

ARE INNOVATIVE FIRMS MORE CIRCULAR WHEN WOMEN HOLD UPPER POSITIONS?

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EXTENDED SUMMARY

The increase in natural disasters, frequent and abrupt temperature changes, water stress, and the growing threat of extinction of animal and plant species, are some of the consequences of a linear model involving extraction, transformation, consumption, and the final and direct disposal of waste on landfills without any form of use or revaluation (Ellen MacArthur Foundation, 2024a; Sundar et al., 2023). In this sense, the paradigm of the circular economy (CE, hereinafter) provides an effective path where the prosperous development of business activities is closely linked to the preservation, care and recovery of ecosystems and their endemic wealth (Kirchherr et al., 2023a). Simultaneously, intercultural and intergenerational integration is promoted to ensure the functioning of a single, shared planet, through: (i) the reduction and elimination of industrial pollutants in air, water bodies, and productive land and (ii) the reduction of the consumption of virgin materials or resources through increased

recycling, leading to a corresponding rise in available resources. To achieve this, processes must be promoted in which goods and services that cater to the needs of present and future humanity are prospectively rethought, within a framework that guides and guarantee the non-transgression of land capacity (Enciso-Alfaro & García-Sánchez, 2024; Desing et al., 2020).

In this way, Richardson et al. (2023), Persson et al., (2022), Steffen et al. (2015) and Rockström et al. (2009) indicate that the biophysical constraints of the Earth system must be understood as the "field of action" of business activities to achieve real planetary sustainability. Thus, they would avoid a rebound effect that, from an environmental perspective, would entail ignoring the true capacity of ecosystems to provide essential services to humanity (Desing et al., 2020).

The demands of society, which are being addressed by organisational leaders, are focused on establishing measures that facilitate the prosperity of communities while moving natural resources from a state of essential care to one of total restoration (Wagner, 2023; Sehrsweeney & Fischer, 2022). In this sense, business literature shows the significant role that women are playing in the establishment and promotion of innovation-oriented projects to mitigate climate change, manage waste properly, promote the optimal use of renewable energy, decontaminate aquatic bodies from plastics and preserve endemic biodiversity (Oyewo et al., 2024; García-Sánchez, et al., 2023a; Gull et al., 2023a; Issa & Zaid, 2023; Atif et al., 2021). Their role is associated with their understanding of the interaction between humanity and nature, as a relationship of interdependence that activates their altruistic and protectionist behaviour in favour of the environment (Gilligan, 1993; Schwartz, 1977). They bring this understanding into their professional environments, channelling it through their roles as independent and executive directors and providing diverse perspectives to the board (García-Sánchez, et al., 2023b; Konadu et al., 2022; García-Sánchez et al., 2021; Atif et al., 2021).

However, despite the necessary transition to an integrated CE aligned with the Earth's system capacity and the potential benefit of women in its establishment, scholars have not addressed this relationship. Previous literature is also inconclusive on the role of women, presenting contrasting views on whether gender diversity on the board is a key factor (i.e. Caby et al., 2024; Lemma et al., 2023; Cordeiro et al., 2020; Ben-Amar et al., 2017), as their presence has either negligible or no impact (i.e. García-Sánchez et al., 2021; Yang et al., 2019). Mixed results that could be associated with the narrow focus of the research conducted, centred on analysing the role that women play in driving individualised environmental strategies that contribute to mitigating adverse harms in full or in part. It is therefore necessary to address their impact in the consideration of an ecological transition towards an integral responsible model.

As a contribution to current knowledge, this research aims to achieve the following objectives: firstly, to discuss and analyse the influence of female directors in establishing a transition towards an integrated CE that positively impacts the capacity of the Earth's system (RQ1); and secondly, to examine the typology of female board members who have the greatest impact on circular business transition by determining the role played by their connection to the company's management team, as well as their external professional expertise and experience (RQ2). In this sense, we argue that independent directors are professionals of recognised prestige who meet the conditions ensuring their impartiality and objectivity of judgement along with prospective knowledge guiding decisions that favour the competitive and sustainable differentiation of the company, thereby increasing its value. In the case of female executive

directors, they have acquired knowledge through their roles, resulting in a knowledge spillover effect that is transferred to the companies, creating significant added value.

In addition to previous research interests, we propose a Composite Score, CET, which makes it possible to assess the impact of circularity initiatives implemented by large companies worldwide in the framework of the planetary boundaries defined by Richardson et al. (2023), Persson et al. (2022), Steffen et al. (2015) and Rockström et al. (2009). Thus, in our composite Score, we link the main CE strategies established in relevant literature (i.e. Kirchherr et al, 2017; 2023a; Geissdoerfer et al. 2017; Korhonen et al. 2018) to determine companies' contributions to maintaining planetary boundaries by linking them to Earth system processes. For example, we measure water recycling in a company, where the impact would result in a decrease in the use of natural water sources, facilitating the maintenance of the planetary boundary, for freshwater use.

Using a panel data comprising 61,549 observations from the period 2013 to 2022 and consisting of 8,923 companies operating in 9 industries and located in 74 geographical areas, we find that the presence of women in organisational leadership positions has a positive and significant impact on the shift from a linear to a circular business paradigm, integrated with the biophysical capacity of the planet Earth. With respect to the categories of female directors and the associated knowledge effect, we observe that the presence of female executive directors exerts a greater influence on the circular transition. This is identified through a more prevalent knowledge spillover effect compared to the prospective knowledge of female independent directors. The results remain robust to across various methodological specifications involving the use of different and complementary techniques and measures.

The intrinsic contributions of our work are manifold. First, following the notions presented by Richardson et al. (2023) and Desing et al. (2020) we present a practical integration of the CE paradigm into the preservation of the planetary boundaries crucial for maintaining a balanced and safe Earth system for human subsistence, providing business guidance directly connected to environmental care. Secondly, our contribution extends to the business and gender literature aligning with findings from García-Sánchez, et al. (2023b), Cambrea et al. (2023), Konadu et al., (2022) and Brahma et al. (2021), who highlight a prevalent impact of female executive directors over female independent directors in terms of environmental performance. In this sense, our work identifies theoretically and empirically a knowledge spillover effect derived from the introspective knowledge that female executive directors possess about companies. Thirdly, from a more operational and procedural standpoint, our proposal for a circular transition score complements previous literature by authors such as Korhonen et al. (2018), Geissdoerfer et al. (2017) and Kirchherr et al. (2017). We identify and quantify in an integrated manner, the main circular strategies that companies belonging to different industries can undertake to promote the care and protection of ecosystems.

This paper is organised into eight sections. Following this introduction, the second section presents our theoretical conception of CE and its integration with planetary boundaries. The third section shows the links between the multi-theoretical framework and the proposed hypotheses. The fourth section outlines the conceptual definition of variables, their measurement, proposed empirical models and the econometric techniques used. The fifth section presents the results of both basic and robust models. Section six presents a complementary analysis of the role of female directors. The seventh section discusses the

results. Finally, the eighth section presents the conclusions, implications and limitations of our research.

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