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ORIGINAL PAPER

Distribution of Power and Value Crucial for a Successful Circular Economy Transition

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Abstract
The circular economy (CE) is heralded as reducing material use and emissions while providing more jobs and growth. We explored this narrative in a series of expert workshops, basing ourselves on theories, methods and findings from science fields such as global environmental input-output analysis, business modelling, industrial organisation, innovation sciences and transition studies. Our findings indicate that this dominant narrative suffers from at least three inconvenient truths. First, CE *can* lead to loss of GDP. Each doubling of product lifetimes will halve the related industrial production, while the required design changes may cost little. Second, the same mechanism *can* create losses of production jobs. This may not be compensated by extra maintenance, repair or refurbishing activities. Finally, 'Product-as-a-Service' business models supported by platform technologies are crucial for a CE transition. But by transforming consumers from owners to users, they lose independence and do not share in any value enhancement of assets (e.g., houses). As shown by Uber and AirBNB, platforms tend to concentrate power and value with providers, dramatically affecting the distribution of wealth. The real win-win potential of circularity is that the same societal welfare may be achieved with less production and fewer working hours, resulting in more leisure time. But it is perfectly possible that powerful platform providers capture most added value and channel that to their elite owners, at the expense of the purchasing power of ordinary people working fewer hours. Similar undesirable distributional effects may occur at the global scale: the service economies in the Global North may benefit from the additional repair and refurbishment activities, while economies in the Global South that are more oriented towards primary production will see these activities shrink. It is essential that CE research comes to grips with such effects. Furthermore, governance approaches mitigating unfair distribution of power and value are hence essential for a successful circularity transition.

Keywords Circular Economy · Product-services · Power Distribution · Value Capturing

Extended author information available on the last page of the article

Introduction

Since the 1970s, humankind strives for an economy in which prosperity, well-being and a positive impact on the environment go hand in hand [64]. The fields of Environmental Economics and Industrial Ecology envisage an economy without waste in which companies use raw materials and other materials in a better, more efficient and smarter way, and in which companies make new products from used raw materials [20, 43]. Products should be designed in such a way that they have a long lifetime can be re-used, easily repaired or refurbished, or that product components can be used again [3, 6, 20, 57]. Market incentives should be in place to reward companies for products that last longer (e.g., [58, 62]). As a result, this should lead to an economy in which companies are not dependent on finite supplies from other parts of the world (compare Rademaker et al. [49]; Tukker et al. [63]). Companies ultimately will have control over their own material flows – and create more value with fewer materials [21]. That is the promise of a circular economy (CE) – at least in theory.

Many parties, including governments, entrepreneurs and citizens – have enthusiastically embraced the concept of the CE [19, 20, 68]. Several studies point to the many potential benefits [4, 21]. The Netherlands is considered one of the forerunners in the circular economy. For instance, the Dutch Raw Materials Agreement sets out the ambition to be 100% circular by 2050 [27]. Currently, The Netherlands are 30.9% circular. This is still far from the 2050 target, but well above the global average of about 8% (see Fig.1 and Aguilar et al. [1]; Circle Economy [13]; Eurostat [22]). Despite its potential and promise, the dominant narrative of CE has been criticized for neglecting social aspects, equity, Global South implications, and being too optimistic about the potential contribution of innovation, new technologies and new business models [26].

In particular, the issue of distribution of power and value has so far remained neglected in the circular economy discourse. This is a serious omission, since a transition to circularity and circular business models can strongly influence the distribution

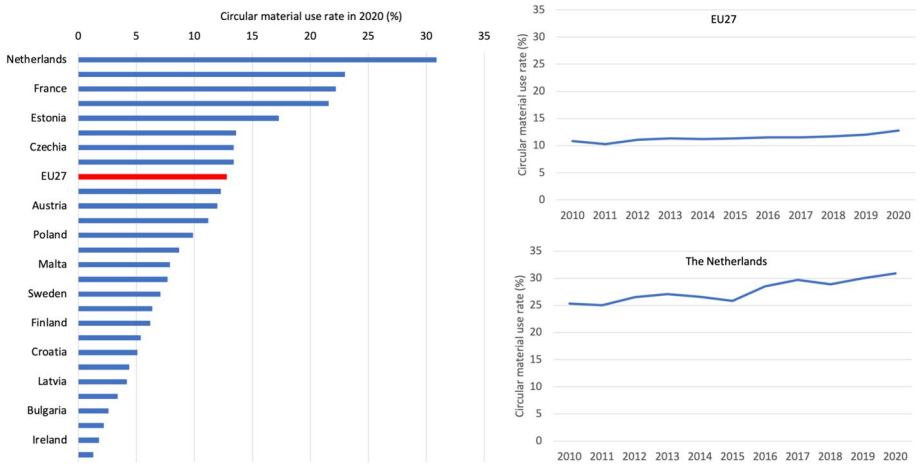


Fig. 1 Left: Circular material use rate (in %) for the European countries for which this data exist, as well as an EU average. (source: Eurostat [22]). Right: Development of the circular material use rate over time for The Netherlands and the EU average

of income and wealth among different actors in circular supply chains and groups in society, as well as between countries. We also see that risks and responsibilities can shift [60, 61]. This implies that ultimately, the circular economy can drastically change the balance of power between different societal stakeholders. Such shifts may have consequences for the widely supported claims that circularity enhances GDP (Gross Domestic Product), creates jobs, and enhances societal equality and prosperity in general [20, 66, 68].

The present paper sets out to do an qualitative assessment whether a circular economy will indeed live up to the aforementioned claims. A short methods section will explain how the analysis was conducted. We then present results. The paper ends with a discussion and conclusions on policy implications before proposing a research agenda.

Methodological Approach

This paper is the result of several discussion workshops, involving the authors, on power and value implications of a transition to a circular economy. These workshops were organized by Het Groene Brein ('The Green Brain'), a scientific think tank on sustainability in the Netherlands, building on the expertise of the participants, their research groups, and of other scholars they are familiar with to underpin the analysis resulting from the discussion workshops. The authors cover scientific fields as diverse as quantitative environmental-economic value chain analysis via e.g. global environmental input-output analysis, business modelling, industrial organisation, innovation sciences, environmental economics and transition studies. These science fields are home to a number of methodologies that are very suitable to study the trade-offs of circularity interventions in terms of GDP, employment, and shifts in power, control over assets, and value capturing potential.

*Global environmental multi-regional input output analysis (GMRIO)*is an often used tool to analyse economy-wide impacts of changes in production volumes, such as changes in GDP and employment. GMRIO essentially divides the economy of a country into a number of economic sectors, characterised by regular economic parameters like value added and employment per sector. It maps further for sectors in a country the volume of (intermediate) products from other sectors in specific countries and their costs (for instance, the German car industry may buy steel from the steel industry in France, electronic equipment from the electronics industry in China, and glass windows from the glass industry in Poland). The input-output table also maps which sectors in which countries buy the output of a specific sector in a country (for instance, the German car industry may sell cars to final consumers in a number of countries). Circularity interventions may for instance enhance repair activities in a specific country, and lead to a longer service life of specific products, implying a lower requirement for primary production in another country. So, GMRIO shows which sectors will enhance production, jobs and value added, but also which sectors in which countries will end up with lower production volumes. Illustrations of such analyses include e.g., [1, 15, 18], but these authors. emphasize this is an emerging topic with only few studies published so far.

*Theories on value chain structures and industrial organisation*are very helpful to understand (changes) in power configurations in value chains. The well-known ' five forces' model of Porter [48] postulates that sectors with a few strong players that have (i) limited

rivalry, (ii) many suppliers, (iii) many buyers, (iv) a high threshold to new entrants, and (v) for which no good output substitutes exist, act as 'choke points' of power in value chains. The few actors in this step in the value chain can squeeze out the many mutually competing suppliers and buyers, and hence capture most value added in the chain. Relating to such insights, Gereffi et al. [25] developed an overview of archetypical value chain configurations, and their implications for the type of competition and power relations in such value chains.

Using these methods, theories and quantitative and qualitative studies as a background, we set out to discuss three key questions about potential impacts of circularity interventions:

1) Will Circularity Enhance GDP?
2) Will Circularity Enhance Employment?
3) Will Circularity lead to a more Equal Distribution of Societal Power, Income and Assets?

We found that the answer on these questions are not unequivocally positive. We hence present them in the next results section as ' inconvenient truths'.

Results: Three Inconvenient Truths

Inconvenient Truth 1: Circularity May Lead to Shrinking of GDP

In our current economy, a plethora of (raw) materials, components and products circulate that vary widely in nature. For products with a short lifespan, the priority is to prevent use at all. When this is not possible, recycling will remain an important circularity strategy. For products that last longer, product lifetime extension is an important circularity strategy as well, in addition to recycling. This can be achieved through repair, refurbishment, and remanufacturing [6, 20].

These different circularity strategies all have the same goal: a decreased consumption of virgin raw materials. This may have economic consequences. If we no longer use products such as disposable plates and cotton buds, that means less production. If we use products such as washing machines longer, this means less production. If we build fewer new viaducts, that also means less production in the road construction sector. Less production also implies fewer sales – leading to less added value and a smaller contribution to the GDP. This will not always fully, but usually only partly, be compensated by a possible growth of the circular services sectors, such as repair and refurbishment [4, 15, 18].

Of course, a smaller GDP due to a circularity transition is not necessarily bad by definition. After all, the ambition of circular economy strategies is that the ultimate use value for final consumers of existing products, buildings and infrastructure remains the same. The same products stay in use longer, and the overall services provided to the consumer do not diminish (compare IRP [30]). The win-win is actually that the same final economic utility is provided while producing fewer products. This enables an economy that, while providing the same amount of useful services as output, is based on less*monetary* added value and materials use. This confirms above all that GDP is an inadequate concept for measuring value

creation in society. Such shortcomings of conventional GDP have been extensively described, and are gradually becoming more prominent. Inefficiency due to production without real added value optically increases GDP, while external costs in terms of environmental impact, use of scarce resources and biodiversity are ignored (e.g. [14, 29, 52]).

Itis also unclear whether the balance between value added components like workers' wages and profit will shift. In their introduction to one of the first papers on CE rebound effects. Zink and Geyer [69] state that proponents of the circular economy 'have tended to look at the world purely as an engineering system and have overlooked the economic part'. In their review of 114 circular economy definitions, Kirchherr et al. [35] found that only a small part included a social equity dimension. The number of papers paying attention to social dimensions and distributive aspects is limited, and they often focus on agenda setting and a qualitative discussion rather than giving quantified insights into the problem (e.g., [10, 45]). In principle, a reduced GDP and reduced wages do not have to be a problem, as long as these wages will allow for obtaining the same economic utility or achieving the same level of wellbeing. If, however, wage earners suffer most from GDP reduction, and cannot afford the same economic utility anymore, an imbalance is introduced that makes consumers worse off.

So, to make a just and fair circular economy possible, we need to change the rules of the game at a system level, to ensure a fair distribution of a potentially reduced GDP in monetary terms, and measure economic success differently as suggested in the emerging post-growth or beyond GDP debate.

Inconvenient Truth 2: Circularity can Cost Jobs

Less production of goods will certainly lead to the disappearance of certain jobs. This follows directly from the discussion in Inconvenient truth 1: if the final economic utility is provided by producing fewer products, this will not only reduce the creation of value added in purely monetary terms and material use, but also the need for labor. Those losses will mainly occur in producing countries, such as China, but the European manufacturing industry will also feel these effects.

Circularity may also imply that for instance products like electronic goods will stay longer in use with the original owners. The export of second-hand electronic goods, currently mainly to low- and middle-income countries, will then be reduced. This will not only reduce access to high quality second-hand products in such countries, but it also implies a reduction in repair, refurbishment, and recycling activities [8]. However, activities such as repair and maintenance can create new jobs emerging especially in consumer countries like in Europe. The number of studies in the scientific literature on global labor impacts of circularity is limited. But available studies suggest that, overall, there will be job losses, with manufacturing in the Global South being particularly vulnerable (see e.g., Donati et al. [18], for a general analysis; de Boer et al. [15], for metal and electrical products, and Repp et al. [50], for clothing/apparel). Moreover, it could also decrease the opportunities for earning a decent livelihood, especially in the Global South [34].

This can be illustrated by the example of a washing machine that thanks to incentives provided by a 'Product as a Service' (PaaS) business model can last twenty years instead of an average of ten years, (although in practice the difference will be less extreme [53]. Let us further assume that in this business model a producer can still earn the same by

offering the washing machine as a service and that the user pays overall the same as if the washing machine was owned (see also Inconvenient truth 3). If we make a highly simplified calculation, then only half new washing machines will need to be produced. So, the amount of labor in production will also be halved. This will be offset by a – probably much smaller – increase in maintenance work. This in theory is not a problem – in line with what was discussed on Inconvenient truth 1, as society ends up with the same final utility provided to consumers with less work – and hence more spare time. In principle, there is nothing wrong in that the entrepreneur creates and captures the same use value with less effort. But can workers in this new situation actually work shorter working days for the same wage? Or does the capital factor absorb (most of) the added value at the expense of the labor factor? And do we end up with a shift of power and value from worker to entrepreneur?

As discussed under Inconvenient truth 1, the transition to a circular economy will therefore raise the question whether we as a society can continue to distribute added value and income fairly in case less labor and workers will be needed. Scientific research into the power distribution and the dynamics of economic value distribution can contribute to the increase our understanding of issues, implications and ways to address these.

Inconvenient Truth 3: Circular Business Models can Concentrate Power and Value Distribution

From a circularity perspective, it is an attractive idea that companies will offer their products as a service (PaaS or Product-service system; e.g. Tukker [60, 61]). A customer, for example, does not longer buy a lamp, but purchases 'light hours'. No longer an office chair is purchased, but a 'sitting' service (compare Bocken et al. [7, 39]).

In theory, if companies retain ownership of their products, they have an incentive to develop longer-lasting, better repairable, and better recyclable products. In the traditional business model, with a given profit margin on a product, the only way to enhance profits is selling more products, even if this is realized via 'planned obsolescence' [9, 56]. In a PaaS business model, however, the service becomes the profit center, and materials and labor simply are costs. Providing the same service with the same product as long as possible hence becomes the recipe for profit enhancement. Such a strategy of 'value retention' is how circular profit can be realised (IRP, [30]). There are now countless examples of companies applying such business models: Bundles and Homie offer a washing machine-as-service, Chainable offers a kitchen-as-a-service and Tiny Library offers baby stuff-as-a-service, while lighting and elevators are provided as services for buildings (e.g., [7, 17, 37]).

Apart from the many pitfalls in the implementation of such a model [60, 61], there is a potentially enormous social consequence. In a PaaS world, much more ownership of materials, whether or not in the form of products, is transferred to a smaller number of companies. The higher capital intensity for PaaS providers will facilitate this. The result is that there is less ownership by end users, because they purchase a service. Ideally this does not matter – or, formulated in the words of the World Economic Forum: 'You will own nothing and be happy' [24].

But will it indeed work out like this? Can it be that by concentrating ownership with providers, this also leads to more power for providers, and increased dependency of users on their service providers? Providers will further usually deploy platforms to offer services to users, which tends to concentrate power even more (see van Alstyne et al. [65]). From the

theory of industrial organization it is well known that if concentration takes place in intermediate steps in value chains (e.g., in production of retail), such players usually have a higher value capturing potential than suppliers and customers [32, 25, 48]. The situation may differ depending on product characteristics and the level of consumer participation – the communal washing centres typical for flats in Sweden under community control are unlikely to be vulnerable to major power shifts [65]. But the cases of Uber, Airbnb, and Just Eat show such power shifts indeed happen if commercial platform providers take center stage. They enable such companies to capture no less as 10–25% of the transaction value between producers/providers and consumers/users (See Supplementary Information; Malhotra and van Alstyne [40], Martin [41], Schor and Attwood-Charles [51], Cemilleri and Neuhofer [12], Calo and Rosenblat [11]). Furthermore, ownership not only offers status and prestige, but also protection and security. Consumers without ownership are dependent and therefore potentially more vulnerable. An obvious example is that house owners who usually build up net worth over time by paying off their mortgage, are better protected against inflation since the value of the house rises with it, and can rely on owning a valuable asset in possible future bad times. Someone who rents does not have such advantages. Job loss probably leads earlier to eviction once rent is not paid anymore, in comparison with foreclosure after not paying a mortgage. Figure2and the Supplementary Information illustrates that if PaaS are indeed combined with platform models operated by just a limited number of actors, there is a genuine danger that an ever more significant power asymmetry will occur to the disadvantage of customers. A promising response would be more cooperative forms of ownership that can prevent such undesirable shifts, but actual examples are hardly available [54].

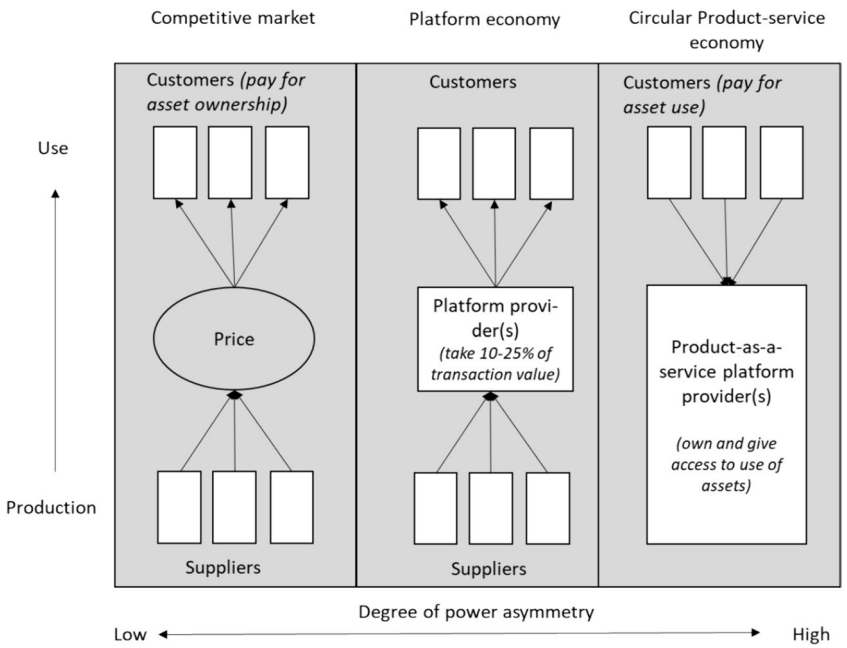


Fig. 2 Value chain characteristics of different market configurations. Inspired by Gereffi et al. [25] and van Alstyne et al. [65].

Implications for Policy and Research: Circular Economy Needs New Rules of the Game

Policy Implications

The three inconvenient truths make it plausible that the circular economy can have a significant effect on social and economic structures. This relationship also applies the other way around: the circular economy can only be made possible by making changes to the current way in which value, risks, and responsibilities are allocated. The same applies to the power relations and power positions that arise as a result or may influence how changes take place and the eventual outcomes.

We see that, for the time being, attempts to realize circular transition are mainly focused on technological and business model innovation [69]. This is the core of much research and the dominant discourse. But the circular transition also requires societal innovation and institutional changes, well beyond for instance facilitating circular change via targeted innovation policies (e.g. [2, 28, 38]). As indicated in Sect. 3, circularity interventions such as putting products on the market that have a longer life, making products suitable for repair and upgrading, etc., is likely to reduce primary production, GDP and number of jobs. At the same time society as a whole does not necessarily get poorer: the final number of products in use, and the utility value they give users in principle does not change.

We see here in the first place that GDP has serious limitations in expressing overall societal welfare. It counts all kinds of 'bads' (expenses on wars, prisons, accidents, and pollution) as positive value for economy society, while leaving out non-monetarised 'goods' such as the benefits of leisure time, unpaid and voluntary work, and a clean environment (e.g. [36, 46]). Second, we see that the win-win mantra that 'circularity is good for GDP and jobs' must be nuanced. The win-win of a circular economy could be phrased as: The same utility value is likely to be created in less working hours. But who reaps these benefits? Can workers be sure they will keep, despite working less, a wage that allows buying an amount of products providing the utility value they could benefit from before the transformation to a circular economy? Or will powerful platform providers capture most added value and channel that to their elite owners and shareholders, at the expense of the purchasing power of ordinary people working fewer hours? Similar distributional effects may occur at a global scale: The rich Global North responsible for using most products may benefit most from repair and refurbishment activities, whereas the countries in the Global South, manufacturing a substantial amount of such products, will see a decline in primary industrial activity.

Precisely these themes, and in particular the shifts in power and value, have been largely invisible in circular economy research until now [10]. Also, the discussion on growth versus degrowth and the political economy of (un)sustainable consumption and production cannot be neglected in CE implementation [42]. Moreover, attention to what has been coined as circular justice is relevant, since the CE may result in shifts in value and jobs away from the Global South [33, 55]. In this case policies are required to counter such unwanted distributional effects.

Research Gaps

Our plea is to scientifically investigate the possible societal consequences of the circular transition in advance. This assessment should prioritize the impact of business models that take ownership away from consumers and that are likely to concentrate value and power

with the provider. Furthermore, institutional analysis is needed of the current rules of the game in value chains [67], as well as political-economic perspectives and frameworks to develop a better understanding what changes in institutions might prevent unwanted value and power shifts. With the proposed research we want to stimulate a societal discussion that should deal with questions such as compare (compare Toxopeus et al. [59]): What scenarios could be developed with regard to distribution of power and value among different societal actors in a circular economy? What implications do power and value redistributions have for different societal actors? Are there upper and lower limits to societally productive power relations? Who should own materials and products? And are shared, more cooperative forms of ownership possible? How does this work out when taking into account circular justice and implications and conditions for the Global South, as well as global value chains?

The desired future is to a large extent a political choice – as are the rights, obligations, and other social and economic rules that must enable such a final vision, but choices are possible, and different values and interests may lead to different preferences and different outcomes. Science can map out the potential effects of the circular economy on these themes, as well as the conditions for doing this in a just and fair way and possible organizational forms that fit with this.

While scenario analyses with regard to physical futures related to circularity and resource-efficiency can already be conducted (e.g., [31, 16, 47]) the scientific challenge is to gain insight into effects on value and power distributions within production and consumption systems within different economic models and institutional control systems. These should be evaluated for their advantages and disadvantages, so that they can serve as input for public debate and political decision-making. If scientists do this right, it can contribute to a foundation for a circular system. And in such a way that it can provide an answer to the discomfort about the excesses of the current economic system.

It is clear that research need to start to work on this scientific challenge right now, so that a timely conversation is possible in a more informed way. After all, we are still in the early, formative phase of the circular transition and the related knowledge paradigm. Science and society are still trying to find out what the concept is and what it isn't [35]. There are still many choices to be made in the transition towards the different national and international circularity targets. But then we need to know what those choices are and what effects they will have. In the case of the energy transition, the distributional implications of costs and benefits across different societal groups entered the agenda relatively late (see e.g. [23]. We must be ahead of that in the circular transition.

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