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The us in reUSe. Theorizing the how and why of the circular economy

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Abstract

Despite considerable interest into circular economy, it remains undertheorized and underdeveloped. In response, this article advances circular economy by drawing on two theories to explain how firms can increase the circularity of resource use and why they are incentivized to do so. We refer to Modern Portfolio Theory to link the resource use of individual companies to the resource use of a group of firms. In doing so, we show how—and under which conditions—resource use decreases when circulated at the group level. We then refer to principles from evolutionary biology to explain why it is beneficial to structure resource flows at the group level, even when the resource-reducing effect might not materialize for individual firms. In combining both perspectives we challenge entrenched ways of "doing" circular economy: We offer an integrated theoretical approach that helps inform managers' decision-making on circular resource use in practice.

1 | INTRODUCTION

Interest continues into circular economy, especially in terms of how it can be organized, measured, and improved as one strategy of achieving greater eco-efficiency. Historically, we can see antecedents to modern day circular economy from both ecological economics and industrial ecology (Bruel et al., 2019; Murray et al., 2017), resulting in both divergent and convergent ideas and assumptions. However, in terms of establishing an overall definition, articles often refer to the circular economy as when "resources are used circularly," alluding to activities like recycling. Based on an analysis of 114 articles, Kirchherr et al. (2017, p. 229), for instance, stated their definition as the "combination of reduce, reuse and recycling."

Beyond a high-level definition of the circular economy however, debates and differing foci ensue. Further, while some assumptions remain constant, we believe that not all should be thought of as cornerstones. Most researchers tend to approach and operationalize circularity at the level of the firm rather than at the macro, for example. However, this arguably constitutes an important and unhelpful bias in the literature as the circularity of resources as a means of societal eco-efficiency is, fundamentally, a macro-level phenomenon. Indeed, the idea of firm-level circularity is conceptually awkward: Rather, firm-level *activities* like recycling and reuse contribute to circularity—the latter unfurling at the macro.

Moreover, scoping circularity disproportionately at the level of the firm affects how we approach its measurement. Although the effectiveness and accuracy of indicators is hotly debated (Kristensen & Mosgaard, 2020; Moraga et al., 2019; Saidani et al., 2019), researchers tend to agree that measures should be deployed at the level of the firm. Thus, regardless of whether the level of analysis concerns entire fields, industries, or clusters (e.g., Chertow & Lombardi, 2005; Zhang et al., 2009) or the organization itself (e.g., Chen et al., 2020; Masi et al., 2018), the assumption is that each firm engages in recycling or reuse and does so as a relatively

Abbreviations: CAPM, Capital Asset Pricing Model; MPT, Modern Portfolio Theory.

bounded entity. In other words, each firm implements its own activities and systems of circularity and is assessed individually on that basis.

However, applying measures at the level of the firm has implications for the assessment of macro-level circularity and eco-efficiency, which are typically derived from aggregating the performances of individual firms. In other words, the "whole" (pertaining to a geographical area, industry, or other macro-based entity) is commonly derived from the sum of its "parts" (i.e., participating firms). Again, whilst acknowledging this as the prevailing approach in the literature, we challenge its logic—which we further demonstrate going forward in this article—by emphasizing that circularity itself unfurls over groups of firms rather than being bounded within a single organization.

On the one hand, these assumptions in the literature have procured a sense of stability; important when moving conceptual frameworks into practice. On the other hand, they have also encouraged entrenched ways of "doing" circular economy that are arguably preventing society from meeting its goals of eco-efficiency. A further example lies in the dominant notion that firms will only engage in the circular economy if there is a financial benefit of doing so, for instance, that is reminiscent of the business case approach for sustainability (e.g., Dyllick & Hockerts, 2002; Hoffman et al., 2014).

Yet, as more researchers join the discourse on the circular economy, especially those who hail from other disciplines, we can see how the persistence of some assumptions can be questioned—even those at the very heart of circular economy, as above. One of the implications of such questioning is that it demands a rethink on what strategies, approaches, and techniques really generate the greatest extent of organizational engagement with circular resource use, and several researchers have started to explore this. Figge, Thorpe, and Good (2021), for example, challenge whether assessing and aggregating circular economy systems at the level of the individual firm accurately captures extents of circularity at the meso- or macro-level, as we argue. Perhaps more importantly Figge, Thorpe, and Good (2021) demonstrate how (re)organizing resource (re)use over *groups* of firms encourages greater degrees of circularity—and thus eco-efficiency, as a societal or macro-level concept—when compared to individual firm-based systems.

In this conceptual paper, we advance the theory and practice of the circular economy by building theory that challenges some of long-standing assumptions on the efficacy of firm-based systems of circularity, and that firm-level financial benefits alone motivate firms to engage in circular resource use. In this way, we contribute to the second theme of this special issue on the circular economy—specifically we challenge entrenched ways of "doing" the circular economy by questioning existing ways of organizing. We do so by borrowing from financial theory and the natural sciences to build a holistic framework that incorporates "bottom-up" and "top-down" perspectives that offers an alternative approach to how we think about the circular economy. In doing so, we follow in the footsteps of other researchers (e.g., Genovese et al., 2017; Ghisellini et al., 2016; Gregson et al., 2015; Lieder & Rashid, 2016) who highlight the multi-leveled nature of the circular economy, and that tracking activity as it flows from one level to another is a crucial component for theory building—as well as being essential for the successful implementation of circular economy principles into practice. In short, by focusing on both bottom-up and top-down approaches simultaneously, we build a more holistic framework.

Overall, our framework details: (1) *how* the circular economy can be organized around groups, and (2) *why* organizations will be incentivized to do so—an already long-established approach in theory building (e.g., Wacker, 1998). Specifically, we use Modern Portfolio Theory (MPT) (Markowitz, 1952, 1959) as a bottom-up approach to explain the former, and principles from evolution (Okasha, 2006; Wilson et al., 2008; Wilson & Gowdy, 2013; Wilson & Wilson, 2007) to explain the latter. In this way, our two approaches overlap in a way that is akin to a Venn diagram (Figure 1), where the shared component reflects the optimal organization of firms, that is, as grouped entities, for eco-efficiency. In other words, eco-efficiency is the common denominator and criteria for success of and for both approaches. At the same time, each approach individually brings a different explanatory perspective, that is, pertaining to "how" and "why" as above.

In taking this approach, we provide a fresh perspective on the organization and assessment practices of "doing" the circular economy. In this way, we question some of the existing assumptions that dominate current theory, as above. In particular, we challenge the idea that the individual firm should be the unit of organizing and assessing circularity—and therefore operationalizing eco-efficiency—as well as the notion that firms are motivated to engage in circular systems by financial incentives.

The rest of our paper is structured as follows. As this is a special issue on circular economy, we dive straight into the first part of our framework by describing MPT and its applicability to circular economy, before doing the same with the principles we use from evolutionary theory. Then we converge the two, highlighting the synergy that arises from doing so, and its value in explaining the "how" and "why" questions we pose, as above. We conclude with a discussion section where we unpack our contribution to circular economy theory, before describing the implications of our framework for both practice and policy. Key decision-makers within organizations as well

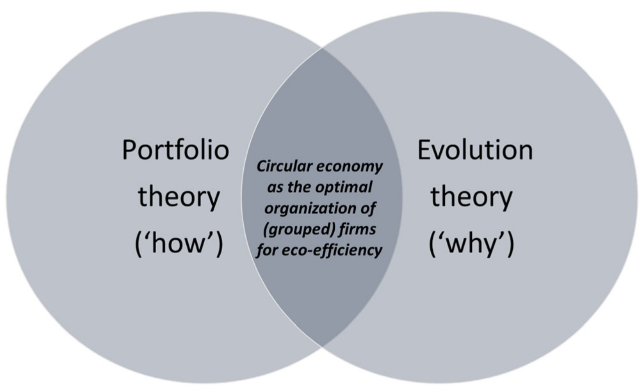

FIGURE 1 Linking the "how" and the "why" of the circular economy [Colour figure can be viewed at wileyonlinelibrary.com]

as policymakers at the macro-level can use our model to enhance societal goals of eco-efficiency through circular resource use. We conclude with some limitations, suggestions for further research, and some final comments.

2 | PORTFOLIO THEORY AND CIRCULAR ECONOMY: A BOTTOM-UP APPROACH

"Risk" and "return" dominate financial decision-making; whilst returns are desirable, risks are undesirable. An asset is risky when it has different possible returns in the future—in other words when the return is, to varying extents, unknown. The higher the range, or spread, of expected returns, the higher the risk. Investing in a group of assets that individually are associated with a high degree of risk, that is, diversification, is usually preferable to investing in a single asset; a long-established notion (e.g., Shakespeare, 1750).

Modern Portfolio Theory (MPT) has formalized the relationship between risk and return at the level of an individual asset, and risk and return at the level of an entire portfolio (Markowitz, 1952, 1959). The main insight of portfolio theory is that returns of individual assets in a portfolio add up, while risks diversify. Thus, the act of combining investments into different assets, that is, as a portfolio, generates (a) lower absolute risk and (b) a higher return–risk efficiency, in comparison to when all funds are invested into any single asset. The rationale underpinning MPT has enabled further developments in financial theory and practice.

Assuming then that risk can be diversified away at the portfolio level—by combining investments into different assets—it is logical for risk-averse investors to diversify. Under the assumption that markets are efficient (Fama, 1965, 1970; Fama & MacBeth, 1973), that is, on the basis that information on assets is available and priced in by investors, investors can be expected to diversify: Concentrating their investments on a single or few assets would mean that they would assume a risk without a potential reward. The assumption of market efficiency enabled the development of the Capital Asset Pricing Model (CAPM) (Lintner, 1965; Mossin, 1966; Sharpe, 1964), where diversifiable, unsystematic risk is clearly separated from non-diversifiable, systematic risk. Assuming that investors can also invest in an asset that is free of risk, CAPM allows to price systematic risk. As there is no reason for investors to assume unsystematic risk, that is, because there is no reward, unsystematic risk has a price of zero.

From the perspective of an individual firm, any unpredictable variation of returns constitutes a risk, that is, something that is undesirable and that a firm tries to minimize. Financial theory allows the identification of the part of the risk that is systematic—and which promises investors a return—and the part of the risk that is unsystematic and consequently irrelevant for investors: Without MPT and CAPM, firms could not distinguish the two.

In this paper, we draw an analogy between financial portfolio theory where risks can be negated at the portfolio level and the resource-reducing effect of the circular economy. In financial portfolio theory, undesirable risk is linked to a desirable return. Analogously, the use of natural resources is undesirable because sustainability demands that we limit their use (e.g., Hardin, 1968; Meadows et al., 1972). At the same time, companies need natural resources, just like they need financial resources, to "produce," that is, to create a return, which is desirable. Natural resources and financial resources are at least to some degree complementary (Neumayer, 2003). In our analogy, we replace the notion of risk in financial portfolio theory by natural resource use, that is, we have two variables in our application of portfolio theory: Return created and natural resources used.

The notion of efficiency is key to both financial portfolio theory and our application. The more return per unit of risk, the more risk-efficient the investment. And, analogously, the more return is created per unit of natural resource use, the more eco-efficient the use of that resource (e.g., DeSimone & Popoff, 1998; World Business Council for Sustainable Development, 1996; World Business Council for Sustainable Development & United Nations Environment Programme, 1998). Whilst in financial decision-making diversifying investments helps to reduce risk, we argue that by closing loops, resources are used (more) circularly, reducing the extent to which virgin resources are used (Pearce & Turner, 1990). Analogously to systematic and unsystematic risk in financial portfolio theory, we can distinguish between resource use that is linear (i.e., where resources are used only once), and that which is circular (i.e., where resources are used over and over again): In the former, resource use is accounted for at the level of the individual firm; in the latter, resources are shared across a group of firms and resource use can only be accounted for at the level of that group. A firm can use both linear and circular resources concurrently, making the accounting for and assessment of resource use challenging.

An assessment of resource use can be undertaken by capitalizing on what MPT has shown (Alvarez et al., 2017). Consequently, when a single system of circularity involves several firms, we cannot determine the extent of resource use and reuse overall by merely adding together individual firm usages: The total derived in this way would exceed the actual extent of use and re-use as it unfurls across the group (Figge, Thorpe, & Good, 2021). By adding up resource usage of individual firms in this way, some resources would be double counted, for example. To overcome this, we need to look at resource use at the portfolio or group level. Just as important as understanding how to assess circular resource use is to understand how circularity reduces resource use: On the same principle as the risk-reducing effect of diversification in financial portfolio theory, a circular use of resources reduces the use of natural resources at the portfolio level, without reducing resource use at the level of the individual firm (Figge, Thorpe, & Manzhynski, 2021). Each firm has the same number of resources at their disposal, which consists of the same resources in the case of circular resource use and different (virgin) resources in the case of linear resource use. In this way, distinguishing which resources are used circularly and which are used linearly is far from trivial.

Whilst eco-efficiency is a phenomenon that can be framed at both micro- and macro-levels, as above, the broader phenomenon of sustainability is a macro-level concept. As Jennings and Zandbergen (1995, p. 1023) argue, "individual organizations cannot become sustainable: Individual organizations simply contribute to the large system in which sustainability may or may not be achieved." By helping to make resources flow between companies more circularly, a firm does not reduce its own resource use; it reduces the use of resources at the portfolio level. Put differently, the benefits of making resources flow between companies more circularly are seen at the portfolio level rather than at the level of the individual firm.

Financial portfolio theory shows the risk–return characteristics of a portfolio depending on how investments across different assets are combined. By investing in assets where returns correlate negatively with the return of other assets in the portfolio, the risk of the portfolio is reduced. A positive return of one asset is (partially) offset by a negative return of another asset. This principle applies analogously to circular resource use. The outflow of a resource of one company must be matched with the inflow of resources by another company. In a perfectly circular economy where resource loops are fully closed and waste is zero, the outflows of companies in the portfolio are perfectly matched with the inflows of other companies; no additional virgin resources are used at the portfolio level. This is in contrast to a perfectly linear economy, where the resource use at the portfolio level is the sum of the resource use of all individual companies within the portfolio.

In practice, resource use is imperfectly circular. Iron, nickel, and copper, for example, are all used between 1.9 and 3 times before they end up as waste (Daigo, 2004; Eckelman & Daigo, 2008; Eckelman et al., 2012; Klose & Pauliuk, 2021); that is, their use is therefore neither fully linear nor fully circular, having elements of both that reflect a hybrid system of sorts. Such systems of imperfect circularity are also arguably more complex and less transparent than perfect systems. In imperfect systems, it is impossible for a firm to conclude whether a resource is linear or circular, for example, without referring to other firms. In other words, without knowing whether other firms reuse the resource, it has the potential to be either circular or linear.

In this way, the principle is the same as that of systematic and unsystematic risk: Whether the risk is systematic or unsystematic depends on the degree to which the return of one firm covaries with the return of other firms. If the returns are negatively or at least not perfectly positively correlated, some of the risk disappears (Markowitz, 1952, 1959). To distinguish between systematic and unsystematic risk investors determine the degree to which the return of an individual firm covaries on average with the returns of the other firms (Lintner, 1965; Mossin, 1966; Sharpe, 1964). Whether a risk is systematic or unsystematic therefore depends on both, the variation of the returns of the firm in question and the variation of the other firms. To be able to dissect a risk into its systematic and unsystematic component we therefore need information (a) on the returns of the firm in question and (b) on the other firms of the market. Consequently, systematic and unsystematic risks are unrecognizable from each other in isolation. Put simply, for the fate of an individual firm it does not matter whether a risk is systematic or unsystematic. In isolation, that is, when distanced from other firms, a company cannot tell the difference, and the difference also does not matter to the individual company.

It is therefore unsurprising that much of the strategy literature is concerned with the management of unsystematic risks, as pointed out by Bettis (1983)—even though they are not rewarded by the financial markets. And the same applies to the management of natural resources. Any unit of a natural resource that a firm uses can be either linear or circular, as above. If it is circular, it does not constitute a burden, and arguably does not need to be taken into account from a societal perspective. Conversely, however, both the literature on corporate sustainability management as well as corporate practice are concerned with managing resource flows within companies, which can be linear or circular, the latter through activities of recycling and reusing. Research has claimed that using resources more eco-efficiently, "doing more with less" (e.g., Young & Tilley, 2006), is in the interest of firms (e.g., Dyllick & Hockerts, 2002; Holliday et al., 2002). Corporate tools designed for managing natural resources therefore concentrate on intrafirm resource flows regardless of if they are linear or circular from a societal perspective. Yet, as recent research has shown lowering intrafirm resource flows can reduce the circularity of resource flows (Figge & Thorpe, 2019). We therefore argue that as current corporate tools for managing natural resources can lead to a decrease of circularity at the portfolio level they are not necessarily fit for purpose when they are applied to circular systems. This does not mean that resource flows should not be managed at the level of the firm. Rather, we argue analogously to Peavy (1984) for systematic and unsystematic risk, that circular resources need to be managed differently than linear resources.

In finance, the assumption of rational investors and the existence of efficient markets, together with the insights of MPT, help to define an equilibrium model, where systematic risk is priced, enabling the distinction between systematic and unsystematic risk at the level of the individual asset. Rational investors will use any opportunity that emerges to benefit from price differences in two different markets—a principle known as arbitrage. Arbitrage ensures that risks are priced the same for all companies and investors. According to the CAPM there is a linear relationship between the degree to which a risk is systematic and its price.

In contrast to the prevailing assumption of efficient markets in finance (Fama, 1965, 1970), there are no natural resource-efficient markets for natural resources. A sign for an efficient market is that there is some form of price discrimination. In an efficient financial market unsystematic and systematic risks are priced differently: Unsystematic risks would have a price of zero while the price of systematic risks would depend on the degree to which returns covary with the rest of the market. A market that is natural resource-efficient would discriminate the price of natural resources based on their scarcity on the societal level. For firms, linear resources would have a higher price than circular resources. In a perfect market the price of circular resources would be zero. Whilst efforts for more documentation and certification of natural resources are undertaken, we actually observe the opposite effect: The price for recycled, that is, circular, polyester has even exceeded the price of virgin polyester, for example (Borulev & Brooks, 2021).

Resources that are homogeneous in physical terms, that is, that have the same quality and characteristics, usually have the same price in the markets today. This is regardless of whether they are used circularly or linearly. This leads us to the conclusion that the markets for natural resources are inefficient regarding their circular use. While the analogous insights of MPT still apply, we can therefore not expect that market forces will lead to a pricing that reflects the scarcity of the resource at the portfolio level. In the absence of any market signal, a clear separation between linear and circular resources is impossible. We can expect companies to treat resources the same—regardless of their circular or linear characteristics.

We can learn from MPT how the resource flows of individual companies can be aggregated to become the resource flows of the entire portfolio (Figge, Thorpe, & Manzhynski, 2021). Put simply, the application of MPT can show us how to make resource flows more circular.

The nonexistence of an efficient market for natural resources prevents the development of a CAPM for natural resources that followed the development of MPT in finance. In finance the CAPM allows us to distinguish between systematic and unsystematic risks; it prices risks accordingly and in this way provides the necessary incentives to deal with risks rationally. The same does not exist for natural resources. Put differently, the application of finance theory can provide great insight into *how* to make resource flows more circular: It provides a roadmap as to *how* groups can coordinate resource flows with the aim of minimizing the use of virgin resources at the group level. Yet finance theory fails to provide a sound rationale as to *why* such resource flows should become more circular.

3 | EVOLUTION AND CIRCULAR ECONOMY: A TOP-DOWN APPROACH

The competitive environment of companies is characterized by uncertainty and risk (Dreyer & Grønhaug, 2004). The implicit assumption within strategy research is that companies are motivated to develop strategies to secure a better market position than their rivals. It is also often assumed that firms can develop such strategies and that they have the foresight to do so.

We challenge this notion by arguing, as above, that efficient markets for natural resources are missing as there is no price discrimination based on the scarcity of resources at the societal level. Companies must use resources efficiently to succeed and they will take these resource prices into account when they decide on which resources they will use and how these resources will be used. Higher (lower) resource prices incentivize companies to use resources more (less) efficiently. By following their self-interest, typically interpreted as profit-maximization, companies will help to maximize the efficiency of resource use at the societal level, thus contributing to societal welfare—if resource prices reflect the relevant societal scarcities. If resource prices do not reflect societal interests, market failures (Bator, 1958) are likely to follow, and social welfare is lost. As explained above, we argue that there is an absence of efficient markets for natural resources, that is, prices do not reflect the scarcity of resources correctly from a societal perspective, sending out distorted price signals. Companies will still aim to use resources efficiently but will base their decisions on these distorted prices. As a result, companies are likely to use linear resource flows less efficiently and circular resource flows more efficiently than necessary to maximize overall efficiency, and thus societal welfare. The likelihood of a bottom-up market-based system of failing is high. In contrast, a top-down system based on evolutionary principles can explain the dynamics that help to maximize societal welfare in the long term.

The implication of distorted prices is that using natural resources more efficiently does not necessarily result in a competitive advantage, which in turn, means that there is a limited incentive for companies to use resources in this way. In short, we argue that strategic management-based theories cannot adequately explain why firms are pressured to use fewer resources in the absence of a potential competitive advantage. We propose that evolutionary forces as an underpinning mechanism offer a convincing explanation.

In classical evolutionary biology, the principle of "survival of the fittest" Spencer (1864) describes and explains how species adapt to changing environments. Individuals of any species that are better adapted to changes in their environment, are referred to as "fitter" in evolutionary biology; they are more likely to survive and prosper, passing on their genes to the next generation. As these genes carry the underlying source of their competitive advantages, their offspring is also more likely to be more fit in the new environment. This mechanism of "natural selection" (Darwin, 1859) helps any species as a whole to adapt to changes in their environment. Consequently, at any one time we can say that the characteristics of species are an emergent property of the demands of their environment.

This mechanism from evolutionary biology has long been applied to firms and markets that operate in changing environments (Alchian, 1950). Companies that are better placed,—or "fitter"—to succeed in their environment are more likely to survive and prosper than companies that are less fit. In other words, firms that are better matched to the demands of their environment will emerge as survivors, whilst those that are not will struggle to do so. As we live in an increasingly resource constrained world, "fitter" in this sense refers to firms that use less resources. Further, firms that use few resources will still be less fit than firms that use even fewer resources, as this is what is increasingly demanded by society. At the same time, there is a crucial difference between the mechanism of natural selection and the beneficial effect of firms seeking to secure competitive advantages, as described in the strategy literature: "Success is based on results, not motivation" (Alchian, 1950, p. 213). In other words, the strategies and activities that firms adopt to make themselves "fitter" are immaterial. From an evolutionary perspective, it is the match between the end performance of a firm and what is demanded by its environment that determines whether the firm emerges as a survivor or whether it perishes. In other words, its strategic means, motives, and specific activities are largely irrelevant.

With very few exceptions (e.g., Safarzyńska et al., 2012; van den Bergh & Gowdy, 2009), the application of evolutionary principles to the corporate world continues to be dominated by individual comparisons—unsurprisingly so, given the foregrounding of classical Darwinian thinking in evolutionary debates. In other words, the logic from this perspective suggests that Firm A is more likely to survive and prosper in comparison to Firm B if the former is fitter than the latter. We can also expect that a third firm, Firm C, will do particularly well in the market if it has the greatest degree of fitness in the market. As above, the resource-reducing effect of circularity does not necessarily manifest itself at the level of the individual company. Figge, Thorpe, and Good (2021) have demonstrated that circular resource use increases the efficiency of resource use at the group level, but not necessarily for the individual firm. If a more efficient use of natural resources is synonymous with greater fitness, it is the group that a company shares resources with that becomes fitter, rather than the individual firm.

A similar discussion has taken place in evolutionary biology. Succinctly, for some species, selection takes place at the group level, that is, not at the level of the individual member of a species (Griffing, 1967; Wynne-Edwards, 1962). We can see this in the ecological example of lions in that their survival depends on their performance as a collaborative group. As part of a social species, lionesses defend their territory, but do so as a collaborative endeavor (Heinsohn & Packer, 1995; Packer & Heinsohn, 1996; Wilson & Wilson, 2007). Their survival therefore depends on the extent to which they work together as a group, in comparison to other rival prides. Subsequently, an individual lion has the best chance of survival if it is part of the most collaborative group as, importantly, selection itself takes place at the group level, rather than at the level of the individual (Craig & Muir, 1996; Muir, 1996).

The principles of group selection have also informed economics (Safarzyńska et al., 2012; van den Bergh & Gowdy, 2009). Specifically, when applied to the efficient use of natural resources by companies, the evolutionary patterns of group selection would, with all other things being equal (for example, the absence of vast inequalities in the financial reserves of different firms), favor groups of companies that use resources in ways that contribute to circularity. This is because groups of firms collectively use less resources than the sum of what they would do individually, giving these groups a competitive edge over other resource users acting alone. Of course, this is not a given, but the advantages of operating in a group have long been noted in ecology, as above, as well as in business management (e.g., through alliances, cartels, and other forms of collaboration). Within the circular economy, non-collaborating firms will find it difficult to engage in the recycling of materials within their individual firm boundaries, and in this respect, it is likely that their only options would be to narrow or slow their use of resources in a similar way to those firms that use resources linearly (Bocken et al., 2016).

Further, the advantages of enhanced circularity at the group level apply even if the firms within a group use resources less efficiently in isolation. Natural selection based on individual resource use would favor the emergence of companies with high operational efficiency of resource use, that is, companies that use natural resources efficiently within the scope of their company regardless of the question of whether these resources are circular or linear. Compared individually, the competitive advantage derives solely from how efficiently the resources are used that the company has at its disposal.

4 | PORTFOLIO THEORY AND EVOLUTION: CONVERGING BOTTOM-UP AND TOP-DOWN APPROACHES

In the penultimate section, we used theories from finance to show *how* companies can foster a more circular resource use. However, such theories fall short in explaining *why* companies should engage in activities for more circular resource use. Conversely, the theories from evolution that we used in the last section can help us understand *why* companies are incentivized to use resources more eco-efficiently—be it through a more eco-efficient linear or circular use—whilst they fail to explain *how* they can do so. In bringing together both approaches synergistically we show how and why companies can use resources more efficiently, and the role the circular economy can play, thereby contributing to advancing steps toward a circular economy.

An eco-efficient use of resources is often compared to the business case for sustainability (Dyllick & Hockerts, 2002): Firms are motivated to decrease resource flows because doing so will procure benefits for themselves—usually scoped as those which are financial in basis. Bocken et al. (2016) distinguish between three strategies to decreasing such resource flows: They can be slowed, narrowed, and/or closed. Extending the lifetime of products and services slows resource use. By using less resources to achieve the same purpose, resource flows are narrowed. When resources are used circularly, resource loops are closed. All three strategies have the potential to increase the eco-efficiency of resource use, and can be used singularly or in combination, with the literature focusing primarily on the strategies narrowing and closing. However, not all three strategies provide the same kind of benefit.

The optimization of resource use within a company, via a reduction in the number of natural resources needed for a given process, narrows resource flows. In turn, this increases eco-efficiency, and can for example help to reduce costs (Marchi et al., 2013; Orsato, 2006; Schaltegger & Figge, 2000)—enhancing the competitiveness of a firm in the process. Companies that can more successfully narrow resource flows in comparison to rival firms can, with all other things being equal, expect to attain a competitive advantage. Clearly, this benefit accrues at the level of the individual firm.

Closing resource loops can also enhance the efficiency of natural resource use. When companies pass on resources after their initial use to other firms to reuse, fewer virgin resources are required overall, enhancing the eco-efficiency of that resource (Figge et al., 2017; Vanhamäki et al., 2020). This can also result in cost reductions and, again, with all other things being equal, in a competitive advantage. However, the benefit accrues at the group level, not at the individual firm, as demonstrated by Figge, Thorpe, and Good (2021).

To date, tools and techniques to manage corporate sustainability are typically company-focused, that is, they scope such sustainability within the individual firm. This is because they either aim to enhance sustainability performance within the boundaries of a firm or, if such tools and techniques extend beyond the scope of the firm, they do so with the ultimate aim of reaping benefits for the said firm. Some tools have the objective of optimizing supply chains, for example, but the overall aim is to garner financial rewards for the individual firm (e.g., Tseng et al., 2019; Wang & Sarkis, 2013). However, when companies cooperate to share resources, the immediate environmental and financial benefit will accrue outside the firm.

From a business case perspective, companies face the challenge of having to choose between different strategies to enhance their eco-efficiency so that they might gain a competitive advantage. Principles from evolutionary biology tell us that whether a strategy is optimal or not will depend on which level selection takes place. An individual firm in competition with others needs to increase the operational eco-efficiency of its activities, that is, how it uses natural resources within the boundaries of the company itself, as the benefit will incur at the level of that individual firm. When a group of firms competes with other groups it needs to ensure that the eco-efficiency of their group increases. In other words, individual firms within the group need to collaborate and focus on the eco-efficiency of the group per se.

Although these two selection pressures are derived at different levels, that is, individual and group, they are not exclusive to each other. In the natural world, species are sometimes exposed to both intragroup and intergroup competition and “different levels of selection work with different net effects on the realized fitness” (Watve et al., 2010, p. 5).

We argue that the same applies to corporations. There can be an advantage of being based in a country that tends to use resources efficiently, for example. Firms contribute to this advantage by sharing resources between them. Yet, simultaneously, the same firms must compete with others—including those with which they are collaborating on resource use—both within their home country as well as with foreign companies. A further complication is that the effectiveness of either strategy is not clearly delineated from the other. Figge and Thorpe (2019) show, for instance, that when a company increases its own eco-efficiency there can be rebound effects. In other words, by increasing its eco-efficiency a company might reduce the resource flows to other companies, thus reducing the return they generate.

Figure 2 summarizes the core of our argument. We distinguish between three levels. Firms (micro-level) contribute to the efficiency of resource use at a group (meso) level by engaging in activities for more circular resource use. Portfolio theory helps to understand *how* the use of resources by individual firms is linked to the efficiency of resource use at the group level (Figge, Thorpe, & Manzhynski, 2021): In other words, the theory shows how the configuration of grouped firms affects overall resource use. Resources need to be used efficiently at a societal (macro) level to achieve sustainability. Evolution theory shows that an efficient use of resources at the societal (macro) level is achieved when groups (at the meso-level) that use resources most efficiently are selected. Evolution theory helps to understand *why* a particular resource use translates into a competitive advantage for that group. Since eco-efficiency is the denominator and criterion for success for both approaches MPT and evolution theory complement each other at the group level by determining (1) *how* individual resource use translates into eco-efficiency at the group level and (2) *why* one group rather than another will survive (see also Figure 1).

We illustrate this in Figure 3 with an example of some typical resources flows within the wood-working industry. We can assume that this cluster of organizations corresponds to one of the groups in Figure 2—for example, Group B, as highlighted. As Figure 3 indicates, resource flows are intricate in this industry, with every step, from logging timber to using wood in the construction and furniture industry, involving the creation of waste. Crucially, this waste can be used by other firms within the group. Logging timber not only produces wood for woodworking plants, for example, it also, as a by-product, yields tree trimmings that biomass plants can use to produce energy

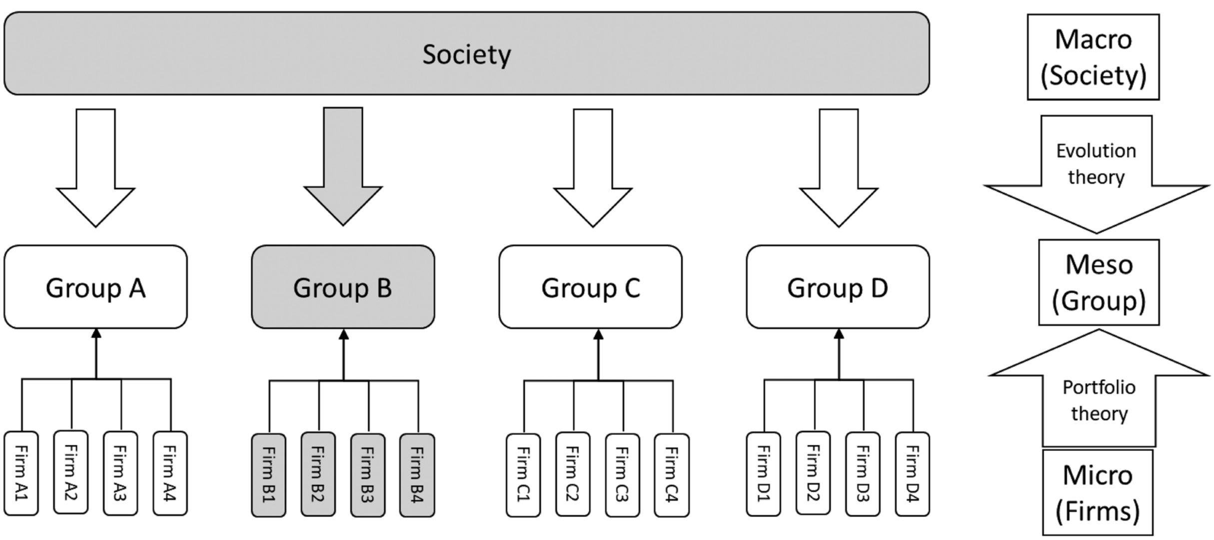

FIGURE 2 Model of group-based circularity

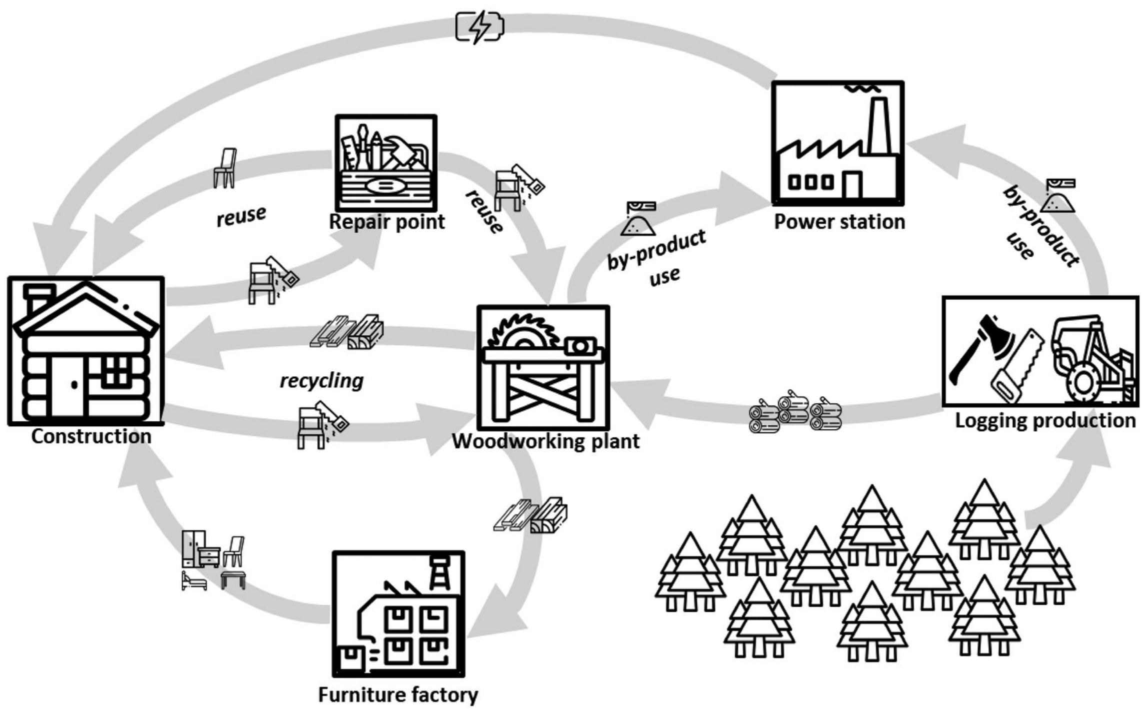

FIGURE 3 Woodworking industry group

(Thakur et al., 2014), which can, in turn, be used by the construction industry. Additionally, different uses of wood (e.g., for construction or furniture) demand different grades of quality (Jozsa & Middleton, 1994). By meeting the differentiated needs of customers, woodworking plants can reduce waste. Moreover, timber components of construction and furniture can be re-manufactured and re-used repeatedly (for example, by repairing and recycling) before being turned into biomass and being fed-back to the biomass plant (Antikainen et al., 2017).

These are just a few examples of ways to close resource loops—in reality, there are likely to be many more—but they all cumulate to the same point: The eco-efficiency of the entire group increases, gaining a competitive advantage over other groups in the construction industry (e.g., Groups A, C, and D in Figure 2). Again, portfolio theory can help to reveal *how* resource flows can be optimized within a group. A resource out-flow of one firm needs to be matched with a resource in-flow of equivalent size of another firm. Put in very practical terms for our example in Figure 2: "The size of the biomass power plant needed depends upon the availability of biomass within the region" (Thakur et al., 2014, p. 249). In summary, the optimization of the portfolio of resource users leads to (1) a reduction in the amount of virgin resources that are used, and (2) an increase in the efficiency of resource use at the group level.

However, this does not mean that the individual efficiencies of all firms also increase. Logging residues have low energy density (Thakur et al., 2014), requiring higher transport costs (Kärhä & Vartiamäki, 2006) compared to the fuel needed in the much higher energy density contexts of powerplants. When the efficiencies of powerplants are compared in isolation, this might put the former at a disadvantage in comparison to the latter. But group selection as a mechanism of evolution (Griffing, 1967; Wynne-Edwards, 1962) shows *why* the use of wood might still be more efficient. The use of biomass in the powerplant helps to increase the overall efficiency of the group, making this group more efficient than a group relying, for example, on fossil fuels—represented by, say, Group A in Figure 2. Theory from evolution indicates that the level on which selection takes place is important when comparative advantages are determined.

5 | DISCUSSION

In this paper, we advance circular economy by demonstrating how resources can be used more circularly, and why and when firms are incentivized to do so. We offer a framework to this effect, which foregrounds circular resource use at the level of the group, rather than as a means of eco-efficiency that is scoped, bounded, and frequently assessed at the level of the individual firm.

In one sense we refer to recent work (e.g., Figge, Thorpe, & Good, 2021) that also emphasizes the need to (re)organize circular resource use as a system that manifests at the group level. We additionally acknowledge research on industrial symbiosis (e.g., Fraccascia et al., 2020; Jacobsen, 2006) that, again, centers on group-level activity.

However, such work offers little explanation as to how systems of circularity can be organized and operationalized. Further, it offers little insight into the underpinning mechanism as to why firms are incentivized to join other firms in light of such systems. In this paper, we have addressed this by amalgamating principles from MPT and evolution to construct a holistic framework that incorporates both "bottom-up" and "top-down" approaches. We now unpack our contribution by explaining further how our framework advances circular economy theory and practice.

5.1 | Advancing circular economy theory

As some researchers have pointed out, the circular economy is undertheorized and underdeveloped (Korhonen et al., 2018; Panwar & Niesten, 2020), especially in ways that can foster its implementation as a mainstream approach to greater eco-efficiency. Our framework brings together two theories—bottom-up and top-down—that each contributes a different approach to improve the efficacy of circular resource use as a vehicle of eco-efficiency, and in a way that can be applied globally, that is, irrespective of firm, or industry conditions.

First, we proposed that MPT (Markowitz, 1952, 1959) is a means to theoretically understand how organizations can better contribute to circularity and eco-efficiency at the societal level, by way of systematic inter-firm collaboration. In other words, the principles of MPT suggest that when we move away from organizing circular resource use at the firm level, that is, as an individual firm endeavor, and instead arrange resource flows at the group level, we can see how circularity is enhanced.

Whilst Figge, Thorpe, and Good (2021) made inroads into building theory surrounding the organization of circular systems by foregrounding the importance of group-orientated organization, they do not address specifically how firms can contribute to circularity, in terms of the intragroup dynamics and structured relations that we have described in this paper. We, therefore, build on such research by offering a bottom-up perspective on how group-level circularity might be theoretically structured—and the subsequent implications for individual group members—with the aim of showing how societal levels of eco-efficiency can be improved via more effective circular resource use.

As a single lens, however, financial theory does little to explain why individual firms might be incentivized to change their practices concerning circular resource use, as the efficient market hypothesis (Fama, 1965, 1970) does not hold for natural resources. In other words, financial theory fails to explain why moving from the use and re-use at the level of the firm to that at the level of the group, might be of benefit. To address the issue of motivation, we incorporated a second theory—evolution—into our framework, which we use to explain how certain mechanisms "naturally" encourage intragroup collaboration through inter-group selection as a top-down process, as seen in some species in ecology (Griffing, 1967; Wynne-Edwards, 1962). Specifically, we demonstrated how firms that participate in highly eco-efficient groups by engaging in activities for circularity will gain a competitive advantage over firms that participate in less eco-efficient groups.

Although each part of our framework either extends or mirrors recent circular economy research as standalone entities, our main contribution lies in the synergy of the two theories: By combining their principles, we offer a more holistic framework that advances circular economy theory by challenging entrenched ways of how we currently understand, organize, and assess the phenomenon. With reference to the long-established business case approach to sustainability (Carroll & Shabana, 2010; Salzmann et al., 2005), it is often assumed that economically orientated incentives will encourage firms to individually adopt circular economy activities: Circular resource use generates cost savings that can be used by firms as an important driver of competitive advantage. The circular economy is portrayed as "an economic opportunity worth billions" (Ellen MacArthur Foundation, 2013). In other words, firms will individually construct and implement systems of circularity because it "pays" to do so.

Yet, when a system of circularity is arranged within a group of firms, the efficacy of a business case approach is more complicated. On the one hand, financial benefits might still emerge. On the other hand, if they do, such benefits will only incentivize firms for certain at the level of the group, that is, on a collective basis. At an individual level, some firms will benefit, but others will not, even though all firms will have taken part in the group's circular system of resource use and that the group as a whole benefits.

Where financial theory fails to answer why firms should be motivated to take part and contribute on this basis, an evolutionary perspective offers a plausible explanation: In effect, the contribution of a firm that individually might use and reuse resources to a poor extent, might still be a vital component to the circularity of resources at the group-level. Taking the principles above, this might generate a source of competitive advantage for the group, which in turn, will benefit all group-member firms—including those with comparatively low eco-efficiency at the individual level. In Figure 3, the power station, for instance, as an individual actor might not be competitive with other power stations external to the group. However, within the group, it is needed for the survival of the group, as well as for the group's competitiveness. Therefore, it is in the self-interest of the group's other firms to ensure the power station, as an essential participant, does not fail, as its absence will also lead to the failure of the group itself. This essentially moves selection from the individual to the group level. How firms within a group ensure the survival of all its members is beyond the scope of our discussion here, but what is key is the self-interest of other actors to assist the survival of all participant firms.

In summary, we advance circular economy theory by challenging entrenched practices of organizing and arranging circular systems that we argue represent somewhat of a barrier to procuring greater extents of eco-efficiency. In this way, we offer a theoretical framework that shifts our thinking and challenges our assumptions independently to any specific firm, industry, or societal conditions.

5.2 | Advancing circular economy practice

Aside from our theoretical contribution, our framework offers an advancement for the circular economy in practice. Specifically, our framework challenges entrenched "ways of doing" circularity and offers both organizations and policymakers a tool to understand how they can improve eco-efficiency of resource use overall.

First, at the organizational level, our framework speaks directly to key decision-makers within firms, especially those that are already interested in adopting circularity principles. We argue that our framework suggests that by shifting their mindset from an individual to a group perspective on resource use and flows, such decision-makers could enhance the extent to which they can achieve their sustainability objectives. Our framework foregrounds inter-firm collaboration in designing circularity systems—and their assessment—and reframes the incentives of doing so. In this way, our framework offers a tangible and relatively straightforward way for firms to enhance their contribution to society's eco-efficiency targets.

Second, at a "higher" level, our framework has implications for policymakers who may be designing incentive schemes to encourage more firms—especially those which are less involved in sustainability initiatives—to devise or participate in circular economy systems. In this paper, we imply that current incentives, tools, and processes that seem to be effective in linear resource systems lack efficacy when resources are used circularly. We think that policymakers have a central role in encouraging firms to abandon the former and embrace those that are more appropriate for the latter (e.g., collective group-level systems). Achieving societal goals of eco-efficiency through circular economy initiatives, requires an acceptance that some individual firms—within a group context—will use resources less circularly and perhaps even linearly within their own firm. This is somewhat of a paradoxical and counterintuitive idea, especially to firms that are familiar with circular economy principles, but which manifests in ways that emphasize outputs of resource use and re-use at the level of the individual firm. Thus, we argue that our framework offers policymakers a reference point in deciding what firm level strategies should be incentivized, that is, those which foreground collaboration, when constructing circular economy systems.

5.3 | Limitations and further research

Whilst we argue that theoretically our framework can be used irrespective of firm, industry, or societal conditions, in reality, the construction of synergistic groups of firms relies on the availability of such firms within geographical areas and which are compatible in the timing of their individual resource flows. In other words, our framework does not take into account spatial and temporal dimensions that might hinder the implementation of some group-level circular economy systems in practice. This highlights the need for empirical work to test such dimensions and to further develop our starting point. Further work, for example, could empirically apply our framework to a specific industry or geographical area.

Further, we have assumed that key decision-makers within firms are able to operationally move to collaborative relationships once they understand how group-level circularity can enhance eco-efficiency. Whilst it is beyond the theoretical scope of our framework to address such operational issues, we acknowledge that it might not be that easy to implement group-level circularity in reality. For example, group-level circularity can require collaboration (Chertow, 2000) between competitors, raising additional tensions and jeopardizing collective action (Christ et al., 2017; Manzhynski & Figge, 2020). These are areas of investigation that need to be addressed if our framework is to have real meaning for how we (re)organize circular resource systems from theory into practice. In other words, it is not clear currently as to whether we create a new way of thinking that challenges existing barriers to the optimization of circular resource use, or if our framework procures a new set of barriers that may or may not be more difficult to overcome.

Finally, our research focuses on the circular use of resources. Narrowing resource flows and extending the duration of resource use are, as previously mentioned, two other strategies to arrive at a more eco-efficient use of resources (Bocken et al., 2016). The relationship between circular resource use on the one hand and narrowing and extending the duration resource flows on the other hand are both a limitation of our research as well as domain where more research is needed. We do not, for example, address the trade-offs and tensions between these strategies, and future research needs to address their interplay.

6 | CONCLUSION

In this paper, we advance theory and practice of the circular economy by proposing a framework that encapsulates a fundamental shift in how firms can participate in circular systems of resource use to enhance societal goals of eco-efficiency. We challenge existing theoretical assumptions and practices and explain how firms can go about (re)organizing activities that contribute to circularity at group and other macro-levels, as well as the incentives of doing so. Our work builds on existing work—albeit that which is only just emerging in the circular economy literature—that emphasizes group-level organization and systems that itself challenges entrenched "ways of doing" the circular economy. We hope that others, beyond the scope of this special issue, will join us in developing radical ways forward in enhancing the role that organizations need to play in bringing about greater extents of eco-efficiency in general, and the circular economy in particular.

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