



THE CONSUMPTION PARADOX IN CIRCULARITY - A STUDY ON THE IMPACT OF JEVONS PARADOX AS A REBOUND EFFECT WITHIN CIRCULAR ECONOMY

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Abstract

With the world's fast depletion of natural resources, forecasted economic development, and a growing middle class in the developing world, plenty have challenged whether conventional linear economic models can safeguard the environment while still bringing economic success. The adoption of business practices that facilitate the re-circulation of material resources propounded by the circular economic model has therefore emerged as the leading model to address the socioeconomic challenges of today. However, the circular economy seems to have fallen to the same downfalls of economic models of the past with a lack of sufficient emphasis given to improving on its shortcomings. This paper specifically introduces the paradoxical rebound effect of increased consumption due to the circularity model. This rebound effect is addressed through multi-industry case studies. As a result of the case studies observations and literature analysis, the paper provides, in what is understood to be a first, a conceptual framework outlining the consumption effects in circular economy.

Keywords: Circular economy, overconsumption, Jevons Paradox, sustainable development, circularity, wastage



INTRODUCTION

Economic models have been plenty over the years and as the global needs changed and evolved, so have the motifs and structures of the economic models that dictated global production and consumption processes. In our world of today that is in dire need of a sustainable shift in the economic paradigm, the Circular Economy model has taken the center stage. The idea and concepts of circular economy (CE) have been studied extensively in academia, business, and government over the past ten years. CE has been gaining popularity since it helps to minimize emissions and consumption of raw materials, open up new market prospects and principally, improve resource efficiency (Tunn et. al., 2019). At the government level, CE is seen as a means of combating global warming as well as a facilitator of long-term growth (Friant et. al., 2020). In its core principle, the European Parliament defines CE as, “a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended.”

The planet's use of raw materials are growing, contributing to climate change by releasing greenhouse gases (Oreskes, 2004.) With the world's population growing, forecasted economic development, and a growing middle class in the developing world, plenty have challenged whether conventional linear economic models can safeguard the environment while still bringing economic success (Riahi et al., 2017). Adoption of business practices that facilitate the re-circulation of material resources propounded by the CE model is therefore the clear answer. (Sachs et al., 2019). Yet, history of economic models makes us beg the question, is it possible for a model to be perfect? Departing not too far from this incessant history, this paper points out the malice of the CE model- neglected increasing consumption. The rebound factor of consumption deeply impacts any potential progress that could be made through CE, which combined with the other overlooked shortcomings, could make to look circularity as more of a threat than savior.

NOT SO ROSY: HURDLES AND CHALLENGES

As with everything else in the world and specifically within economic thought, all that seems rosy, hides a fundamental weakness. And with a model as widely discussed as the CE, there definitely are several shortcomings. Figure 1 is created on the basis of challenges of CE as observed in policies implemented and as observed in research on the field of CE. The challenges within the CE framework can be divided into four spheres. **i) Cultural factors:** The lack of intensity of motivation to make a change from the production side can really hamper the potentiality in transitioning to circularity. On a similar note, this lack of drive from the consumers' side to actively take part in the transition due to a shortcoming in awareness, plays out the similar

effect on the circularity process. Cultural factors are complemented or sometimes supplemented by; **ii) Regulatory factors:** Knowledge and awareness are key to the transition and this becomes more assertive within policy making and regulations. While this sphere is admittedly trying to encompass a very broad array of issues, on a more narrowed note, crony capitalist intentions and badly researched policies can greatly deter societies from achieving any kind of circularity within economic processes. Now going more into the dimension of production chains and commodities; **iii) Market factors** such as having a high investment cost to facilitate the transition to sustainable technology and a lower price of virgin raw material compared to utilising recycling facilities draw a big hurdles in motivating the producing sector to take the necessary steps to implement the CE model. The three aforementioned factors are explained very briefly and certainly have more examples and dimensions within them, however, the reason this paper would not like to dwell deep into those factors is to draw emphasis on the next factor that is very often not talked about enough in the discipline of CE. The cultural, regulatory and market factors have been heavily covered by academia and policy makers. The three factors as evident are revolving around the features of production and innovative technology. **iv) Rebound factors** are a departure from this thought process to introduce the side of consumption and consumerism.



Figure 1. The four spheres of shortcomings of Circular Economy.
Conceptualised through policy analysis and literature review.

REBOUND AND INTRODUCTION TO JEVONS PARADOX

Rebound effect is relatively new or an often neglected discussion point in economics research, hence, to find a universal meaning for it gets maligned due to the lack of enough research to pinpoint a concise definition. Nonetheless, as a landmark research in the field, a

definition of the rebound effect is provided by Thiesen et al. (2008) as, “the rebound effect deals with the fact that improvements in efficiency often lead to cost reductions that provide the possibility to buy more of the improved product or other products or services.” A classic example from this perspective is a driver who substitutes a vehicle with a fuel-efficient version, only to reap the benefits of its lower operating expenses to commute longer and more frequently" (Druckman et al., 2011). However, there are a variety of viewpoints on rebound effects from other fields of study. Furthermore, despite an increase in study on the topic, there has been no precise agreement on a definition.

When studying the increase in energy consumption due to coal burning, Jevons initially presented the idea of rebound effect in academic literature in 1865 (Jevons, 1865). As a result, the notion became known as the 'Jevons paradox.' Subsequent scientific study had not been mainstream until the 1980s; once economists adopted Jevons' theories due to global oil crises and growing global warming fears (Vivanco et al., 2016).

Although the concept of rebound effect was developed from the original paradox theory by Jevons, the contemporary economics have traversed, to expand the scope of what is meant by rebound effects and to provide Jevons Paradox a more concise definition. As observed in Lundstrom and Laurenti (2020), the concept of rebound effects have taken various iterations in different disciplines and has come to encompass several spheres of challenges and negative externalities. Walnum et al. (2014) carried out a systematic study of rebound effect research and observed the presence of seven viewpoints in which each provides unique interpretations and suppositions on the phenomenon: psychological study, ecological economics, energy economics, ecological economics, socio-technological discipline, evolutionary economics and urban planning. An eighth important position that of industrial ecology was also identified in further studies (Lundstrom and Laurenti, 2020). The notion of rebound effect has indeed been dubbed as environmental rebound effect in industrial ecology. The ERE notion extends beyond indicators of energy usage to include a broad variety of environmental concerns such as emissions.

Therefore, while Jevons Paradox being a theory worthy to stand on its own, it has over the years become a part of the rebound framework. This raises the enquiry as to how one would actually identify what Jevons paradox is and how it differs in the larger picture of the rebound framework. The simplest answer is that rebound encapsulates any and every negative or undesired outcome of an economic model or policy, Jevons paradox's sole attention goes to the externalities related to consumption practices and levels. According to the Jevons paradox, an improvement in resource efficiency leads to an automatic increasal of resource use, conversely to the idea that resource use will reduce over time. A popular example usually used to explain the Jevons paradox is that of the Watt steam engine. Jevons in his work, *The Coal Question*

(1865) talked about how the improved steam engine design that was created by James Watt during the Industrial Revolution actually enabled for a reduced cost in running the trains with more efficient usage of coal. This led to a boom in the usage of trains, leading to, at the end of the day, a higher consumption of coal.

According to traditional economic understanding, lowering the cost of a commodity through efficiency increases the demand for it. If demand rises swiftly in response to a price drop. Under the assumption that the demand is elastic, then an improvement in efficiency raises net consumption, facilitating for the presence of Jevons paradox. Recognizing the Jevons Paradox is crucial in respect to understanding and achieving the Sustainable Development Goals since it casts doubt on the narratives that underpin such as sustainable textile policies, reformation of the automobile sector and the sustainable energy policies aimed at increasing energy efficiency. Moreover, the Jevons paradox has sparked a heated discussion amongst academics attempting to show or reject its validity in the field of sustainability research.

THE PARADOX AND LIMITS IN CIRCULAR ECONOMY

As with any other economic model, rebound effects exist in plenty within the CE model. Figure 2 presents the set of rebound effects that could be faced by policies for CE. The table has been made based on landmark works done in the field rebound framework within CE.

| Changes brought by the circular economy | Elements of rebound effects | References |
|--|---|---|
| Lower costs of products/services | More consumption Resource depletion | Schröder et al. (2019), Sorrell and Dimitropoulos (2008) |
| Promotion of transportation (new routes for transporting resources) | Workers' and citizens' health or safety issues Lower quality of life | |
| Increase in recycling, remanufacturing, or waste management facilities | Social conflicts Increase in emissions | Annamalai (2015), Campbell-Johnston et al. (2020), Genovese and Pansera (2020), Gregson et al. (2015) |
| Discarded products or waste sent to other regions/cities/countries | Pollution caused by processing or landfills | |
| New policies or regulations for circular systems | Extra investment Social inequality Lack of transparency | Moreau et al. (2017), Rizzo et al. (2016) |
| Supply and demand networks | Market monopoly Resource imbalance | |

Figure 2. Rebound effects of circular economic practices

Source: Chen, 2021

The figure 2 represents all the rebound effects that could be understood from circular economic practices. However, if observed, the rebound effects of more consumption and resource depletion, as well as increase in emission, as highlighted in the table, we can observe that these are the result of Jevons paradox. Jevons paradox plays a critical role within the rebound effects that are observed within the circular economy. Within the current model of CE, the emphasis on resource efficiency and affixation to technological progress eventually and definitively leads to a reduced cost of the products. A continuation of the current paradigm would therefore be still susceptible to the concept of limits to growth, introduced by Meadows et. al. (1972).

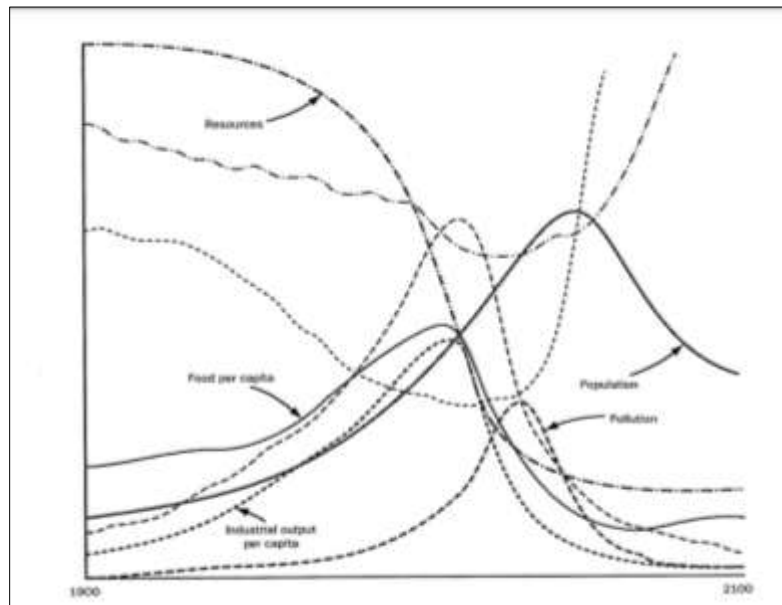


Figure 3. The original projections of the limits to growth model.

Source: Meadows et. al. (1972)

The concept of limits to growth aimed to forecast a future of environmental exhaustion as a result of development practices (as seen on figure 3). Circular economy, while being conceived as a model to counteract against the possible doom proposed by the limits growth theory, would only go on to follow it or even possibly aggravate its impacts on resource exhaustion. With the resources still on a decline, the impact of Jevons paradox would mean a drastic reduction in global food and resource availability.

Jevons Paradox would negatively affect CE progress from two different dimensions: from i) the consumer side and ii) the producer side.

i) From the consumer side, this cost reduction concerns the effect of unmonitored consumption practices. The lowered costs are bound to be utilised by the consumers who would then look to consume more. However with more consumption rises the usage of the raw materials. This

creates the potential to use more of natural resources and strain natural ecosystems considerably more when compared to before implementing circular economic policies.

The electric car industry, which is seen as the poster child of sustainability progress, is a perfect embodiment of Jevons paradox in consumer dimension. The electric car industry, with its increasing efficiency in terms of batteries, owing to R&D emphasis, leads to a reduced cost of vehicles (Parajuly et. al., 2020). The per-unit reduction of the cost of the vehicle leads to more consumption, which means more demand for the vehicle in the automobile sector. This is very much evident within the growth of Tesla Automobiles. Tesla had seen an unprecedented 87% increase in vehicle deliveries in the year 2021¹. Other automobile companies have also understood this shift in the market and have been exploring electric car productions. However, this boom facilitates a higher demand for the raw materials that are required to make the electric cars. What is critical here is lithium mining. Lithium is a core mineral required to make the batteries of these electric cars. Lithium is present in many parts of the world such as in China, as well as in the Atacama region in Latin America. This quick boom and demand for electric cars leads to strain on the lithium mining region. As analysed by Agusdinata et. al. (2018), this strain would lead to ecological imbalances and social displacement of the communities. A pathway to sustainability can quickly become its downfall.

ii) The producer side presents a much more complex picture when compared to the consumer dimension. Only by prioritizing lifespan and the act of using above the procurement of raw material-based items will we be able to reduce consumption. That message is yet to be completely embraced by corporations, even those who are beginning to see the benefits of a circular economy.

An interesting paper by the World Resources Institute called, *Elephant in the Boardroom*, observed the selling and consumption patterns within the fashion industry. The largely US-centric study portrayed the role the private sector played in aggravating the Jevons paradox in achieving commodity circularity. In many of its U.S. stores, a well-known fast fashion clothes firm² displays two prominent slogans, typically on adjoining displays. One encourages the consumers to "rewear, reuse, and recycle," yet immediately adjacent to that is a notice saying, "We have new stuff coming in everyday, why don't you?" Consumers continue to be captivated by the prospect of purchasing new clothing. Through 2030, the global footwear and clothing market is expected to increase at a rate of roughly 5% per year, culminating in about

¹ Reported by the Wall Street Journal, "Tesla Reports 87% Growth in Annual Vehicle Deliveries" - 2 January, 2022.

² The paper by World Resources Institute had taken the decision to hide the name of the brand due to predictable reasons; and this paper, in respect of the decision, will not mention the name of the brand.

100 million tons of output (WRI, 2019). If the goal of CE is to reduce wastage, then this is the worst data to hinder the success of the CE model.

The producer dimension of Jevons paradox in CE practices plays out identically to other discourses such as the questioned intentions of the private sector in achieving sustainability progress and the suspicion regarding the real motivations of corporate social responsibility.

Brands have been on and about to capitalise on the increased interests of people on preferring for a more sustainable way of life. This may be through giving marketing spotlight to goods made from recycled materials or producing products conceived to be more environmentally viable (Mhlanga, 2018). Yet the intentions of the private sector have always been the same throughout history and that is profit maximisation. By enabling the CE model, corporations would definitely take on creating more recycling infrastructure or circularity friendly commodities (Hina et. al., 2021). However, a lack of regulation on the consumption side would only lead to the corporations utilising this new image created to sell more to an unrestricted consumer base, in the longer run enabling for more waste creation and resource exhaustion.

TAKEAWAYS FROM THE CURRENT DISCOURSE

A departure from the conventional structure of having a literature review to introduce the topic of discussion was elemental for this paper. This is owed much due to the nature of the paper, as well as taking into consideration the volume, or lack of, of other works that has been done on Jevons paradox in the CE model. The majority of the work that has been done in regards to the rebound effects and circular economy, as well as Jevons paradox and circular economy have not been focused on providing a structural framework to understand the issue, with an exception of Chen (2021) that had provided the Figure 2. An in-depth critical outlook on circularity and its effects on consumption is also seen to be absent. The report by World Resources Institute³ is the closest to showcasing this critical school of thought, yet without a structural framework and a lack of sufficient emphasis of the theory of Jevons paradox, the paper does not achieve its full potential. While papers have gone on to mention Jevons paradox, none of them have been able to completely identify what in its exact essence Jevons paradox means for the circularity progress or getaways to avoid the challenge of the unregulated consumption patterns. Therefore, this paper aims to be one of the first papers done on this concern, aiming to provide a much deeper understanding of what Jevons paradox in circular economy could mean and how it could be avoided. This idea can only be understood in

³ It is the same report as that that had been mentioned earlier in this work, the citation is provided in the references.

its best sense by having a conceptual framework, which this paper has attempted to make (Figure 4). However, to create a conceptual framework to understand Jevons paradox's impacts, as well as to propose solutions. It is very much important to have a set of solution entry points and this set of solution entry points could be derived efficiently based on research works that had been carried out in the field of circularity as well as rebound effects.

Lundström and Laurenti (2020) explores Jevons Paradox through the environmental lens, depicting growing consumption straining the environment- the inverse effect of circular economic process. The paper's chief motivation was to outline the issue of air emission travel and the role of peer-to-peer boat sharing. However, within the paper, it is very interesting to identify the kind of solutions the paper has proposed in regards to reducing air travel emissions which would correlate well to policies required for reducing the impact of Jevons paradox in CE. The paper proposes the concept of boat sharing amongst people, so as to enable for a lessened use of air travel. This has seen results in reducing emissions as well. This does give the concept or the idea on how societies can be regulated and there can be policies taken in position to enable community based changes which would help in reducing the effects of rebound. The scope of controlling the effects of Jevons paradox in circularity through community based operations is explored in this work by Lundström and Laurenti. The mechanism emulates the community-based monitoring mechanisms proposed by Ostrom (2002). This would definitely enable in creating a paradigmatic change in the contemporary CE model.

Spontaneously Chen (2021) brings in elements of economic inequality and role of economic policies while also presenting a need for community based operations and social measures to reduce the effect of increased consumption. Chen (2021) extends to understand what Jevons paradox means for socio-economic inequalities. Giampietro and Mayumi (2018), Ruzzenenti et. al. (2019) have also studied the linkage of Jevons Paradox with sustainable economic practices. These works have pointed out how resource efficiency and technological innovation seems to be the only drivers and indicators to assess the progress on CE, and an increase in scope of indicators is a necessity.

THE FRAMEWORK

The rebound effects through Jevons paradox in CE, as presented earlier, can be impacted by actions from the side of the producer as well as the consumer. Therefore initiatives on avoiding these rebound effects should come from both the private sector and the governments. A desired understanding and change in this context can only come through a i) **a systematic analysis** of the various Jevons paradox rebound effects, ii) **proposal of solutions**

to tackle these effects, iii) **depiction of all actors** involved as a result of the policies made for CE and all this would desirably culminate in iv) **a paradigmatic shift** in the understanding of the future of CE to include consumption as a key indicator.

The Jevons effects⁴ in CE play a key role in how the future of the CE model is shaped. To avoid the Jevons effects means having a core framework that enlists possible rebounds, a rounded solutions strategy and naming the involved actors. This paper, in what is understood to be a first, has created a conceptual framework outlining the Jevons effects in CE (Figure 4).

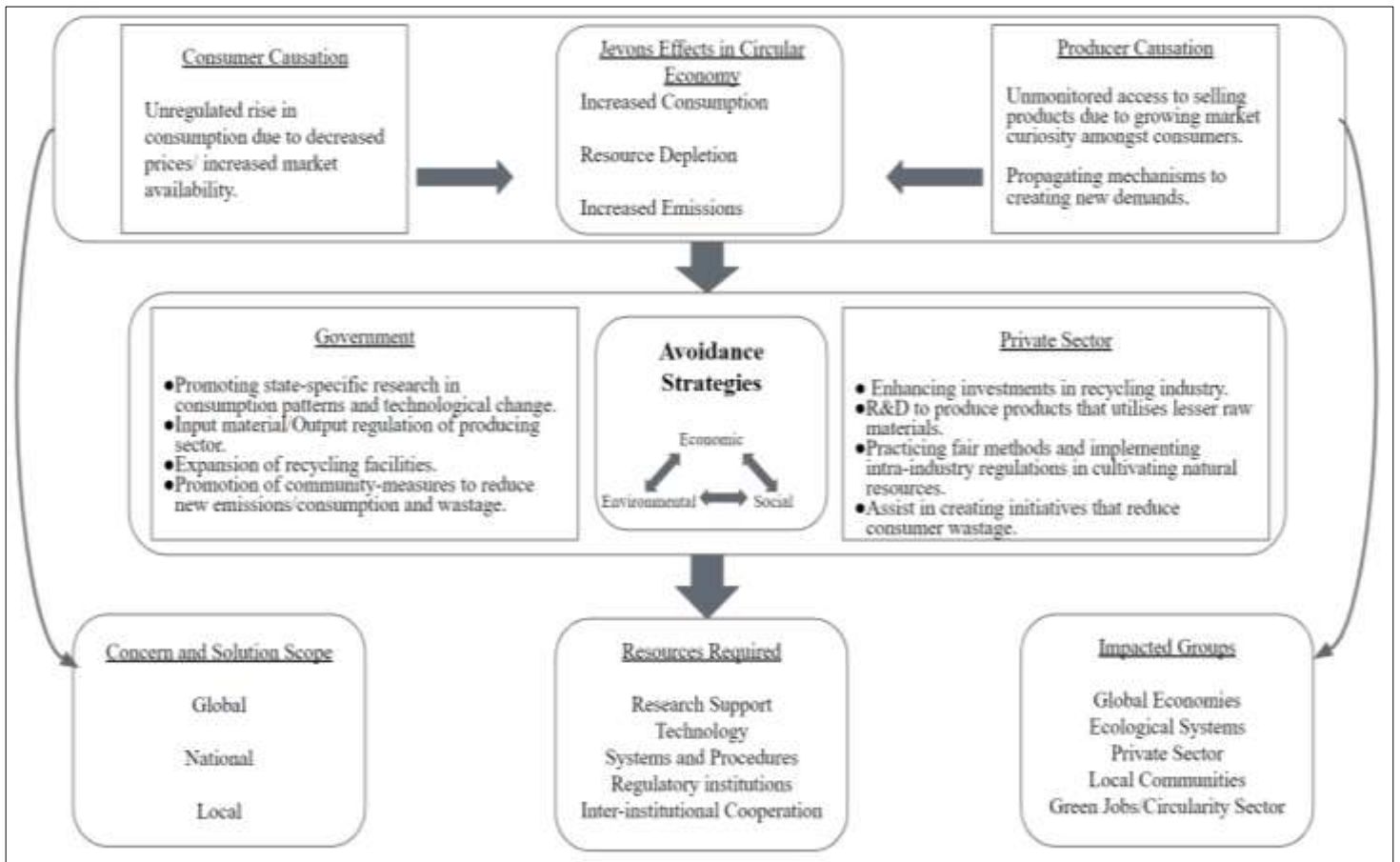


Figure 4. Core conceptual framework outlining all possible Jevons effects in Circular Economy

The framework aims to encompass all the points that had been discussed in this paper. The first tier presents the Jevons effects in CE. Here, the effects that arise from consumer

⁴ Jevons effects is a term coined by the author of this paper. Jevons effects are the set of rebound effects that relates to increased demand and consumption pattern of commodities due to a new economic policy or model. Increased consumption can be neutral in nature, however with a world running low on natural resources, Jevons effects would often be used in the negative connotation.

actions and producer actions have been depicted separately to emulate the multifold causation process behind enabling the Jevons effects. The description of the effects and causation factors have been made based on the rebound effects table by Chen, 2021 (Figure 2) and on the conception of dual dimensions of Jevons paradox in CE, conceived in this work⁵.

The second tier presents the broad strategies to avoid the CE model from falling into the Jevons effects trap. The strategies have been made based on the evaluation of the policies outlined in the European Green Deal. The European Green Deal also stumbles in the paradigm that fails to observe consumption as a key element in circularity progress. Hence, the strategies that have been divided between actions that can be taken by the government and private sector; are based on inspiration and information from Annamalai (2015) and Schroder et. al. (2019). The strategies have been made in accordance with the solution model (Appendix A).

The third tier presents the list of resources required for facilitating the strategies, the scope of impact of the Jevons effects and the strategies and the impacted groups. The resource section is the set of tools required to initiate the outlined strategies. The tier has been made taking inspiration from the global sustainability framework by Mann, 2009 (Appendix B). However, this paper would like to include 'Inter-institutional Cooperation' in its resource list. Cooperation is often neglected in inclusion in normative economic works. Cooperation and partnership would be a key tool in achieving any and all of the outlined strategies, this in accordance with acknowledging the extreme importance of SDG 17 (Partnership for the Goals). Therefore, cooperation should be a key element to be discussed for the future of an effective economic circularity and social welfare; with inclusion of it in the framework, this work aims to spread the message on the importance of inter-institutional cooperation.

FRAMEWORK CHARACTERISTICS AND LIMITATIONS

Circular economy is an evolving and dynamic concept. Hence, it would, while rectifying some of its Jevons effects, might go on to produce others. Acknowledging this element, the Jevons effects in CE framework (Figure 4) is made in a way to accommodate for this inclusion of new possible effects and strategies. The framework is not a closed or completed one. It is simply a structural guide from which academia and policy-makers could make concrete inferences and is open to modifications with changing times.

⁵ Refer to consumer side and producer side dimensions in 'The Paradox and Limits in Circular Economy' chapter.

The research process and the framework creation chiefly faced difficulties with quantification of the rebound effects, owing to its dynamic nature. A rebound effect once changed, becomes something else completely, which would then require a new set of calculative and literature analysis. Therefore, the investigated phenomenon becomes 'different' with the efficiency improvement introduced, a long-standing predicament when dealing with evolving socio-economic systems. A lack of sufficient etymological resources on consumption and rebound effects within CE had also been a challenge to the creation of this paper, nonetheless, hope prevails that this situation changes in the future to introduce more critical analyses of CE.

THE WAY FORWARD

Circularity is not the end goal, but the means to achieving a more equitable and healthy world. Hence, the blind drive that does not produce sufficient study on negative rebound outcomes of CE would only fast-track our fall to the future predicted by the limits to growth theory. For a society that is constantly aware of its scarcity of resources, it is essential that this scarcity also becomes integral to the economic model we call our future.

The improvement in efficiency of technology that comes with CE practices is set to raise the net consumption, and this consumption has to be guided in a way to ensure that it does not mean an accelerated exhaustion of natural resources. While resource efficiency and technological innovation are fundamental to assessing the CE progress, this paper emulates that consumption should also be an indicator that is held in the same importance as the two. We require measurements to retain our attention on the outcomes we intend, as well as objectives to guarantee that we stay within the safe operating zone and do not extend beyond the planet's ability to sustain its ecological system. The inter-institutional cooperation between governments and private sector would be important in enabling the sustainability of the global natural, social and economic environments. It is high time that the key stakeholders in the CE model refer to the Jevons effects, consumption patterns and various social dimensions, beyond the contemporary parochial outlook on CE, to achieve circularity, in its right sense.

The framework to understand consumption in CE being ever-evolving, calls for further research into analysing global consumption levels under circularity policies and critical evaluations of consumerism. The paper has not only aimed to invigorate a larger discourse around the Jevons effects of CE but to also to set a norm of exploring the Jevons effects in any contemporary "the next big thing" economic models.

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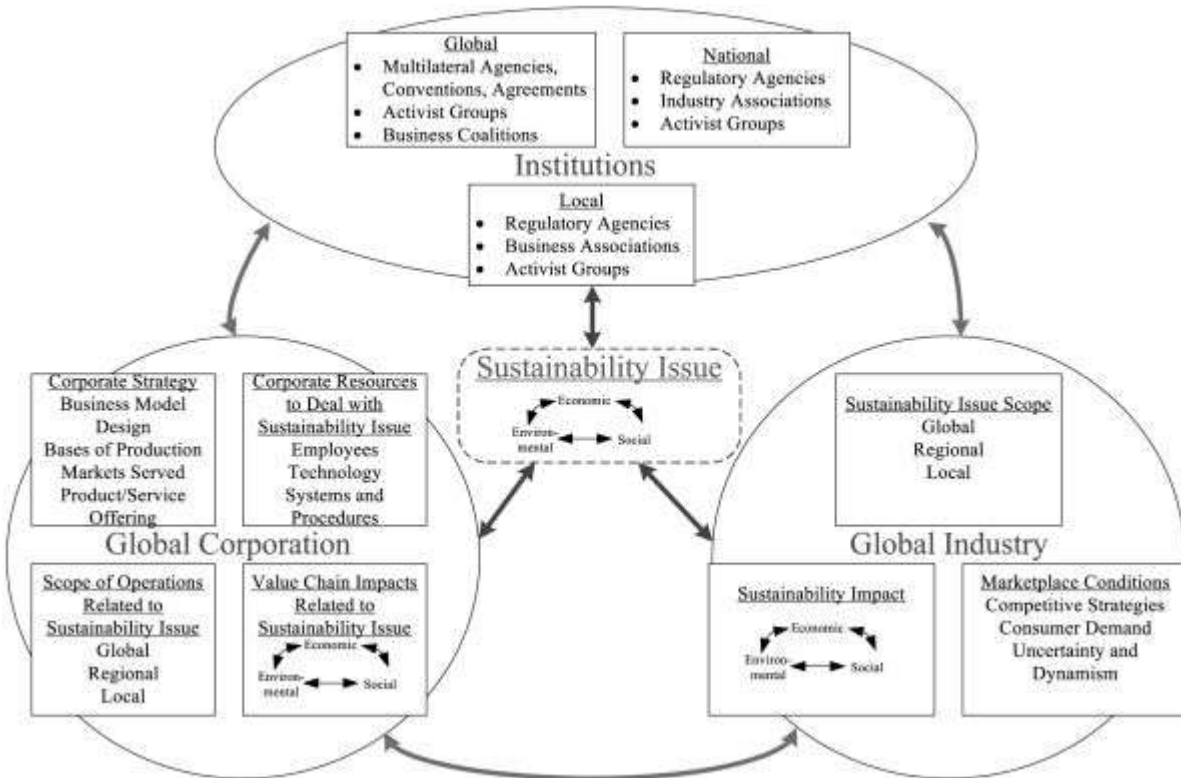
APPENDICES

Appendix A- Solution Model



Source: Chen, 2021

Appendix B- Global Sustainability Business Framework



Appendix C- Solution Entry Points

