothesis *H1* (related to institutional stability) will be assessed through the degree of political stability (*Political Stability*) and confidence in law and order (*Rule of Law*). The testing of hypothesis *H2* (related to free and fair governance) will rely on freedom of expression and citizens’ political involvement (*Voice*) and the control of local corruption (*Control of Corruption*) while the ability of governments to implement policies (*Regulatory Quality*) and the efficiency of the administrative infrastructure (*Government effectiveness*) will assess our last hypothesis.

The financial variables were winsorized at the 10th and 90th percentiles to address the influence of outliers. In this regard, we should expect firms that are benefiting from a high degree of liquidity (*Cash Ratio*), an expansion of their activities (*Sales Growth*), and solid financial performance (*ROA*) to engage more easily in initiatives that could strengthen their corporate green dimension. Similarly, large firms (*Ln(Assets)*) should be better equipped to establish recycling facilities. However, firms with a high degree of indebtedness (*Debt/Equity*) may neglect the development of their sustainable practices to meet their financial obligations. Furthermore, the study of Hussain et al. (2018) offers some guidance regarding the potential impact of corporate governance characteristics on sustainability performance. On the one hand, larger boards (*Board Size*) and the duality of CEO (*CEO Duality*) can limit the effectiveness of monitoring managerial activity leading to negative consequences on the firm’s environmental performance. On the other hand, a governing board with a high degree of independence (*Independent*) is more committed to a variety of stakeholders while the presence of a CSR committee (*CSR Committee*) can also capture the board’s commitment towards sustainability. Such a level of engagement should incentivize firms to develop their green practices. Additionally, we should expect a high degree of recycling performance from firms operating in countries with extreme changes in the local temperature (*Temp*). Campiglio *et al*. (2023) pointed out that the asset value can decrease because of the physical risks that emerge from long-term shifts in temperature and weather events. Consequently, firms might be more persuaded to strengthen their recycling performance. Those firms might be encouraged to invest more in recycling initiatives when rival businesses are already engaged in sustainable practices. Additionally, growing large economies (*GDPc* and *GDPg*) subject to a low inflation rate (*Inflation*) should favour high production output and thus higher recycling performance for firms with more competitive recycling facilities.

The coefficients of equation (1) are estimated using a panel regression with time effects, the firms’ fixed effects and standard errors clustered at the industry level, because each sector of activity may have different capabilities to adopt eco-friendly practices. The results are shown in Table 5. In light of the wide criticism of the significance testing of a null hypothesis (Gill, 1999; Schwab *et al*., 2011), we will limit the interpretation of the significant coefficients estimated in Table 5 to the effect sizes. The first three columns report the estimated coefficients in the absence of corporate governance variables. Overall, the panel estimates reveal that firms recycle more waste and more paper in more politically stable countries providing some support to our first hypothesis. A 0.1-point improvement in the index of *Political Stability* is associated with an expected increase of 0.44 percentage points in the level of waste recycling (column (4)) and a 5.5% increase in the volume of paper recycled (column (6))[[1]](#footnote-1). Table 5 also reveals that a stronger rule of law and an intense control of local corruption are negatively and significantly associated with the use of recycled water (column (5)).

The financial control variables show a weak capacity to predict the firms’ engagement in recycling practices. In terms of governance, the only dimension with a significant and positive estimated coefficient is *Board Size* in column (5) dealing with *Recycled Water*. According to Dalton and Dalton (2005), larger boards provide access to networking opportunities, and valuable human capital captured by the capacity to provide advice, the experiences and skills of the board’s members. Such advantages of a larger board can positively influence the firm’s green strategy. However, our macroeconomic variables are significantly related to our recycling proxies. Interestingly, the economic growth (*GDPg*) is associated with a lower level of recycled water probably because of higher demand and thus a higher consumption of water for operational activities (columns (2) and (5)). The recycled waste as a percentage of a firm’s total waste also suffers a contraction when the inflation rate tends to be higher (columns (1) and (4)). To check the consistency of the previous results, we will address different robustness tests in the following subsections.

{Table 5}

**4.2 Alternative financial variables**

For our first robustness check, we will use an alternative set of financial features that will capture the level of debt (*Debt/Assets*), the operational performance (*EBITDA/Revenue*), the firm’s capacity to repay its short-term obligations (*Quick Ratio*), the financial market value (natural logarithm of *Capitalization*) and corporate performance (*Tobin’s Q*). Estimates performed using a panel approach with time effects, firms’ fixed effects and clustered standard errors are presented in Table 6. As in Table 5, we notice that the financial dimensions have no repercussions on the firm’s green activities except for *EBITDA/Revenue* in columns (1) and (4). An improvement in operational performance results in a higher production of waste and thus a larger proportion of recycled waste. In terms of institutional framework, the estimated coefficients remain consistent with those reported above. However, the effect sizes are now larger for *Political Stability* in columns (4) and (6). Table 6 confirms the persistent effect of economic growth (*GDPg*) on *Recycled Water* providing some support that firms tend to increase their consumption of water to satisfy a growing demand resulting from the national economic expansion. If their facilities to recycle water have limited production capacities, that index will tend to decrease.

{Table 6}

**4.3 Subsample analysis**

In this subsection, we investigate the effects of institutional quality on corporate sustainability using subsample analysis. First, the U.S. firms represent the largest subsample of our data set while 12 countries of our sample include less than 10 firms (see Table 2). In Table 7, we re-estimate equation (1) using the subsample that excludes the listed firms from the U.S. (columns (1)-(3)) and the subsample based on countries with at least 10 firms (columns (4)-(6)). Results are similar to the findings reported in Table 5, with *Political Stability* presenting positive and significant effect sizes (columns (1) and (4)). The level of recycled waste generated by non-U.S. firms increases by 0.43 percentage points following a 0.1 improvement in political stability. However, anticorruption policies seem to inhibit the water recycling activities (columns (2)-(4)). That result was also estimated in the previous tables. Second, the pandemic period severely affected the listed firms, as the managers had difficulties in developing appropriate strategies to cope with the consequences of micro and macro uncertainty that emerged in 2020 and 2021 Sharma *et* *al*., 2020). Hence, estimates from columns (1)-(3) in Table 8 use only the observations prior to the pandemic crisis (2012-2019) and those from columns (4)-(6) the post-pandemic observations (2020-2024). More water and paper were recycled in countries with a more stable political environment prior to the pandemic crisis. Additionally, strong enforcement of rules and laws (*Rule of Law*) contributed to a higher degree of waste recycled during the post-pandemic period (column (4)). This finding is in line with Stef et al. (2023) who identified the rule of law as the most important institutional dimension in limiting carbon emissions. However, the endogeneity of the institutional proxies and a firm’s financial features is not controlled by the static panel regression. The following subsection will address the endogeneity issue of our econometric equation through a dynamic panel approach.

{Table 7}

{Table 8}

**4.4 Dynamic panel approach**

Recycling operations require investment. Once such investments are made, a firm may pursue its ecological engagement over a certain period. Econometrically, this implies that our recycling proxies will be persistent over time, and the 1-year lag values can explain their variance. A static panel approach cannot properly estimate the impact of a lagged dependent variable as it would be strongly correlated with the error term of equation (1) (Nickell, 1981). The studies of (Arellano and Bover, 1995) and Blundell and Bond (1998) proposed the system Generalized Method of Moments (GMM) estimator to overcome such bias. The system GMM requires the construction of two equations, namely an equation in levels (equation (2)) and an equation in first-differences (equation (3)).

*Recyclei,t = γRecyclei,t-1 + ψ(Institutioni,t-1)+ Φ(Financiali,t-1)+ λ(Governancei,t-1)+ τ (Macroi,t-1)+* *αi + βt + ξi,t* (2)

*∆Recyclei,t = ν∆Recyclei,t-1 + η(∆Institutioni,t-1)+ δ(∆Financiali,t-1)+ φ(∆Governancei,t-1)+ ν (∆Macroi,t-1)+ ∆βt +∆ ξi,t* (3)

The coefficients will be estimated using the lagged values of the first-differences as instruments for the endogenous variables, whereas the lagged values of the variables in levels as instruments will be used for the first-differenced variables (Blundell and Bond, 1998). In this framework, we will treat our institutional variables, the financial features and corporate governance variables as endogenous. On the one hand, changes in the efficiency of institutions can be determined by multiple legal reforms and the investments made by governments in the infrastructure and the training of public servants. On the other hand, fluctuations in the financial market can have direct consequences on the strategic behaviour of listed firms that can adjust their governance and capital structure.

Following the recommendations of Windmeijer (2005) and Roodman (2009), we will rely upon robust standard errors corrected for finite sample bias to address the downward bias of asymptotic standard errors and rely upon collapsed instruments to avoid the overfitting of the endogenous variables. Table 9 presents the estimations of the system GMM with the initial set of financial control variables (columns (1)-(3)) and the alternative set of financial features (columns (4)-(6)).

Our dynamic panel regressions confirm the path dependency of the recycling performance, as the first-order serial correlation is significant at the 1% level. The 1-year lagged values of the dependent variables have a positive contribution to the variance of our dependent variables. In this dynamic frame, *Political Stability* is the only institutional dimension with a robust effect (columns (1) and (4)), partially confirming our first hypothesis (*H1*), which assesses the relationship between institutional stability and corporate recycling performance, here specifically the practice of recycling waste. A 0.1-point improvement in this index leads to an increase in *Recycled Waste* in the following year ranging from 0.77 (column (1)) to 0.95 (column (4)). Additionally, waste recycling activities also benefit from a high degree of government effectiveness suggesting that the quality of public policies and the government's commitment to its policies can encourage firms to develop such activities. Furthermore, alternative institutional variables will be employed in the following subsection to understand the mechanism that drives this robust finding.

{Table 9}

**4.5 Alternative institutional variables**

The indexes constructed by the *World Bank* are not the only time-variant measures that can assess the functioning of institutions at the national level. In this regard, the *Legatum Institute* relied on the expertise of more than 100 academics and experts to develop a variety of indicators that can identify solutions to raise the level of prosperity. Among those measures, six time-variant variables can be used within the framework of institutional theory to explain a firm’s incentives to recycle, namely the constraints imposed on the government executive (*Executive Constraints*), the degree to which institutions are held accountable for their actions (*Political Accountability*), the effectiveness of the judicial system in applying the law (*Rule of Law (Legatum)*), the integrity of the national government (*Government Integrity*), the quality of the services provided by the government (*Government Effectiveness (Legatum)*) and the performance of the regulatory institutions (*Regulatory Quality* *(Legatum)*). As in Table 9, the relevance of these indicators will be addressed using a dynamic panel approach with time effects, collapsed instruments and corrected standard errors.

Table 9 highlights the estimates of the system GMM. Columns (1) and (4) show that higher percentages of *Recycled Waste* are reported in countries where the institutions can more easily be held accountable by the public for their policies and decisions (*Political Accountability*). An increase of 0.44 percentage points in the level of recycled waste can be expected following an improvement of 1 point in the indicator of political accountability (column (1)). The previous tables also showed that *Recycled Waste* tends to be higher in countries that are more politically stable (*Political Stability*). In an environment that is not subject to severe political fluctuations, citizens can more effectively use their vote to sanction political actors aiming for reelection who are responsible for not establishing stringent control of waste management on the part of large listed firms. Voters may thus incentivize local authorities to better monitor firms. This follows the research line of Stef and Ben Jabeur (2023), who provided evidence of the voters’ capacity to persuade incumbent politicians to adopt a greener agenda prior to elections. Additionally, more efficient judicial systems (*Rule of Law (Legatum)*) encourage firms to recycle more waste, whereas more limitation on executive power (*Executive Constraints*) is negatively associated with *Recycled Waste*. As opposed to the *Rule of Law (Legatum)*, which captures the fairness, independence, and effectiveness of the judiciary, a high value of *Executive Constraints* may suggest the executive has less control over firms, which in turn could lead them to recycle less waste.

{Table 10}

**4.6 Heckman selection model**

One may speculate that the source of endogeneity stems from the willingness and the operational capacity of firms to generate data on their recycling performance. This may lead to a sample selection bias affecting the accuracy of the estimated coefficients.[[2]](#footnote-2) Such bias can be addressed using the selection model of Heckman (1979) which is composed of two equations, namely the outcome regression:

*Recyclei,t = α0 + α1 (Institutioni,t-1)+ α2 (Financiali,t-1) + α3 (Governancei,t-1) + α4 (Macroi,t-1)+* *+ βt + µi* (4)

and the selection equation capturing the condition when the recycling performance is observed:

*λ0 + λ1 (Sectori)+ λ2 (Institutioni,t-1)+ λ3 (Financiali,t-1) + λ4 (Governancei,t-1) + λ5 (Macroi,t-1)+* *βt + Ωi > 0* (5)

where *µi* and *Ωi* are the error terms, *α0* and *λ0* the intercepts. To strengthen the identification of the equations systems, we will follow the recommendation of Breen (1996) to use a different set of variables in the selection equation. In this regard, we expect that the activity sector determines the possibility that a recycling performance is observed. *Sector* is a vector that identifies firms operating in the sectors of consumer staples (a), materials (b), communication (c), information technology (d), consumer discretionary (e), industry (f), energy (g), utilities (h) and health care (i). Table 11 shows the results based on Heckman’s two-step consistent estimator. A selection effect is confirmed in the case of *Recycled Water* and *Recycled Paper* for which the inverse of Mill’s ratio is statistically significant. In column (3), all the sectorial dummy variables have a significant estimated coefficient. The sectors of consumer staples, communications and industry tend to report more information on recycled water than the other sectors. Additionally, less observations on the amount of recycled paper are associated with the sectors of consumer staples, industry and energy.

The outcome equation of column (2) reconfirms the system GMM findings presented in Table 9 dealing with the positive effect of *Government Effectiveness* and *Political Stability* on *Recycled Waste*. Compared to the static panel approach of Table 5, the Heckman selection model points out that more water is recycled in countries that better control local corruption (*Control of Corruption*). When authorities monitor illegal activities more efficiently, firms can have stronger incentives to recycle more of the used water. In Table 12, the Heckman two-step selection approach was applied for the alternative set of institutional variables. As in Table 10, the effectiveness of the judiciary (*Rule of Law (Legatum)*) and the degree of political accountability (*Political Accountability*) are two significant institutional dimensions that favour the recycling of waste (column (2)). Interestingly, high levels of recycled water and paper are expected in countries with honest and effective governments (*Government Integrity*; *Government Effectiveness (Legatum)*) that facilitate the private sector development (*Regulatory Quality (Legatum)*).

{Table 11}

{Table 12}

**5. Conclusion**

A firm’s recycling performance can be significantly influenced and improved by an adequate institutional environment. In this context, analysing the consequences of institutional quality on three recycling dimensions i.e., waste, water and paper, our robust empirical results lead us to conclude that the recycling performance of listed firms tends to be higher in countries with a high level of political accountability that are more politically stable. In such countries, the electorate can persuade authorities to more effectively monitor the waste management of large listed firms. This may lead to a significantly higher level of waste being recycled by those firms. Hence, it is fair to infer that voters can persuade politicians to adopt pro-environmental initiatives.

This research provides a range of practical implications for policymakers and managers. First, the successful integration of sustainable practices within organizations emerges as a consequence of good institutional quality. The transition from a linear economy to a circular economy requires a fundamental shift in how firms operate and has profound implications for the capabilities they need. Institutions and public administrations exert substantial influence in facilitating the adoption of green practices by firms. Given that the political actors can have a major role in increasing a firm’s level of recycled waste, public policy shall focus on providing a more predictable agenda and monitoring more effectively the ecological impact of firms. Second, firms must acquire the necessary knowledge and skills to create goods that have a longer duration of use, efficiently use resources, and include sustainable methods across their whole supply chains. In this frame, incumbent public policymakers should support those firms by providing more predictable financial and nonfinancial policies, allowing managers to maintain or improve the cost efficiency of their businesses. Furthermore, firms must traverse complex regulatory landscapes and successfully include other stakeholders that may provide valuable information on how to minimize the production of waste. This study emphasizes the need for companies to allocate resources to the adoption of these novel practices to prosper and provide enduring value for themselves and society. Furthermore, it is vital to account for the size of firms and industry. For large enterprises, it is also recommended that firms invest more in recycling technology, which enables the reuse of waste with the long-term objective of reducing costs without compromising product quality. Policymakers and supply chain managers should promote collaboration among small and medium-sized enterprises (SMEs) and provide technical, financial, and policy support to advance circular economy practices such as resource efficiency, waste reduction, and product life-cycle extension. Moreover, firms need to use more advanced technologies associated with environmentally friendly processes or products, such as waste recycling, pollution prevention, energy conservation, green product design, or corporate environmental management, which likely contribute to this outcome, although firms may be motivated by considerations beyond environmental sustainability.

In terms of caveats, we should highlight that even if waste management represents an important dimension of the CE, CE is a complex and holistic system that encompasses several other dimensions as well. Therefore, even if there is a paucity of microeconomic data concerning the other aspects of the 3Rs, namely repair and reuse, future research should also analyze the influence of institutional quality on these other pillars. Additionally, we performed our empirical analysis on a sample of listed firms. Our research should be expanded to include more small and medium-sized firms, which are likely to have more limited financial resources to develop their eco-friendly practices.

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| **Table 1. Description of variables** | |
| **Variable** | **Definition** |
| **A. Recycling variables** | |
| Recycled Waste | Ratio between waste that is recycled, and the total waste, both hazardous and non-hazardous, generated by the firm. Source: Bloomberg Terminal. |
| Recycled Water | The percentage of the total water used to support its operational processes that the firm recycles. This data is collected by Bloomberg as reported by the firm. Source: Bloomberg Terminal. |
| Recycled Paper | Natural logarithm of the total amount of paper a firm sends for recycling, in thousands of metric tonnes. Source: Bloomberg Terminal. |
| **B. Institutional variables** | |
| Control of Corruption | Variable that captures perceptions of the extent to which public power is exercised for private gain, as well as "capture" of the state by elites and private interests. Source: Worldwide Governance Indicators (World Bank). |
| Government Effectiveness | Variable that captures perceptions of the quality of public and civil services, and the degree of their independence from political pressures, the quality of public policy, and the credibility of the government's commitment to such policies. Source: Worldwide Governance Indicators (World Bank). |
| Political Stability | Variable that captures the perceptions of the likelihood of political instability and/or politically motivated violence, including terrorism. Source: Worldwide Governance Indicators (World Bank). |
| Regulatory Quality | Variable that captures perceptions of the ability of the government to formulate and implement sound policies and regulations that favour private sector development. Source: Worldwide Governance Indicators (World Bank). |
| Rule of Law | Variable that captures perceptions of the extent to which agents have confidence in and abide by legal rules, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence. Source: Worldwide Governance Indicators (World Bank). |
| Voice | Variable that captures perceptions of the extent to which citizens can participate in selecting their government, as well as freedom of expression, freedom of association, and free media. Source: Worldwide Governance Indicators (World Bank). |
| Executive Constraints | Variable that assesses the level of checks and balances, and separation of powers — especially with respect to the executive. Source: Legatum Institute (Fifteenth Edition, The Legatum Prosperity Index 2021). |
| Political Accountability | Variable that measures the degree to which the public can hold public institutions accountable, capturing the degree of political pluralism, and other mechanisms of accountability. Source: Legatum Institute (Fifteenth Edition, The Legatum Prosperity Index 2021). |
| Rule of Law (Legatum) | Variable that captures the fairness, independence, and effectiveness of the judiciary (in applying both civil and criminal law), along with the accountability of the public to the law. Source: Legatum Institute (Fifteenth Edition, The Legatum Prosperity Index 2021). |
| Government Integrity | Variable that assesses the integrity of a government, encompassing both the absence of corruption and the degree to which government fosters citizen participation and engagement, through open information and transparent practices. Source: Legatum Institute (Fifteenth Edition, The Legatum Prosperity Index 2021). |
| Government Effectiveness (Legatum) | Variable that represents a combination of the quality of public service provision, the quality of the bureaucracy and the competence of officials. Source: Legatum Institute (Fifteenth Edition, The Legatum Prosperity Index 2021). |
| Regulatory Quality (Legatum) | Variable that encompasses all aspects of the running of the regulatory state — whether it is burdensome and impedes private sector development, and whether it is smoothly and efficiently run. Source: Legatum Institute (Fifteenth Edition, The Legatum Prosperity Index 2021). |
| **C. Financial variables**  (Source: Bloomberg Terminal) | |
| Debt/Equity | Total debt as a percentage of the total shareholders' equity. |
| Debt/Assets | Total debt as a percentage of a firm’s total asset value. |
| Sales Growth | Annual growth of sales revenue. |
| EBITDA/Revenue | Earnings Before Interest, Taxes, Depreciation and Amortization as a percentage of total revenue. |
| Cash Ratio | Firm’s total cash as a percentage of current liabilities. |
| Quick Ratio | Ratio between a firm’s current assets and current liabilities. |
| Assets | Total value of all short- and long-term assets. |
| Capitalization | Firm’s market capitalization. |
| ROA | Ratio between net income and a firm’s total asset value. |
| Tobin’s Q | Sum of the market capitalization, total liabilities, preferred equity and minority interest as a percentage of total assets. |
| **D. Corporate governance variables** (Source: Bloomberg Terminal) | |
| CEO Duality | Dummy variable that identifies if the firm's Chief Executive Officer (CEO), or equivalent, also serves as the Chair of the board. |
| Board Size | Number of individuals who serve on the firm’s board that monitor the operations and management. |
| Independent | Number of independent directors as a percentage of firm’s board size. |
| CSR Committee | Dummy variable equal to 1 if the firm has a corporate social responsibility (CSR) committee, 0 otherwise. |
| **E. Macro(economic) variables** | |
| Temp | Temperature change in degrees Celsius with respect to a baseline climatology, corresponding to the period 1951-1980. Source: Food and Agriculture Organization of the United Nations (FAO). 2022. FAOSTAT Climate Change, Climate Indicators, Temperature change. |
| GDPc | Gross domestic product (GDP) per capita in constant 2015 U.S. $. Source: World Development Indicators (World Bank). |
| GDPg | Annual percentage growth rate of GDP. Source: World Development Indicators (World Bank). |
| Inflation | Inflation rate. Source: World Development Indicators (World Bank). |
| **Notes:** Data were collected in October 2023 while the database was updated in April 2025 to include the 2022-2024 period. | |

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| **Table 2. Descriptive statistics by country** | | | |
| **Country** | **Firms** | **Firm-year Observations** | **Recycled Waste** | | **Recycled Water** | **Recycled Paper** |
| Argentina | 5 | 33 | 20.87 | | . | 0.10 |
| Australia | 5 | 44 | 20.22 | | 30.39 | . |
| Austria | 10 | 73 | 57.16 | | . | 0.72 |
| Belgium | 10 | 81 | 69.53 | | 15.27 | 1.01 |
| Brazil | 59 | 430 | 47.43 | | 29.89 | 1.09 |
| Canada | 44 | 329 | 25.96 | | 56.12 | 1.44 |
| Chile | 14 | 122 | 27.78 | | 28.53 | 3.74 |
| China | 59 | 324 | 53.44 | | 65.47 | 2.35 |
| Colombia | 5 | 43 | 28.05 | | 46.45 | 1.36 |
| Croatia | 3 | 22 | 43.78 | | 9.66 | 0.44 |
| Denmark | 14 | 135 | 52.47 | | 10.95 | . |
| Finland | 30 | 258 | 63.89 | | 8.59 | 0.13 |
| France | 47 | 424 | 58.36 | | 54.66 | 0.90 |
| Germany | 39 | 336 | 63.56 | | 31.66 | 1.08 |
| Greece | 13 | 74 | 56.30 | | 19.57 | 0.15 |
| Indonesia | 13 | 76 | 52.31 | | 2.39 | . |
| Ireland | 7 | 46 | 69.36 | | 68.24 | . |
| Italy | 47 | 334 | 48.52 | | 17.02 | 0.61 |
| Japan | 46 | 344 | 80.83 | | 35.09 | 0.77 |
| Luxembourg | 129 | 868 | 70.72 | | 16.84 | 2.43 |
| Malaysia | 5 | 26 | 57.19 | | . | 0.39 |
| Mexico | 19 | 119 | 39.99 | | 13.17 | 0.35 |
| Netherlands | 16 | 133 | 59.15 | | 32.05 | 2.35 |
| Norway | 16 | 150 | 73.30 | | 55.53 | 2.89 |
| Peru | 16 | 114 | 48.27 | | . | 1.06 |
| Philippines | 6 | 44 | 36.89 | | 64.33 | . |
| Poland | 14 | 82 | 44.09 | | 17.13 | 0.04 |
| Portugal | 11 | 77 | 44.36 | | . | 2.02 |
| Romania | 6 | 44 | 70.91 | | 1.89 | 0.62 |
| Saudi Arabia | 7 | 49 | 41.87 | | . | 0.34 |
| Singapore | 4 | 23 | 31.11 | | 48.86 | . |
| South Africa | 12 | 86 | 62.02 | | 4.23 | 0.09 |
| South Korea | 6 | 49 | 18.12 | | 52.57 | . |
| Spain | 30 | 217 | 58.90 | | 8.31 | 1.58 |
| Sweden | 35 | 279 | 65.78 | | 58.75 | 1.36 |
| Switzerland | 32 | 276 | 56.49 | | 35.15 | 0.51 |
| Thailand | 37 | 267 | 46.77 | | 15.49 | 1.17 |
| United Arab Emirates | 5 | 26 | 57.13 | | . | 0.03 |
| United Kingdom | 51 | 387 | 55.12 | | 30.53 | 3.83 |
| United States | 169 | 1221 | 45.88 | | 34.35 | 2.01 |
| **Mean** |  |  | **54.446** | | **31.626** | **1.433** |
| **Notes:** The column of firm-year observations reports the maximum number of observations per firm that was used for the basic econometric model aiming to explain *Recycled Waste*. | | | | | | |

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| **Table 3. Summary statistics** | | | |  |  |  |  |  |  |
|  |  |  |  | ***t*-test (difference in means)** | | | | | |
| **Variable** | **Mean** | **Standard Deviation** | **Median** | **Control of Corruption** | **Government Effectiveness** | **Political Stability** | **Regulatory Quality** | **Rule of Law** | **Voice** |
| **A. Recycling variables** |  |  |  |  |  |  |  |  |  |
| Recycled Waste | 54.446 | 31.725 | 58.683 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.476 | 0.045\*\* | 0.007\*\*\* |
| Recycled Water | 31.626 | 31.979 | 18.000 | 0.000\*\*\* | 0.659 | 0.002\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| Recycled Paper (natural logarithm) | 1.433 | 2.091 | 0.558 | 0.505 | 0.278 | 0.186 | 0.002\*\*\* | 0.112 | 0.087\* |
| **B. Institutional variables** |  |  |  |  |  |  |  |  |  |
| Control of Corruption | 0.930 | 0.883 | 1.123 | - | - | - | - | - | - |
| Government Effectiveness | 1.092 | 0.668 | 1.298 | - | - | - | - | - | - |
| Political Stability | 0.362 | 0.586 | 0.402 | - | - | - | - | - | - |
| Regulatory Quality | 1.046 | 0.674 | 1.189 | - | - | - | - | - | - |
| Rule of Law | 1.028 | 0.776 | 1.336 | - | - | - | - | - | - |
| Voice | 0.774 | 0.810 | 0.995 | - | - | - | - | - | - |
| Executive Constraints | 69.105 | 15.110 | 72.763 | - | - | - | - | - | - |
| Political Accountability | 83.407 | 17.015 | 90.116 | - | - | - | - | - | - |
| Rule of Law (Legatum) | 63.451 | 13.455 | 66.352 | - | - | - | - | - | - |
| Government Integrity | 74.867 | 17.101 | 83.900 | - | - | - | - | - | - |
| Government Effectiveness (Legatum) | 78.411 | 17.385 | 90.073 | - | - | - | - | - | - |
| Regulatory Quality (Legatum) | 64.293 | 12.144 | 65.879 | - | - | - | - | - | - |
| **C. Financial variables** |  |  |  |  |  |  |  |  |  |
| Debt/Equity | 75.407 | 57.780 | 60.165 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.387 | 0.000\*\*\* | 0.002\*\*\* |
| Debt/Assets | 26.451 | 14.002 | 26.263 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| Sales Growth | 6.445 | 12.612 | 4.995 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.001\*\*\* | 0.000\*\*\* |
| EBITDA/Revenue | 17.730 | 10.911 | 15.031 | 0.838 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.353 | 0.804 |
| Cash Ratio | 0.490 | 0.385 | 0.361 | 0.000\*\*\* | 0.030\*\* | 0.000\*\*\* | 0.039\*\* | 0.004\*\*\* | 0.000\*\*\* |
| Quick Ratio | 0.932 | 0.486 | 0.806 | 0.048\*\* | 0.014\*\* | 0.045\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.005\*\*\* |
| Assets (M$) | 10113.027 | 12178.556 | 4505.711 | 0.000\*\*\* | 0.000\*\*\* | 0.024\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| Capitalization (M$) | 8523.571 | 10666.221 | 3537.992 | 0.000\*\*\* | 0.000\*\*\* | 0.165 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| ROA | 4.771 | 4.427 | 4.211 | 0.007\*\*\* | 0.818 | 0.000\*\*\* | 0.003\*\*\* | 0.002\*\*\* | 0.365 |
| Tobin’s Q | 1.577 | 0.700 | 1.320 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| **D. Corporate governance variables** |  |  |  |  |  |  |  |  |  |
| CEO Duality | 0.264 | 0.441 | - | 0.000\*\*\* | 0.039\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| Board Size | 9.720 | 3.016 | 9.000 | 0.000\*\*\* | 0.045\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| Independent | 60.005 | 23.529 | 57.143 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| CSR Committee | 0.359 | 0.480 | - | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.005\*\*\* | 0.043\*\* | 0.019\*\* |
| **E. Macro(economic) variables** |  |  |  |  |  |  |  |  |  |
| Temp | 1.493 | 0.603 | 1.446 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.516 | 0.608 | 0.608 |
| GDPc ($) | 36621.725 | 21282.502 | 36161.292 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| GDPg | 2.154 | 3.061 | 2.326 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| Inflation | 2.613 | 4.572 | 1.742 | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* | 0.000\*\*\* |
| **Notes :** The table reports the *p*-values of the *t*-test for difference in means between the subsample of observations subject to a high-quality institutional environment and the subsample of observations dealing with a low-quality institutional environment.A high-quality institutional environment was classified as an environment for which the institutional variable (*Control of Corruption*, *Government Effectiveness*, *Political Stability*, *Regulatory Quality*, *Rule of Law* or *Voice*) was higher than the median of the sample. \* indicates a significant difference at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | | | | |

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| **Table 4. Correlation matrix** | | | | | | | | | |
| Variables | Recycled Waste | Recycled Water | Recycled Paper | Contr. Of Corr. | Gov. Effect. | Political Stability | Regulatory Quality | Rule of Law | Voice |
| Control of Corruption | 0.094\*\*\* | 0.062\*\* | 0.039 |  |  |  |  |  |  |
| Government Effectiveness | 0.132\*\*\* | 0.009 | 0.002 | 0.931\*\*\* |  |  |  |  |  |
| Political Stability | 0.141\*\*\* | -0.029 | -0.155\*\*\* | 0.850\*\*\* | 0.821\*\*\* |  |  |  |  |
| Regulatory Quality | 0.088\*\*\* | -0.044\* | 0.057 | 0.933\*\*\* | 0.912\*\*\* | 0.811\*\*\* |  |  |  |
| Rule of Law | 0.111\*\*\* | -0.022 | 0.065 | 0.956\*\*\* | 0.948\*\*\* | 0.836\*\*\* | 0.956\*\*\* |  |  |
| Voice | 0.064\*\*\* | -0.104\*\*\* | 0.074\* | 0.747\*\*\* | 0.626\*\*\* | 0.720\*\*\* | 0.792\*\*\* | 0.772\*\*\* |  |
| Debt/Equity | -0.017 | -0.096\*\*\* | -0.012 | -0.063\*\*\* | -0.074\*\*\* | -0.094\*\*\* | -0.040\*\*\* | -0.043\*\*\* | 0.004 |
| Debt/Assets | -0.042\*\*\* | -0.077\*\*\* | 0.077\* | -0.118\*\*\* | -0.117\*\*\* | -0.140\*\*\* | -0.082\*\*\* | -0.092\*\*\* | -0.047\*\*\* |
| Sales Growth | -0.038\*\*\* | 0.050\*\* | -0.026 | -0.080\*\*\* | -0.096\*\*\* | -0.089\*\*\* | -0.098\*\*\* | -0.101\*\*\* | -0.088\*\*\* |
| EBITDA/Revenue | -0.183\*\*\* | 0.112\*\*\* | -0.084\* | -0.038\*\*\* | -0.072\*\*\* | -0.076\*\*\* | -0.027\*\*\* | -0.058\*\*\* | -0.014\* |
| Cash Ratio | -0.079\*\*\* | 0.140\*\*\* | -0.049 | -0.075\*\*\* | -0.067\*\*\* | -0.053\*\*\* | -0.077\*\*\* | -0.077\*\*\* | -0.074\*\*\* |
| Quick Ratio | -0.031\*\*\* | 0.062\*\* | 0.066 | -0.031\*\*\* | -0.021\*\* | -0.014 | -0.024\*\*\* | -0.020\*\* | -0.019\*\* |
| Assets | -0.051\*\*\* | 0.099\*\*\* | 0.021 | 0.116\*\*\* | 0.116\*\*\* | 0.020\*\* | 0.123\*\*\* | 0.132\*\*\* | 0.074\*\*\* |
| Capitalization | -0.009 | 0.035 | 0.147\*\*\* | 0.165\*\*\* | 0.161\*\*\* | 0.027\*\*\* | 0.165\*\*\* | 0.173\*\*\* | 0.097\*\*\* |
| ROA | 0.067\*\*\* | -0.056\*\* | 0.079\* | -0.020\*\* | -0.015\* | -0.063\*\*\* | -0.030\*\*\* | -0.032\*\*\* | -0.068\*\*\* |
| Tobin’s Q | 0.043\*\*\* | -0.148\*\*\* | 0.084\* | 0.062\*\*\* | 0.065\*\*\* | -0.036\*\*\* | 0.039\*\*\* | 0.045\*\*\* | -0.030\*\*\* |
| CEO Duality | 0.139\*\*\* | -0.100\*\*\* | -0.032 | -0.056\*\*\* | 0.081\*\*\* | -0.008 | 0.014 | 0.058\*\*\* | -0.008 |
| Board Size | -0.005 | -0.007 | -0.146\*\*\* | 0.034\*\*\* | -0.004 | -0.076\*\*\* | 0.028\*\*\* | 0.018\*\* | 0.050\*\*\* |
| Independent | -0.065\*\*\* | 0.063\*\*\* | 0.065 | 0.470\*\*\* | 0.472\*\*\* | 0.328\*\*\* | 0.509\*\*\* | 0.505\*\*\* | 0.375\*\*\* |
| CSR Committee | -0.158\*\*\* | 0.114\*\*\* | -0.001 | -0.019\*\* | -0.040\*\*\* | -0.077\*\*\* | 0.019\*\* | 0.001 | 0.059\*\*\* |
| **Notes:**  Pairwise correlation coefficients were generated using the *Stata* command *asdoc* developed by (Shah, 2021) \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | | | | |

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| **Table 5. Institutional quality and corporate recycling performance** | | | | | | |
| **Dependent variable:** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** |
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Control of Corruption t-1 | 0.999 | -12.131\* | -0.151 | -0.451 | -13.423\*\* | -0.226 |
|  | (2.192) | (5.848) | (0.261) | (2.667) | (5.587) | (0.315) |
| Government Effectiveness t-1 | 2.540 | 3.575 | -0.059 | 3.447 | 3.640 | 0.193 |
|  | (2.635) | (5.028) | (0.282) | (2.614) | (5.192) | (0.392) |
| Political Stability t-1 | 4.186\*\* | 2.213 | 0.350\*\* | 4.355\*\* | 2.304 | 0.436\*\* |
|  | (1.627) | (2.171) | (0.120) | (1.724) | (2.222) | (0.149) |
| Regulatory Quality t-1 | 0.550 | -1.171 | -0.368 | 0.127 | -1.514 | -0.476 |
|  | (3.927) | (3.328) | (0.429) | (3.684) | (3.217) | (0.439) |
| Rule of Law t-1 | 0.115 | -7.570\* | 0.831\*\* | -0.499 | -6.578\* | 0.895\* |
|  | (2.702) | (3.626) | (0.356) | (3.111) | (3.288) | (0.415) |
| Voice t-1 | 5.238 | -2.683 | -0.279 | 5.119 | -3.266 | -0.355 |
|  | (5.007) | (4.311) | (0.254) | (4.222) | (4.482) | (0.223) |
| Debt/Equity t-1 | -0.001 | 0.013 | -0.002 | -0.008 | 0.011 | -0.002 |
|  | (0.009) | (0.017) | (0.002) | (0.010) | (0.019) | (0.001) |
| Sales Growth t-1 | -0.008 | 0.028 | 0.001 | -0.009 | 0.027 | 0.002 |
|  | (0.026) | (0.044) | (0.004) | (0.026) | (0.046) | (0.005) |
| Cash Ratio t-1 | 0.640 | -0.977 | -0.122 | 0.325 | -1.069 | -0.092 |
|  | (1.260) | (1.393) | (0.136) | (1.265) | (1.410) | (0.161) |
| Ln(Assets) t-1 | -1.802 | -1.417 | 0.175 | -1.563 | -1.690 | 0.034 |
|  | (1.522) | (2.319) | (0.177) | (1.458) | (2.320) | (0.164) |
| ROA t-1 | 0.154 | -0.057 | 0.012 | 0.139 | -0.042 | 0.010 |
|  | (0.129) | (0.151) | (0.014) | (0.131) | (0.159) | (0.018) |
| CEO Duality t-1 |  |  |  | -0.705 | -1.629 | 0.055 |
|  |  |  |  | (1.126) | (1.802) | (0.079) |
| Board Size t-1 |  |  |  | -0.324 | 0.370\*\* | -0.020 |
|  |  |  |  | (0.179) | (0.132) | (0.025) |
| Independent t-1 |  |  |  | 0.028 | -0.036 | -0.008 |
|  |  |  |  | (0.044) | (0.059) | (0.005) |
| CSR Committee t-1 |  |  |  | 1.561 | 0.837 | 0.044 |
|  |  |  |  | (1.126) | (1.885) | (0.183) |
| Temp t-1 | 0.065 | -0.018 | -0.119 | 0.120 | -0.027 | -0.111 |
|  | (0.468) | (0.612) | (0.081) | (0.507) | (0.562) | (0.090) |
| Ln (GDPc t-1) | -6.861 | 46.295\*\*\* | -1.895\*\*\* | -8.752 | 44.314\*\* | -2.017\*\* |
|  | (12.153) | (13.352) | (0.531) | (11.246) | (13.589) | (0.688) |
| GDPg t-1 | 0.091 | -0.488\*\*\* | 0.020 | 0.041 | -0.484\*\*\* | 0.016 |
|  | (0.124) | (0.136) | (0.016) | (0.125) | (0.140) | (0.016) |
| Inflation t-1 | -0.321\*\*\* | -0.260 | 0.005 | -0.335\*\*\* | -0.269 | 0.005 |
|  | (0.083) | (0.247) | (0.011) | (0.093) | (0.238) | (0.010) |
| Intercept | 125.775 | -406.707\*\* | 19.599\*\* | 147.030 | -384.404\*\* | 22.653\*\* |
|  | (119.472) | (132.623) | (6.513) | (107.711) | (137.880) | (8.237) |
| Observations | 8065 | 1617 | 451 | 7658 | 1580 | 430 |
| Firms | 1096 | 298 | 100 | 1096 | 296 | 97 |
| Within-R | 0.014 | 0.064 | 0.116 | 0.017 | 0.068 | 0.133 |
| Time and firm effects | Yes | Yes | Yes | Yes | Yes | Yes |
| **Notes**: Coefficients are estimated using a panel regression approach with time effects and firms’ fixed effects. Standard errors clustered at industry level are reported in parentheses. \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | |

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| **Table 6. Institutional quality and corporate recycling performance. Alternative financial variables** | | | | | | |
| **Dependent variable:** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** |
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Control of Corruption t-1 | 0.323 | -10.560\* | -0.080 | -0.794 | -11.837\*\* | -0.148 |
|  | (2.171) | (5.227) | (0.286) | (2.714) | (4.893) | (0.311) |
| Government Effectiveness t-1 | 3.583 | 3.435 | 0.069 | 3.892 | 3.391 | 0.366 |
|  | (2.247) | (4.907) | (0.346) | (2.379) | (5.029) | (0.501) |
| Political Stability t-1 | 4.204\*\* | 1.881 | 0.393\*\* | 4.221\*\* | 1.849 | 0.450\*\* |
|  | (1.630) | (2.350) | (0.141) | (1.660) | (2.266) | (0.177) |
| Regulatory Quality t-1 | -1.201 | -0.861 | -0.394 | -1.284 | -1.161 | -0.446 |
|  | (3.798) | (3.665) | (0.422) | (3.629) | (3.725) | (0.404) |
| Rule of Law t-1 | 0.436 | -7.815\* | 0.668\* | -0.611 | -6.741\* | 0.660 |
|  | (2.732) | (3.902) | (0.359) | (3.211) | (3.475) | (0.363) |
| Voice t-1 | 5.071 | -1.352 | -0.127 | 5.372 | -1.983 | -0.267 |
|  | (5.001) | (5.781) | (0.311) | (4.330) | (5.888) | (0.295) |
| Debt/Assets t-1 | -0.003 | 0.067 | -0.010 | -0.021 | 0.051 | -0.015 |
|  | (0.035) | (0.072) | (0.010) | (0.039) | (0.075) | (0.008) |
| EBITDA/Revenue t-1 | 0.112\*\* | 0.018 | -0.000 | 0.109\*\* | 0.011 | 0.002 |
|  | (0.037) | (0.042) | (0.006) | (0.043) | (0.041) | (0.006) |
| Quick Ratio t-1 | 0.726 | 0.099 | -0.084 | 0.437 | 0.174 | -0.030 |
|  | (1.400) | (1.376) | (0.110) | (1.372) | (1.530) | (0.125) |
| Ln(Capitalization) t-1 | 0.126 | 0.925 | 0.010 | 0.026 | 0.870 | -0.068 |
|  | (0.745) | (1.790) | (0.157) | (0.765) | (1.624) | (0.161) |
| Tobin’s Q t-1 | 0.333 | 0.041 | 0.017 | 0.361 | 0.433 | 0.008 |
|  | (1.037) | (1.783) | (0.117) | (1.072) | (1.662) | (0.126) |
| CEO Duality t-1 |  |  |  | -0.689 | -2.274 | 0.050 |
|  |  |  |  | (1.140) | (1.863) | (0.093) |
| Board Size t-1 |  |  |  | -0.251 | 0.335\* | -0.018 |
|  |  |  |  | (0.202) | (0.150) | (0.019) |
| Independent t-1 |  |  |  | 0.041 | -0.052 | -0.008 |
|  |  |  |  | (0.048) | (0.064) | (0.005) |
| CSR Committee t-1 |  |  |  | 1.334 | 0.626 | 0.017 |
|  |  |  |  | (1.047) | (1.957) | (0.151) |
| Temp t-1 | 0.086 | -0.000 | -0.123 | 0.173 | 0.021 | -0.114 |
|  | (0.440) | (0.516) | (0.082) | (0.485) | (0.487) | (0.090) |
| Ln (GDPc t-1) | -10.395 | 43.427\*\* | -2.022\*\* | -12.738 | 41.657\*\* | -2.025\*\* |
|  | (10.499) | (13.562) | (0.658) | (9.288) | (13.818) | (0.674) |
| GDPg t-1 | 0.052 | -0.470\*\*\* | 0.021 | 0.026 | -0.468\*\*\* | 0.021 |
|  | (0.126) | (0.127) | (0.017) | (0.126) | (0.134) | (0.017) |
| Inflation t-1 | -0.322\*\*\* | -0.268 | 0.004 | -0.339\*\*\* | -0.282 | 0.004 |
|  | (0.089) | (0.249) | (0.011) | (0.097) | (0.238) | (0.010) |
| Intercept | 144.736 | -402.584\*\* | 22.374\*\* | 171.847\* | -383.059\*\* | 23.701\*\* |
|  | (105.422) | (131.295) | (7.023) | (91.793) | (134.569) | (7.240) |
| Observations | 7980 | 1612 | 451 | 7613 | 1578 | 431 |
| Firms | 1085 | 295 | 98 | 1,085 | 293 | 96 |
| Within-R | 0.015 | 0.055 | 0.108 | 0.017 | 0.061 | 0.131 |
| Time and firm effects | Yes | Yes | Yes | Yes | Yes | Yes |
| **Notes**: Coefficients are estimated using a panel regression approach with time effects and firms’ fixed effects. Standard errors clustered at industry level are reported in parentheses. \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | |

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| **Table 7. Institutional quality and corporate recycling performance. Subsamples** | | | | | | |
|  | **Subsample without U.S. firms** | | | **Subsample without countries that include less than 10 firms** | | |
| **Dependent variable:** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** |
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Control of Corruption t-1 | -0.625 | -12.641\* | -0.202 | -0.611 | -15.655\*\* | -0.104 |
|  | (3.707) | (5.560) | (0.340) | (3.383) | (5.540) | (0.338) |
| Government Effectiveness t-1 | 3.914 | 6.393 | 0.072 | 5.064 | 4.781 | 0.017 |
|  | (2.459) | (4.592) | (0.380) | (2.800) | (5.628) | (0.457) |
| Political Stability t-1 | 4.301\* | 4.333 | 0.267 | 4.934\*\* | 2.736 | 0.578\*\* |
|  | (2.101) | (3.094) | (0.180) | (1.567) | (2.316) | (0.203) |
| Regulatory Quality t-1 | -0.189 | -3.325 | 0.198 | 0.253 | 1.106 | -0.546 |
|  | (4.301) | (3.796) | (0.316) | (3.547) | (3.227) | (0.442) |
| Rule of Law t-1 | -0.910 | -4.135 | 0.511 | -1.383 | -5.958 | 1.320\*\* |
|  | (2.839) | (4.084) | (0.426) | (2.874) | (3.691) | (0.564) |
| Voice t-1 | 5.243 | -1.248 | -0.158 | 5.312 | -4.763 | -0.918\*\* |
|  | (4.281) | (4.528) | (0.205) | (4.186) | (4.952) | (0.287) |
| Debt/Equity t-1 | -0.010 | -0.001 | -0.001 | -0.007 | 0.003 | -0.002 |
|  | (0.012) | (0.023) | (0.001) | (0.010) | (0.017) | (0.001) |
| Sales Growth t-1 | -0.013 | 0.027 | -0.005 | -0.010 | 0.011 | 0.002 |
|  | (0.028) | (0.029) | (0.003) | (0.029) | (0.047) | (0.005) |
| Cash Ratio t-1 | 1.095 | -2.611\*\* | -0.146 | 0.092 | -1.055 | -0.178 |
|  | (1.324) | (0.858) | (0.130) | (1.294) | (1.384) | (0.127) |
| Ln(Assets) t-1 | -1.690 | -0.828 | 0.035 | -1.331 | -1.373 | 0.087 |
|  | (1.552) | (1.601) | (0.144) | (1.667) | (2.211) | (0.181) |
| ROA t-1 | 0.110 | -0.008 | 0.022 | 0.152 | -0.092 | 0.009 |
|  | (0.128) | (0.099) | (0.018) | (0.140) | (0.172) | (0.017) |
| CEO Duality t-1 | -2.179\* | -0.056 | 0.073 | -0.760 | -1.467 | 0.080 |
|  | (1.125) | (1.202) | (0.206) | (1.172) | (1.908) | (0.078) |
| Board Size t-1 | -0.354 | 0.307\*\* | 0.012 | -0.317 | 0.360\* | -0.023 |
|  | (0.191) | (0.109) | (0.017) | (0.182) | (0.159) | (0.024) |
| Independent t-1 | 0.023 | -0.029 | -0.006 | 0.042 | -0.041 | -0.011\* |
|  | (0.050) | (0.069) | (0.005) | (0.048) | (0.061) | (0.006) |
| CSR Committee t-1 | 1.788 | 0.979 | 0.203 | 1.612 | 1.780 | 0.046 |
|  | (1.063) | (1.611) | (0.126) | (1.157) | (1.717) | (0.187) |
| Temp t-1 | 0.225 | 0.271 | -0.065 | 0.169 | 0.109 | -0.159\* |
|  | (0.522) | (0.841) | (0.080) | (0.526) | (0.613) | (0.082) |
| Ln (GDPc t-1) | -8.831 | 30.418 | -1.371 | -14.490 | 47.360\*\*\* | -2.899\*\*\* |
|  | (14.194) | (16.878) | (0.942) | (15.018) | (10.188) | (0.804) |
| GDPg t-1 | 0.058 | -0.463\*\* | 0.014 | -0.044 | -0.233\*\* | 0.017 |
|  | (0.122) | (0.140) | (0.017) | (0.131) | (0.070) | (0.010) |
| Inflation t-1 | -0.343\*\*\* | -0.308 | 0.003 | -0.345\* | -0.136 | 0.022 |
|  | (0.096) | (0.255) | (0.008) | (0.161) | (0.173) | (0.021) |
| Intercept | 150.407 | -254.415 | 14.531 | 202.339 | -420.874\*\*\* | 31.756\*\* |
|  | (134.145) | (162.485) | (9.007) | (148.939) | (97.700) | (9.642) |
| Observations | 6442 | 1376 | 327 | 7247 | 1484 | 397 |
| Firms | 927 | 260 | 79 | 1032 | 278 | 88 |
| Within-R | 0.019 | 0.060 | 0.141 | 0.018 | 0.071 | 0.147 |
| Time and firm effects | Yes | Yes | Yes | Yes | Yes | Yes |
| **Notes**: Coefficients are estimated using a panel regression approach with time effects and firms’ fixed effects. Standard errors clustered at industry level are reported in parentheses. \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | |

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| **Table 8. Institutional quality and corporate recycling performance. Pre-pandemic and post-pandemic periods** | | | | | | |
|  | **Pre-pandemic period** | | | **Post-pandemic period** | | |
| **Dependent variable:** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** |
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Control of Corruption t-1 | 1.188 | -0.664 | -0.688 | 8.025 | 1.247 | 0.438 |
|  | (5.458) | (4.912) | (0.683) | (7.248) | (6.482) | (1.246) |
| Government Effectiveness t-1 | -1.042 | 2.862 | -0.204 | -4.305 | 2.049 | 2.115\*\* |
|  | (2.638) | (5.137) | (0.457) | (5.259) | (6.928) | (0.719) |
| Political Stability t-1 | 2.281 | 5.865\*\* | 0.315\* | -3.479 | -1.243 | -0.386 |
|  | (1.937) | (1.900) | (0.142) | (6.068) | (10.961) | (0.782) |
| Regulatory Quality t-1 | -0.923 | -4.119 | -0.265 | -0.354 | 6.829 | -0.023 |
|  | (2.993) | (7.473) | (0.333) | (4.681) | (6.454) | (0.904) |
| Rule of Law t-1 | 1.178 | -10.707\* | 0.718\* | 15.678\*\* | -11.596 | 1.031 |
|  | (5.299) | (4.686) | (0.381) | (6.582) | (7.348) | (1.793) |
| Voice t-1 | -1.242 | -0.478 | -0.405 | -14.978\* | -16.805 | 3.136 |
|  | (10.775) | (3.282) | (0.730) | (7.573) | (17.544) | (3.085) |
| Debt/Equity t-1 | -0.029 | -0.027 | -0.006 | 0.034\*\* | 0.029 | -0.003 |
|  | (0.017) | (0.021) | (0.004) | (0.014) | (0.034) | (0.003) |
| Sales Growth t-1 | -0.015 | -0.019 | 0.002 | 0.004 | 0.044\* | -0.005 |
|  | (0.035) | (0.037) | (0.003) | (0.018) | (0.023) | (0.009) |
| Cash Ratio t-1 | 0.364 | -3.437\* | -0.012 | 1.408 | 0.905 | -0.386 |
|  | (3.704) | (1.844) | (0.228) | (1.670) | (0.633) | (0.362) |
| Ln(Assets) t-1 | -0.549 | -2.336 | -0.048 | -7.044\* | -4.367\* | -0.004 |
|  | (1.704) | (4.981) | (0.296) | (3.312) | (2.325) | (0.296) |
| ROA t-1 | 0.060 | -0.224 | -0.006 | 0.187 | -0.199\* | 0.032 |
|  | (0.121) | (0.242) | (0.018) | (0.148) | (0.096) | (0.042) |
| CEO Duality t-1 | 0.206 | -0.647 | -0.197 | 0.262 | 0.103 | 0.075 |
|  | (1.385) | (1.106) | (0.184) | (1.117) | (1.362) | (0.151) |
| Board Size t-1 | -0.469\*\* | -0.113 | -0.107 | 0.274 | -0.497 | -0.051 |
|  | (0.162) | (0.188) | (0.094) | (0.319) | (0.473) | (0.064) |
| Independent t-1 | 0.072 | 0.023 | -0.001 | -0.004 | -0.009 | -0.017 |
|  | (0.048) | (0.064) | (0.004) | (0.053) | (0.030) | (0.010) |
| CSR Committee t-1 | 1.381 | 1.200 | -0.244 | 0.889 | -1.046 | 0.142 |
|  | (2.313) | (1.526) | (0.361) | (1.098) | (1.192) | (0.306) |
| Temp t-1 | -0.916 | -0.295 | -0.068 | 0.555 | 2.367 | -0.223 |
|  | (0.988) | (0.658) | (0.093) | (0.510) | (1.707) | (0.242) |
| Ln (GDPc t-1) | 1.178 | 59.178\*\* | -0.432 | -32.786 | 12.308 | -2.117 |
|  | (15.967) | (20.206) | (0.789) | (20.788) | (19.398) | (3.516) |
| GDPg t-1 | 0.375 | -0.539\*\* | 0.001 | 0.008 | -0.293 | 0.016 |
|  | (0.376) | (0.166) | (0.012) | (0.099) | (0.173) | (0.031) |
| Inflation t-1 | -0.700\* | 0.024 | 0.004 | -0.309\*\*\* | -0.576 | 0.001 |
|  | (0.336) | (0.165) | (0.011) | (0.083) | (0.335) | (0.011) |
| Intercept | 48.292 | -527.906\*\* | 9.035 | 438.440\* | -41.029 | 19.844 |
|  | (160.527) | (175.791) | (9.502) | (213.191) | (197.464) | (32.009) |
| Observations | 3450 | 754 | 233 | 3206 | 630 | 149 |
| Firms | 875 | 209 | 65 | 1071 | 237 | 61 |
| Within-R | 0.018 | 0.100 | 0.263 | 0.027 | 0.087 | 0.268 |
| Time and firm effects | Yes | Yes | Yes | Yes | Yes | Yes |
| **Notes**: Coefficients are estimated using a panel regression approach with time effects and firms’ fixed effects. Standard errors clustered at industry level are reported in parentheses. \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | |

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| **Table 9. Institutional quality and corporate recycling performance. A dynamic panel approach** | | | | | | | |
| **Dependent variable:** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** | |
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | |
| Lagged dependent variable | 0.735\*\*\* | 0.825\*\*\* | 0.809\*\*\* | 0.747\*\*\* | 0.841\*\*\* | 0.837\*\*\* | |
|  | (0.089) | (0.110) | (0.251) | (0.089) | (0.091) | (0.193) | |
| Control of Corruption t-1 | -7.075 | -3.933 | 0.635 | -2.423 | 2.396 | 0.740 | |
|  | (6.060) | (8.561) | (0.777) | (6.743) | (6.175) | (0.763) | |
| Government Effectiveness t-1 | 12.682\* | -4.376 | 0.268 | 16.924\*\* | -2.752 | -0.465 | |
|  | (7.430) | (5.382) | (0.825) | (8.061) | (5.373) | (1.006) | |
| Political Stability t-1 | 7.662\*\* | -3.001 | 0.075 | 9.468\*\* | -3.071 | 0.048 | |
|  | (3.784) | (3.827) | (0.397) | (4.020) | (3.592) | (0.367) | |
| Regulatory Quality t-1 | -3.097 | -12.595 | 0.260 | -11.623 | -10.338 | -0.056 | |
|  | (7.357) | (7.880) | (0.671) | (7.914) | (7.061) | (0.675) | |
| Rule of Law t-1 | -11.324 | 3.704 | -0.527 | -15.521\* | 3.555 | 0.200 | |
|  | (8.779) | (8.572) | (0.894) | (9.011) | (7.513) | (1.255) | |
| Voice t-1 | -0.903 | 4.447 | 0.006 | -0.819 | 1.769 | -0.100 | |
|  | (2.748) | (5.757) | (0.243) | (2.847) | (3.839) | (0.272) | |
| Debt/Equity t-1 | 0.033 | -0.011 | -0.001 |  |  |  | |
|  | (0.022) | (0.038) | (0.002) |  |  |  | |
| Sales Growth t-1 | -0.025 | -0.003 | 0.002 |  |  |  | |
|  | (0.087) | (0.052) | (0.007) |  |  |  | |
| Cash Ratio t-1 | 2.252 | 0.929 | -0.029 |  |  |  | |
|  | (3.379) | (2.600) | (0.346) |  |  |  | |
| Ln(Assets) t-1 | -2.163 | 2.609 | 0.189 |  |  |  | |
|  | (1.745) | (4.495) | (0.201) |  |  |  | |
| ROA t-1 | 0.419 | -0.132 | -0.008 |  |  |  | |
|  | (0.326) | (0.257) | (0.027) |  |  |  | |
| Debt/Assets t-1 |  |  |  | -0.043 | 0.014 | 0.004 | |
|  |  |  |  | (0.110) | (0.173) | (0.017) | |
| EBITDA/Revenue t-1 |  |  |  | 0.275 | 0.013 | -0.003 | |
|  |  |  |  | (0.218) | (0.084) | (0.011) | |
| Quick Ratio t-1 |  |  |  | 0.287 | 2.746 | 0.041 | |
|  |  |  |  | (2.918) | (2.002) | (0.400) | |
| Ln(Capitalization) t-1 |  |  |  | -1.133 | -0.424 | 0.030 | |
|  |  |  |  | (1.988) | (2.488) | (0.304) | |
| Tobin’s Q t-1 |  |  |  | -1.780 | -2.304 | 0.030 | |
|  |  |  |  | (2.061) | (3.073) | (0.209) | |
| CEO Duality t-1 | -0.701 | 0.964 | -0.320 | 0.681 | -0.236 | 0.066 | |
|  | (2.497) | (2.465) | (0.310) | (2.561) | (2.080) | (0.338) | |
| Board Size t-1 | 0.877 | -0.385 | -0.015 | 1.619\*\*\* | 0.244 | -0.014 | |
|  | (0.617) | (0.674) | (0.059) | (0.628) | (0.515) | (0.071) | |
| Independent t-1 | -0.008 | 0.069 | -0.009 | 0.112 | -0.001 | -0.004 | |
|  | (0.093) | (0.092) | (0.009) | (0.096) | (0.081) | (0.012) | |
| CSR Committee t-1 | 0.110 | -0.869 | 0.157 | -1.364 | 0.219 | 0.089 | |
|  | (2.018) | (1.987) | (0.258) | (2.021) | (1.772) | (0.327) | |
| Temp t-1 | 1.517 | -2.278 | 0.133 | -0.251 | -0.783 | -0.101 | |
|  | (1.913) | (3.477) | (0.246) | (1.977) | (2.841) | (0.489) | |
| Ln (GDPc t-1) | 7.618\* | 10.348 | -0.560 | 6.999\* | 6.337 | -0.409 | |
|  | (4.360) | (9.966) | (0.971) | (4.075) | (7.510) | (1.631) | |
| GDPg t-1 | -0.533 | 0.905 | -0.013 | -1.041\* | 0.846 | 0.014 | |
|  | (0.688) | (0.664) | (0.055) | (0.624) | (0.687) | (0.055) | |
| Inflation t-1 | -0.143 | -0.375 | 0.005 | -0.242 | -0.155 | 0.006 | |
|  | (0.154) | (0.627) | (0.027) | (0.165) | (0.568) | (0.054) | |
| Intercept | -52.642 | -106.527 | 4.264 | -58.438\* | -51.608 | 4.095 | |
|  | (38.660) | (107.751) | (8.354) | (35.486) | (72.615) | (12.757) | |
| Observations | 6747 | 1310 | 353 | 6717 | 1308 | 353 | |
| Firms | 1087 | 271 | 82 | 1076 | 269 | 81 | |
| Number of instruments | 46 | 46 | 46 | 46 | 46 | 45 | |
| AR(1) (*p*-value) | 0.000 | 0.000 | 0.141 | 0.000 | 0.000 | 0.128 | |
| AR(2) (*p*-value) | 0.652 | 0.181 | 0.294 | 0.556 | 0.244 | 0.294 | |
| AR(3) (*p*-value) | 0.842 | 0.786 | 0.293 | 0.707 | 0.871 | 0.319 | |
| Hansen test (*p*-value) | 0.144 | 0.645 | 0.675 | 0.366 | 0.593 | 0.871 | |
| Hansen test excluding group | . | . | . | . | . | . | |
| Difference (null H = exogenous) | 0.144 | 0.645 | 0.675 | 0.366 | 0.593 | 0.871 | |
| **Notes**: Coefficients are estimated using a GMM (Generalized Method of Moments) system method with robust standard errors corrected for finite sample bias and time effects. Instruments were collapsed. The table reports the two-step estimation. Hansen test excluding group (Difference (null H = exogenous)) examines the validity (the exogeneity) of our instrument subset used in the level equation. Robust standard errors are reported in parentheses. \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | |

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| **Table 10. Institutional quality and corporate recycling performance. A dynamic panel approach with alternative institutional variables** | | | | | | | |
| **Dependent variable:** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** | **Recycled Waste** | **Recycled Water** | **Recycled Paper** | |
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | |
| Lagged dependent variable | 0.549\*\*\* | 0.860\*\*\* | 0.820\*\*\* | 0.542\*\*\* | 0.851\*\*\* | 0.539\*\*\* | |
|  | (0.048) | (0.097) | (0.225) | (0.048) | (0.099) | (0.207) | |
| Executive Constraints t-1 | -0.791\*\* | 0.248 | -0.023 | -0.677\*\* | -0.018 | 0.027 | |
|  | (0.316) | (0.327) | (0.019) | (0.295) | (0.272) | (0.037) | |
| Political Accountability t-1 | 0.443\*\* | -0.123 | 0.005 | 0.488\*\*\* | 0.040 | -0.021 | |
|  | (0.172) | (0.177) | (0.014) | (0.177) | (0.176) | (0.032) | |
| Rule of Law (Legatum) t-1 | 0.713\*\* | -0.470 | 0.009 | 0.648\*\* | -0.400 | -0.013 | |
|  | (0.343) | (0.412) | (0.028) | (0.304) | (0.422) | (0.055) | |
| Government Integrity t-1 | 0.144 | 0.131 | -0.003 | 0.126 | 0.488 | -0.067 | |
|  | (0.359) | (0.529) | (0.029) | (0.386) | (0.522) | (0.067) | |
| Government Effectiveness (Legatum) t-1 | -0.370 | 0.429 | 0.001 | -0.407 | 0.226 | 0.051 | |
|  | (0.322) | (0.364) | (0.028) | (0.335) | (0.397) | (0.058) | |
| Regulatory Quality (Legatum) t-1 | -0.107 | -0.574 | -0.042 | -0.208 | -0.437 | -0.070 | |
|  | (0.555) | (0.697) | (0.039) | (0.564) | (0.689) | (0.052) | |
| Debt/Equity t-1 | -0.001 | -0.004 | 0.001 |  |  |  | |
|  | (0.035) | (0.032) | (0.002) |  |  |  | |
| Sales Growth t-1 | 0.047 | -0.006 | 0.003 |  |  |  | |
|  | (0.108) | (0.045) | (0.007) |  |  |  | |
| Cash Ratio t-1 | -0.947 | 0.534 | -0.175 |  |  |  | |
|  | (5.642) | (2.532) | (0.272) |  |  |  | |
| Ln(Assets) t-1 | -0.910 | 1.119 | -0.134 |  |  |  | |
|  | (2.078) | (2.954) | (0.285) |  |  |  | |
| ROA t-1 | 0.543 | -0.110 | -0.011 |  |  |  | |
|  | (0.521) | (0.199) | (0.026) |  |  |  | |
| Debt/Assets t-1 |  |  |  | -0.124 | 0.012 | -0.006 | |
|  |  |  |  | (0.153) | (0.160) | (0.017) | |
| EBITDA/Revenue t-1 |  |  |  | -0.089 | -0.003 | -0.008 | |
|  |  |  |  | (0.356) | (0.080) | (0.018) | |
| Quick Ratio t-1 |  |  |  | -0.048 | 1.831 | 0.044 | |
|  |  |  |  | (4.977) | (2.154) | (0.337) | |
| Ln(Capitalization) t-1 |  |  |  | 1.096 | -0.218 | -0.242 | |
|  |  |  |  | (2.067) | (2.320) | (0.329) | |
| Tobin’s Q t-1 |  |  |  | 1.687 | -1.426 | -0.046 | |
|  |  |  |  | (2.825) | (3.034) | (0.347) | |
| CEO Duality t-1 | -0.684 | 1.469 | -0.063 | -0.345 | 0.632 | 0.322 | |
|  | (3.403) | (2.202) | (0.359) | (3.395) | (2.349) | (0.466) | |
| Board Size t-1 | 0.438 | -0.351 | 0.048 | 0.411 | 0.358 | -0.033 | |
|  | (0.919) | (0.616) | (0.048) | (0.864) | (0.471) | (0.064) | |
| Independent t-1 | 0.049 | -0.015 | 0.003 | 0.099 | -0.066 | 0.016 | |
|  | (0.118) | (0.069) | (0.010) | (0.113) | (0.075) | (0.012) | |
| CSR Committee t-1 | -1.248 | -0.121 | -0.081 | -1.637 | 1.624 | -0.161 | |
|  | (2.174) | (1.558) | (0.249) | (2.407) | (1.711) | (0.403) | |
| Temp t-1 | 0.425 | 1.030 | -0.215 | 0.498 | 0.148 | -0.511 | |
|  | (1.953) | (3.191) | (0.278) | (2.002) | (3.496) | (0.370) | |
| Ln (GDPc t-1) | 1.984 | 1.567 | 0.770 | 1.324 | -1.667 | 1.010 | |
|  | (6.064) | (8.343) | (0.588) | (6.798) | (6.868) | (1.060) | |
| GDPg t-1 | -0.784 | 0.378 | -0.000 | -0.511 | 0.457 | 0.067 | |
|  | (0.486) | (0.555) | (0.040) | (0.546) | (0.640) | (0.060) | |
| Inflation t-1 | -0.352\*\* | -0.533 | -0.028 | -0.406\*\* | -0.447 | -0.041 | |
|  | (0.177) | (0.515) | (0.020) | (0.183) | (0.612) | (0.031) | |
| Intercept | 3.835 | -0.884 | -3.271 | -0.661 | 20.515 | -0.957 | |
|  | (40.158) | (53.817) | (3.674) | (40.772) | (51.235) | (7.028) | |
| Observations | 6747 | 1310 | 353 | 6717 | 1308 | 353 | |
| Firms | 1087 | 271 | 82 | 1076 | 269 | 81 | |
| Number of instruments | 46 | 46 | 46 | 46 | 46 | 46 | |
| AR(1) (*p*-value) | 0.000 | 0.000 | 0.126 | 0.000 | 0.000 | 0.070 | |
| AR(2) (*p*-value) | 0.804 | 0.184 | 0.282 | 0.757 | 0.249 | 0.672 | |
| AR(3) (*p*-value) | 0.908 | 0.864 | 0.302 | 0.704 | 0.917 | 0.544 | |
| Hansen test (*p*-value) | 0.064 | 0.360 | 0.815 | 0.129 | 0.548 | 0.964 | |
| Hansen test excluding group | . | . | . | . | . | . | |
| Difference (null H = exogenous) | 0.064 | 0.360 | 0.815 | 0.129 | 0.548 | 0.964 | |
| **Notes**: Coefficients are estimated using a GMM (Generalized Method of Moments) system method with robust standard errors corrected for finite sample bias and time effects. Instruments were collapsed. The table reports the two-step estimation. Hansen test excluding group (Difference (null H = exogenous)) examines the validity (the exogeneity) of our instrument subset used in the level equation. Robust standard errors are reported in parentheses. \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | |

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| **Table 11. Institutional quality and corporate recycling performance. Heckman selection model** | | | | | | |
| **Outcome:** | **Recycled Waste** | | **Recycled Water** | | **Recycled Paper** | |
|  | **Selection Equation** | **Outcome Equation** | **Selection Equation** | **Outcome Equation** | **Selection Equation** | **Outcome Equation** |
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Sector: Consumer Staples | -0.037 |  | 0.405\*\*\* |  | -0.338\*\*\* |  |
|  | (0.060) |  | (0.058) |  | (0.103) |  |
| Sector: Materials | -0.078 |  | -0.755\*\*\* |  | 0.887\*\*\* |  |
|  | (0.081) |  | (0.107) |  | (0.097) |  |
| Sector: Communication | 0.196\*\* |  | 0.202\*\*\* |  | -0.097 |  |
|  | (0.077) |  | (0.076) |  | (0.127) |  |
| Sector: Information Technology | 0.024 |  | -0.350\*\*\* |  | 0.223\*\* |  |
|  | (0.065) |  | (0.072) |  | (0.094) |  |
| Sector: Consumer Discretionary | 0.096 |  | -0.275\*\*\* |  | 0.007 |  |
|  | (0.059) |  | (0.062) |  | (0.090) |  |
| Sector: Industry | -0.100 |  | 0.147\*\* |  | -0.410\*\*\* |  |
|  | (0.072) |  | (0.070) |  | (0.127) |  |
| Sector: Energy | -0.242\*\*\* |  | -0.523\*\*\* |  | -0.339\*\*\* |  |
|  | (0.075) |  | (0.083) |  | (0.129) |  |
| Sector: Utilities | 0.074 |  | -0.223\*\*\* |  | -0.114 |  |
|  | (0.073) |  | (0.077) |  | (0.116) |  |
| Sector: Health Care | 0.156\*\* |  | -0.855\*\*\* |  | 0.133 |  |
|  | (0.075) |  | (0.079) |  | (0.118) |  |
| Control of Corruption t-1 | 0.250\*\* | -8.037\*\*\* | 0.411\*\*\* | 59.795\*\*\* | -0.587\*\*\* | 0.459 |
|  | (0.102) | (1.704) | (0.108) | (4.758) | (0.168) | (0.550) |
| Government Effectiveness t-1 | 0.178\*\*\* | 5.983\*\*\* | 0.317\*\*\* | -14.059\*\* | 0.121 | -2.138\*\*\* |
|  | (0.058) | (2.300) | (0.062) | (6.389) | (0.087) | (0.803) |
| Political Stability t-1 | -0.091 | 7.793\*\*\* | -0.016 | -14.050\*\*\* | 0.109 | -1.619\*\*\* |
|  | (0.087) | (1.303) | (0.099) | (3.632) | (0.137) | (0.325) |
| Regulatory Quality t-1 | -0.236\*\* | -4.079\* | 0.329\*\*\* | -18.670\*\*\* | 0.228 | 0.205 |
|  | (0.112) | (2.168) | (0.117) | (5.578) | (0.181) | (0.551) |
| Rule of Law t-1 | 0.255\*\*\* | 6.058\*\* | -0.044 | -25.255\*\*\* | -0.348\*\*\* | 2.617\*\*\* |
|  | (0.043) | (2.543) | (0.045) | (6.699) | (0.064) | (0.766) |
| Voice t-1 | -0.000 | 1.124 | -0.001\*\* | -4.058 | 0.000 | -0.278 |
|  | (0.000) | (1.080) | (0.000) | (2.485) | (0.000) | (0.296) |
| Debt/Equity t-1 | -0.008\*\*\* | 0.006 | -0.001 | 0.018 | 0.001 | -0.001 |
|  | (0.001) | (0.007) | (0.001) | (0.020) | (0.002) | (0.002) |
| Sales Growth t-1 | 0.061 | -0.102\*\*\* | 0.090\* | 0.170\*\* | -0.137\* | -0.016\* |
|  | (0.044) | (0.032) | (0.046) | (0.076) | (0.073) | (0.009) |
| Cash Ratio t-1 | 0.183\*\*\* | -7.916\*\*\* | 0.225\*\*\* | 2.806 | 0.032 | -0.209 |
|  | (0.015) | (0.988) | (0.015) | (2.569) | (0.023) | (0.320) |
| Ln(Assets) t-1 | 0.020\*\*\* | -0.845\*\* | -0.004 | -7.187\*\*\* | -0.010 | 0.187\*\* |
|  | (0.004) | (0.380) | (0.004) | (1.034) | (0.006) | (0.092) |
| ROA t-1 | -0.049 | 0.786\*\*\* | -0.008 | -0.848\*\*\* | 0.021 | 0.131\*\*\* |
|  | (0.039) | (0.090) | (0.041) | (0.228) | (0.060) | (0.027) |
| CEO Duality t-1 | 0.024\*\*\* | 7.772\*\*\* | -0.021\*\*\* | 4.424\* | 0.022\*\* | -0.400\* |
|  | (0.006) | (0.903) | (0.007) | (2.336) | (0.009) | (0.235) |
| Board Size t-1 | -0.000 | 0.488\*\*\* | 0.003\*\*\* | 0.609\* | -0.001 | -0.076\* |
|  | (0.001) | (0.139) | (0.001) | (0.355) | (0.001) | (0.043) |
| Independent t-1 | 0.139\*\*\* | -0.095\*\*\* | 0.306\*\*\* | -0.118\*\* | 0.297\*\*\* | -0.004 |
|  | (0.039) | (0.019) | (0.038) | (0.058) | (0.057) | (0.005) |
| CSR Committee t-1 | 0.079\*\* | -9.952\*\*\* | 0.031 | -7.333\*\*\* | -0.039 | -0.363 |
|  | (0.036) | (0.812) | (0.039) | (2.303) | (0.054) | (0.226) |
| Temp t-1 | -0.312\*\*\* | 1.833\*\* | -0.211\*\*\* | -1.191 | 0.309\*\*\* | -0.454\*\* |
|  | (0.050) | (0.783) | (0.052) | (2.274) | (0.080) | (0.199) |
| Ln (GDPc t-1) | -0.075\*\*\* | -0.919 | -0.030\*\*\* | 11.855\*\*\* | -0.025\*\* | 0.219 |
|  | (0.009) | (1.157) | (0.009) | (3.041) | (0.012) | (0.367) |
| GDPg t-1 | -0.004 | -0.286 | -0.024\*\*\* | 1.497\*\*\* | -0.003 | 0.110\*\* |
|  | (0.004) | (0.194) | (0.007) | (0.487) | (0.007) | (0.049) |
| Inflation t-1 | 0.747\* | -0.596\*\*\* | -1.038\*\* | 1.543\*\*\* | -4.860\*\*\* | 0.043 |
|  | (0.451) | (0.099) | (0.471) | (0.403) | (0.733) | (0.029) |
| Intercept | -0.037 | 69.452\*\*\* | 0.405\*\*\* | 55.683\*\* | -0.338\*\*\* | -4.727 |
|  | (0.060) | (10.708) | (0.058) | (27.698) | (0.103) | (3.571) |
| Observations | 10886 | | 10886 | | 10886 | |
| Lambda (Inverse of Mill’s ratio) (p-value) | -3.804 (0.321) | | -46.460\*\*\* (0.000) | | 1.510\*\*\* (0.000) | |
| Rho (Variance of errors in outcome equation) | -0.126 | | -0.954 | | 0.678 | |
| Sigma (Covariance of errors in selection function) | 30.211 | | 48.681 | | 2.226 | |
| Time effects | Yes | | Yes | | Yes | |
| **Notes**: Coefficients are estimated using the two-step Heckman selection model with time effects. Standard errors are reported in parentheses. \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | |

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| **Table 12. Institutional quality and corporate recycling performance. Heckman selection model with alternative institutional variables** | | | | | | |
| **Outcome:** | **Recycled Waste** | | **Recycled Water** | | **Recycled Paper** | |
|  | **Selection Equation** | **Outcome Equation** | **Selection Equation** | **Outcome Equation** | **Selection Equation** | **Outcome Equation** |
| **Variables** | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| Sector: Consumer Staples | -0.041 |  | 0.421\*\*\* |  | -0.413\*\*\* |  |
|  | (0.060) |  | (0.059) |  | (0.106) |  |
| Sector: Materials | -0.069 |  | -0.703\*\*\* |  | 0.828\*\*\* |  |
|  | (0.081) |  | (0.107) |  | (0.098) |  |
| Sector: Communication | 0.200\*\*\* |  | 0.239\*\*\* |  | -0.225\* |  |
|  | (0.077) |  | (0.076) |  | (0.131) |  |
| Sector: Information Technology | 0.017 |  | -0.377\*\*\* |  | 0.161\* |  |
|  | (0.065) |  | (0.073) |  | (0.096) |  |
| Sector: Consumer Discretionary | 0.093 |  | -0.263\*\*\* |  | -0.058 |  |
|  | (0.058) |  | (0.062) |  | (0.091) |  |
| Sector: Industry | -0.115 |  | 0.137\* |  | -0.491\*\*\* |  |
|  | (0.073) |  | (0.071) |  | (0.130) |  |
| Sector: Energy | -0.219\*\*\* |  | -0.508\*\*\* |  | -0.434\*\*\* |  |
|  | (0.076) |  | (0.085) |  | (0.132) |  |
| Sector: Utilities | 0.068 |  | -0.201\*\*\* |  | -0.183 |  |
|  | (0.072) |  | (0.077) |  | (0.118) |  |
| Sector: Health Care | 0.003 |  | -0.016\*\*\* |  | -0.002 |  |
|  | (0.004) |  | (0.004) |  | (0.007) |  |
| Executive Constraints t-1 | 0.006\*\* | -0.439\*\*\* | 0.006\*\* | -0.058 | -0.005 | -0.002 |
|  | (0.003) | (0.091) | (0.003) | (0.255) | (0.004) | (0.027) |
| Political Accountability t-1 | 0.028\*\*\* | 0.227\*\*\* | 0.046\*\*\* | -0.379\*\* | -0.044\*\*\* | 0.003 |
|  | (0.005) | (0.058) | (0.005) | (0.150) | (0.008) | (0.014) |
| Rule of Law (Legatum) t-1 | -0.003 | 1.306\*\*\* | -0.016\*\*\* | -2.075\*\*\* | 0.054\*\*\* | -0.175\*\*\* |
|  | (0.004) | (0.110) | (0.005) | (0.294) | (0.007) | (0.043) |
| Government Integrity t-1 | -0.004 | -0.595\*\*\* | -0.012\*\*\* | 1.543\*\*\* | -0.020\*\*\* | 0.084\*\*\* |
|  | (0.004) | (0.100) | (0.004) | (0.271) | (0.006) | (0.032) |
| Government Effectiveness (Legatum) t-1 | -0.010\* | 0.005 | -0.026\*\*\* | 0.672\*\*\* | 0.008 | 0.041\*\* |
|  | (0.005) | (0.086) | (0.006) | (0.242) | (0.008) | (0.020) |
| Regulatory Quality (Legatum) t-1 | -0.000 | -0.167 | -0.001\*\* | 1.161\*\*\* | -0.000 | 0.094\*\*\* |
|  | (0.000) | (0.115) | (0.000) | (0.308) | (0.000) | (0.030) |
| Debt/Equity t-1 | -0.008\*\*\* | 0.013\* | -0.002 | 0.013 | 0.000 | 0.001 |
|  | (0.001) | (0.007) | (0.001) | (0.019) | (0.002) | (0.002) |
| Sales Growth t-1 | 0.084\* | -0.093\*\*\* | 0.103\*\* | 0.178\*\* | -0.150\*\* | -0.020\*\* |
|  | (0.044) | (0.032) | (0.046) | (0.076) | (0.075) | (0.009) |
| Cash Ratio t-1 | 0.176\*\*\* | -7.360\*\*\* | 0.215\*\*\* | 0.882 | 0.035 | -0.586\* |
|  | (0.015) | (0.985) | (0.015) | (2.577) | (0.023) | (0.327) |
| Ln(Assets) t-1 | 0.021\*\*\* | -1.345\*\*\* | -0.004 | -6.248\*\*\* | -0.010\* | 0.135 |
|  | (0.004) | (0.375) | (0.004) | (1.019) | (0.006) | (0.098) |
| ROA t-1 | -0.097\*\*\* | 0.767\*\*\* | 0.056 | -0.792\*\*\* | 0.025 | 0.140\*\*\* |
|  | (0.038) | (0.089) | (0.040) | (0.227) | (0.059) | (0.027) |
| CEO Duality t-1 | 0.033\*\*\* | 8.151\*\*\* | -0.016\*\* | -0.480 | 0.014 | -0.388 |
|  | (0.006) | (0.880) | (0.007) | (2.241) | (0.010) | (0.237) |
| Board Size t-1 | 0.001 | 0.622\*\*\* | 0.005\*\*\* | 0.153 | -0.001 | -0.073\* |
|  | (0.001) | (0.141) | (0.001) | (0.359) | (0.001) | (0.042) |
| Independent t-1 | 0.169\*\*\* | -0.086\*\*\* | 0.344\*\*\* | -0.212\*\*\* | 0.257\*\*\* | -0.003 |
|  | (0.039) | (0.019) | (0.038) | (0.059) | (0.058) | (0.006) |
| CSR Committee t-1 | 0.098\*\*\* | -8.448\*\*\* | -0.064\* | -9.783\*\*\* | -0.061 | -0.236 |
|  | (0.035) | (0.819) | (0.038) | (2.364) | (0.053) | (0.233) |
| Temp t-1 | -0.257\*\*\* | 1.200 | 0.043 | 6.194\*\*\* | 0.054 | -0.504\*\* |
|  | (0.055) | (0.765) | (0.058) | (2.193) | (0.087) | (0.196) |
| Ln (GDPc t-1) | -0.077\*\*\* | 1.629 | -0.028\*\*\* | -10.751\*\*\* | -0.033\*\*\* | -0.851\*\* |
|  | (0.008) | (1.247) | (0.008) | (3.283) | (0.013) | (0.354) |
| GDPg t-1 | -0.001 | -0.162 | -0.025\*\*\* | 1.506\*\*\* | -0.003 | 0.061 |
|  | (0.004) | (0.191) | (0.006) | (0.458) | (0.007) | (0.049) |
| Inflation t-1 | -0.857\*\* | -0.552\*\*\* | -2.185\*\*\* | 1.573\*\*\* | -2.249\*\*\* | 0.020 |
|  | (0.403) | (0.095) | (0.422) | (0.394) | (0.643) | (0.029) |
| Intercept | -0.041 | 36.467\*\*\* | 0.421\*\*\* | 196.575\*\*\* | -0.413\*\*\* | 2.196 |
|  | (0.060) | (10.130) | (0.059) | (25.322) | (0.106) | (2.792) |
| Observations | 10886 | | 10886 | | 10886 | |
| Lambda (Inverse of Mill’s ratio) (p-value) | -6.383\* (0.086) | | -46.417\*\*\* (0.000) | | -2.249\*\*\* (0.000) | |
| Rho (Variance of errors in outcome equation) | -0.212 | | -0.955 | | 0.682 | |
| Sigma (Covariance of errors in selection function) | 30.089 | | 48.616 | | 2.252 | |
| Time effects | Yes | | Yes | | Yes | |
| **Notes**: Coefficients are estimated using the two-step Heckman selection model with time effects. Standard errors are reported in parentheses. \* indicates significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level. | | | | | | |

1. 5.5% represents the difference between the exponential value of *Recycled Paper*’s coefficient from column (6) and 1. [↑](#footnote-ref-1)
2. We are grateful to one anonymous referee for pointing this econometric issue. [↑](#footnote-ref-2)