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Rebound effects of circular business models on the consumer level: a review

Michał Bączyk, Vivian S.C. Tunn, Blanca Corona, Ernst Worrell

Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, the Netherlands

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Abstract: This paper addresses consumer behaviour in circular economy (CE), specifically by examining consumer-level rebound effects in response to circular business models (CBMs). Despite the centrality of consumer behaviour in CE, there is a limited understanding of how consumers engage with CBMs and to what extent the environmental benefits of circular strategies may be offset by their behaviour. To this end, we conducted a systematic literature review to assess the evidence from real-life case studies of CBMs. We identified consumer behaviours leading both to rebound effects, and to reduction of environmental costs of consumption. We also showed that consumer behaviour was influenced by contextual factors and by the characteristics of the CBMs. This suggests that CBMs may only enable sustainable consumption in specific contexts.

Introduction

Circular business models (CBM) are practical and financially viable operationalizations of circular economy (CE) strategies of closing, slowing and narrowing of resource loops (Bocken et al., 2016; Geissdoerfer et al., 2017, 2020; Nußholz, 2017; Pigneur & Osterwalder, 2010).

However, deployment of CE strategies may lead to unintended systemic responses resulting in lower-than-expected economic, social, or environmental benefits, due to so-called rebound effects (Castro et al., 2022; Metic & Pigosso, 2022). CBMs bring new products and services to the markets or lead to the creation of new markets, thus we consider them to be innovations acting as potential rebound triggers. Further, we consider consumer behaviour to be a potential rebound driver because the magnitude of rebound depends on changes in consumption behaviour due to implementation of CBMs. In this context, we understand consumer behaviour as acts and processes of acquisition and/or use of goods and services (Poças Ribeiro et al., 2019). The realisation of the maximal environmental benefits of CBMs depends thus on consumer behaviour because it requires consumers to engage in a series of anticipated, circular behaviours (Camacho-Otero et al., 2020).

Despite the central role of consumer behaviour in CE, this topic has only recently been recognized (Castro et al., 2022; Ferasso et al., 2020; Metic & Pigosso, 2022; van Loon et al., 2021). There is a limited understanding of how consumers behave when engaging with CBMs, and real-life accounts are missing. To date, only one published study systematically reviewed rebound effects on the consumer level (Reimers et al., 2021). Nonetheless, it focused only on indirect rebound and did not address the context of CE. Furthermore, insights from energy efficiency economics cannot be directly translated into the context of CE (Castro et al., 2022; Hertwich, 2005). Thus, rebound effects on the consumer level triggered by CBMs, necessitate further investigation.

This study contributes to filling this research gap by answering: “How do consumers behave toward CBMs?”. This is accomplished with a systematic literature review focusing on empirical accounts of CBM implementations.

Methodology

We conducted a systematic literature review (Smart et al., 2017), following the Tranfield et al. (2003) protocol.

Operationalization

Against the theoretical background, we determined two outcomes of consumer behaviour toward CBMs. First, *conservation* being consumption behaviour in line with the anticipated benefits of CBMs, leading to lower environmental burdens compared to satisfying a need with an equivalent linear product or service. Second, *rebound* being consumption behaviour leading to offsetting of the potential environmental gains. To distinguish rebound mechanisms, we follow the typology proposed by Metc and Pigosso (2022), Table 1.

Level	Direct effects	Indirect effects
Micro	Price Income Time Motivational	Re-spending Substitution Motivational Consumption accumulation
Meso	Sufficiency	N/A

Table 1. Circular economy rebound types and mechanisms on the consumer level.

Because of divergent CBMs nomenclature (Lüdeke-Freund et al., 2019), we included all business models (BMs) identified in the prominent papers on CBMs (Bocken et al., 2016; Lüdeke-Freund et al., 2019; Nußholz, 2017), to capture the breadth of the most commonly used terms, see Table 2.

Inclusion criteria

Given the focus on consumers, we examined empirical papers on business to consumer (B2C) and consumer to consumer (C2C) BMs CBMs where consumer behaviour is addressed explicitly. In the case of C2C BMs, we focused only on for-profit settings where consumer interactions are facilitated by a firm. We did not apply any selection criteria regarding the industry product types, or temporal scope.

Strategy	CBMs
Slowing	Functional sales, Gap-exploiter, Hiring, Leasing, Lifetime products, Long-lasting products, Next-life sales, Pay-per-use, Product as a service, Product service system (PSS), Product sharing, Product value extension, Re-marketing, Refurbished products, Remanufactured products, Renting, Repairable products, Second hand products, Sharing platform, Upgradeable products, Used products
Closing	Circular products, cradle-to-cradle, green products, Products made of recycled and/or recyclable materials
Narrowing	Eco-efficient products

Table 2. Circularity strategies and CBMs.

Search terms

We collected data from articles published in peer reviewed journals, written in English, accessible in January 2023 in multidisciplinary academic databases suitable as primary search engines (Gusenbauer & Haddaway, 2020): Web of Science Core Collections and Scopus.

We created search strings by linking key words related to CBMs from Table 2 with “*consumer behaviour OR user behaviour*” using Boolean AND operator.

Coding

In the first coding cycle, we extracted descriptive information about each case and key findings about consumer behaviour. In the second coding cycle, we associated consumer behaviour to rebound and conservation mechanisms, and in the third coding cycle we synthesized contextual and BM related factors influencing consumption.

Results

We have identified 1053 non-duplicate articles and included 10 in the sample after having applied inclusion criteria to abstracts and full text. Table 3 presents the overview of the selected case studies.

In the sample, we identified four conservation mechanisms related to consumption behaviour and two rebound mechanisms.

Conservation mechanisms

CBMs facilitated *product lifespan extension* through preservation of product functionality by repair and maintenance behaviour. Owners of modular and semi-modular phones were more likely to repair their smartphone, with repair rates of 87% and 85% (Amend et al., 2022), compared to average 25% repair rate of regular smartphones (Jaeger-Erben et al., 2021).

Description	CBM	Consumption category	Product	Location	Sample		Key findings
					Survey	Interview	
Car sharing (Retamal et al., 2022)	PSS	Mobility	Car	Japan	998	49	Car sharing used both to substitute and complement private vehicles
Bicycle subscription (Niessen et al., 2023)	PSS	Mobility	Bicycle	Germany, The Netherlands, Belgium, UK	122	54	Bike subscribers cycled more frequently and over larger distances than before
Pay-per-use washing machine (Bocken et al., 2018)	PSS	White goods	Washing machine	The Netherlands	77	77	Domestic pay-per-wash reduced average washing temperature and frequency
Clothing library (Johnson & Plepys, 2021)	PSS	Consumer goods	Clothing	Sweden	57	-	Clothing rental substituted and complemented purchases of new dresses
Shared laundry #1 (Moon et al., 2019)	PSS	White goods	Washing machine	Thailand	192	69	Laundromat-only users had the lowest number of annual washing cycles, those using both private washing and laundromats had the highest
Shared laundry #2 (Moon et al., 2020)	PSS	White goods	Washing machine	Thailand, Japan	170 + 185	-	Tokyo: shared machines used generally in addition to domestic laundry; Bangkok: shared machines used generally as a substitute of domestic laundry
Shopping on the second-hand platform (Parguel et al., 2017)	Second-hand platform	Consumer goods	Durables and semi-durables	France	541	-	Second hand platforms encouraged indulgent consumption
Modular smartphones (Amend et al., 2022)	Repairable products	Electronics	Smartphone	Germany	1720	-	Smartphone modularity enhanced repair behaviour when paired with repair services
Smartphone reuse (Makov & Vivanco, 2018)	Second-hand products	Electronics	Smartphone	USA	341	-	Second hand phones substituted nearly half of the demand for new devices
Peer-to-peer boat sharing (Warmington-Lundström & Laurenti, 2020)	Product sharing	Leisure	Boat	Finland	104 + 29	-	Lessees: boat renting substituted nearly half of new boat purchases, savings re-spend in other consumption categories; lessors: additional income spent on boat maintenance or personal use, and in other consumption categories.

Table 3. Overview of the selected case studies.

Modularity had a positive effect on self-repair and use of repair service. Similarly, in the study of boat sharing, 55% of lessors prolonged life of their boats by investing additional income from renting into maintenance (Warmington-Lundström & Laurenti, 2020).

Circular offerings played a role in *formation of pro-environmental habits*. Lower environmental burden was achieved in laundry and mobility habits. Users of pay-per-use domestic washing machines reduced laundry temperature and frequency over timespan of two to five months (Bocken et al., 2018). Similarly, shared laundry users run fewer wash cycles per year compared to those who washed only at home and those who supplemented domestic laundry with shared laundry, even when accounting for differences in maximum load (Moon et al., 2019, 2020). Regarding mobility habits, bike subscriptions enabled a modal shift away from high-emission means of transport (Niessen et al., 2023). The subscribers intensified cycling: they biked more frequently and travelled longer distances. Even after the subscription expiry nearly two thirds of users, who did not cycle before, continued to cycle.

Availability of car-sharing service (CSS) allowed users to meet their mobility demands with a lower material footprint through *substitution of ownership with access* to a shared vehicle (Retamal et al., 2022).

Lastly, in some cases, circular offerings were chosen instead of linear ones, leading to *substitution of demand for new products*. Dresses rented from a clothing library substituted 70% of demand for new apparel (Johnson & Plepys, 2021), second-hand phones replaced 58% of new phones that would have been bought otherwise (Makov & Vivanco, 2018), and peer-to-peer boat sharing replaced 43% of the demand for new boats (Warmington-Lundström & Laurenti, 2020).

Rebound mechanisms

In half of the cases, CBMs supplemented consumption of conventional products and services, leading to *consumption accumulation*. Shared cars were used in addition to already owned vehicles (Retamal et al., 2022), clothing rental was accompanied with purchases of new apparel (Johnson & Plepys, 2021), shared

laundry facilities were used on top of domestic laundry and encouraged use of tumble drying instead of natural drying (Moon et al., 2019, 2020). Lastly, users of a second-hand platform made impulsive purchases and acquired excessive numbers of items (Parguel et al., 2017).

Re-spending was the focal point of two studies: smartphone reuse (Makov & Vivanco, 2018), and boat sharing (Warmington-Lundström & Laurenti, 2020). Environmental benefits of engagement with CBMs were offset by re-spending when money saved thanks to engaging in circular consumption was directed to purchases of other goods and services. In the case of used phones, re-spending was the main contributor of rebound effect because the savings were spent on consumption with high environmental costs such as food, non-durable goods and transportation. In the case of boat sharing, more than half of lessees of boats redirected their extra income to travelling.

Consumption and consumer context

Consumption accumulation tended happen when CBMs were enabling conspicuous consumption, as a way to signal *social status* (i.e. driving a sports car or wearing a dress to stand out). Contrarily, conservation was observed when consumers engaged with CBMs as a primary mode of meeting their needs (i.e. doing laundry exclusively at a laundromat).

Socio-cultural context influenced consumption accumulation. For example, in Japan owning a washing machine is considered an essential need. Shared laundry thus was generally used in addition to private washing, spurring additional consumption. However, in Thailand, the high share of exclusive shared laundry users was related to the *spatial-infrastructure context*, namely lack of space for a washing machine at home. Similarly, in Japan, the successful substitution of private car ownership with CSS was feasible because an excellent public transportation system made living car-free possible, and high parking costs made it financially attractive. Likewise, in Sweden, low carbon footprint of clothing rental was achievable because most consumers used low-emission public transport to get to the store.

Change of life circumstances facilitated more sustainable consumption through engagement with CBMs. Both bike subscribers and users of shared laundry formed new habits after moving to a new city or country.

Regarding *consumer context*, we saw that consumer characteristics influenced the outcomes of engagement with CBMs, for that behaviour depended on consumer segment. For example, “eco-friendly” clients of the clothing library constituted only a fifth of the customer base. Only a third of shared laundry users in Bangkok did laundry exclusively at shared laundry facility, which had the lowest environmental impact, compared to other consumer segments. This suggests that CBMs enable sustainable consumption among only a fraction of consumers. *User heterogeneity* had thus a significant effect on the magnitude of rebound effects. For instance, 45% of boat sharing users causing rebound were responsible for 47% of rebound effect. Thus, a minority user type wiped out the environmental savings made by other users.

Surprisingly, we saw that pro-environmental *values* played little role in engagement with CBMs. This could be explained by norm deactivation by situational factors. In the context of sustainable consumption, people who generally endorse pro-environmental values might act against them when they must balance and manage multiple, conflicting goals (Steg, 2015).

Business model and product characteristics

The three cases presenting only conservation mechanisms had a common denominator: the CBM was built around sufficiency. The pricing structure of the pay-per-wash encouraged lower laundry temperatures, modular phones were designed to facilitate repair, and the bike subscription enabled a modal shift toward a “zero” emission vehicle in the use phase. Nonetheless, the convenience offered by CBMs contributed to consumption accumulation: the use of additional tumble-drying service substituted natural drying, and large shared washing machines were used to wash items too large to fit a private washing machine. Interestingly, the second-hand platform provided a favourable context for self-licensing behaviour and reduced cognitive

dissonance, even among “pro-environmental” consumers.

Discussion and Conclusion

The results show that consumer behaviour toward CBMs indeed leads to rebound effects through consumption accumulation and re-spending but also to conservation through creation of pro-environmental habits, the substitution of ownership with access, and the substitution of demand for primary products.

Nonetheless, CE rebound through consumption accumulation seems to be one of the most prominent rebound mechanisms, with CBMs being an additional engine of growth (Laurenti et al., 2016). This challenges the proposition that sustainable consumption can be achieved through circularity. Rebounds were only absent in sufficiency-based BMs. However, such BMs were viable in specific socio-cultural, infrastructural consumption contexts. Our findings are in line with recent publications on factors influencing circular consumption systems (Gomes et al., 2022).

We identify three main caveats of the reviewed body of literature. First, only one study performed direct measurement of behaviour. The other studies relied on surveys, which might not be fully representative of actual behaviour because humans do not remember everything they do, make estimation errors, or provide socially desirable answers. Second, survey-based approach allowed describing consumer behaviour; however, it inhibited the authors from putting forward in-depth explanations of the observed behaviour. Third, while some studies provided statistics about user behaviour per consumer segment, many were limited to qualitative accounts. As a result, the magnitude of rebound could not be estimated, given the high user heterogeneity. Thus, future studies should combine rebound quantification with psychological and sociological theory-driven approaches to produce in-depth insights into consumer-related rebound effects (Bögel & Upham, 2018; Evans, 2018; Warde, 2015).

This review study has several limitations. First, the number of identified cases was relatively low, probably due to the low number of empirical peer-reviewed studies on the topic.

Second, the identified cases spanned across a wide range of CBMs, product categories and geographical locations. This heterogeneity combined with a small sample limits the external validity of our synthesis. To overcome these limitations, further cases should be identified through snowballing and a search in grey literature.

To conclude, this study contributes to the burgeoning field of research on unintended consequences of CE by mapping the knowledge on consumer-related rebound effects of CBMs. Future work should focus on developing case studies across different consumption categories and socio-cultural settings.

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