Improving ‘eco-efficiency’ with insights from investment theory

The circular economy seems to be an obvious answer to the need to manage natural resources in a more sustainable way. ***Frank Figge, Andrea Stevenson Thorpe,*** *and* ***Siarhei Manzhynski*** *write that to optimise overall eco-efficiency it pays to take a broader perspective and analyse resource use at several levels by applying insights from studies of (surprisingly) investment portfolios.*

“Spaceship Earth” needs to steer a new course. Not only is our planet awash in waste, but to keep pace with the growing consumption of an ever-expanding population, we extract vast amounts of non-renewable resources, of which (by definition) we only have a limited supply. This tension has been partially addressed by strategies of eco-efficiency, the aim being to make “more with less”. In the long term, though, the problem remains: no matter how efficiently we use crude oil, minerals and other resources, they will eventually be depleted.

To address this issue, the circular economy has been presented as a more adequate answer. The circular economy is a model of production and consumption that involves reusing, repairing, and recycling existing materials and products to extend their life cycle and reduce waste. The idea is simple, and already applied. Most households are familiar with the five Rs of zero waste (reduce, refuse, reuse, recycle, rot). Informal systems of recycling in India and Brazil have been around for decades, while examples of industrial symbiosis such as the Kalundborg project in Denmark, where a cluster of industrial companies share excess energy, water and material since 1972, are well-known models.

Yet the circular economy as a concept is under-theorised, and existing insights from different scientific streams remain disjointed, as do practical initiatives. This is why we set out to build a comprehensive theory to better understand the organisation of circular systems and implications for how society manages earth’s natural resources.

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Exploring imperfect systems

Isn't the need to use resources circularly self-evident, and the concept of circular economy childishly simple? Two observations point to the contrary:

- First, there is discord between theory and practice. In principle, fully circular systems are straightforward and theoretical designs stipulate the reuse of resources over and over again, without waste nor need to resort to virgin resources. However, perfect circularity, is somewhat of a quixotic notion. For instance, copper is used about 1.9 times before it is disposed of, iron 2.67 times and nickel about 3 times. While full circularity is desirable, there is a need to address the arguably more plausible scenario of imperfect circular systems of resource use.
- Second, recent research has demonstrated that the degree of circularity must be assessed at the group level, not merely by adding together individual resource users, because the whole is greater than the sum of its parts. This, we argue, reflects the complexity of imperfectly circular systems. In particular, the amount of waste generated is irregular and differentiated across resource users and with respect to the specific resource in question. In other terms, micro-level resource use does not sum up neatly to macro-level resource use.

Borrowing from financial studies to model circularity

To build our theory on the organization of imperfect systems, we drew inspiration from an unexpected domain: financial studies. Specifically, we borrowed from modern portfolio theory, which describes what can be observed in financial markets. While the returns of individual assets add up to the return of a portfolio of assets, the risks do not. The risks of individual assets may disappear completely, partly, or not at all at the portfolio level. In short, portfolio theory reveals the contrast between the risk-return profile of each individual asset, and the risk-return profile of the portfolio as a whole. Covariance matrices can be built to help investors determine the best combinations of return and risk of the portfolio overall, i.e. those that maximise the return generated for a given level of risk.

These principles may be applied to the arena of natural resource use. We need natural

resources such as minerals or precious metals to generate a return – something that we can now think of as products or services. As in financial contexts, users are encouraged to seek eco-efficiency, to maximise the return for a given amount of natural resources or to minimise the amount used for a given return. How so?

There is a parallel between the effect of diversification in finance and the resource-reducing effect of circular economy systems in general and industrial symbiosis in particular: the use of natural resources is reduced in the circular economy by building a portfolio of collaborating resource users. Similarly to calculating portfolio risks, the resource use of a group can be calculated, and the optimal combinations, the most "circularly efficient", thus determined.

Determining optimal circularity

In conclusion, the efficient – and therefore more sustainable – use of resources at the macro level (the societal level) cannot be guaranteed by merely maximising efficiency at the individual firm level. Rather, it is the interplay between several variables that determines the "right" combination of resource users. The more efficient arrangement, at the societal level, may even be counter-intuitive. For instance, a situation where users reuse and recycle less, rather than more, can lead to higher circularity. Indeed, while it is in the interest of individual resource users to lower total resources use, this might remove the opportunities that their waste generates for other users and so translate into lower eco-efficiency…

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