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Economy and its symbiosis with Circularity

Abelino Reis Guimarães Neto¹[0000-0003-4003-5358], Rodrigo Rodrigues²[0000-0003-0428-7275],
Jacqueline Zonichenn Reis³[0000-0001-6710-6430], Julio Cesar Raymundo⁴[0000-0001-7383-7520]
and Rodrigo Franco Gonçalves⁵[000-003-2206-3136]

¹ Universidade Paulista (UNIP), São Paulo – SP, Brasil
reisabelino@gmail.com

² Universidade Paulista (UNIP), São Paulo – SP, Brasil
rodrigo.rodrigues01@hotmail.com

³ Universidade Paulista (UNIP), São Paulo – SP, Brasil
zonichenn@hotmail.com

⁴ Universidade Paulista (UNIP), São Paulo – SP, Brasil
juliocesar@fatecpg.com.br

⁵ Universidade Paulista (UNIP), São Paulo – SP, Brasil
rofranco212@gmail.com

Abstract. The risks of harming the future of humanity through the several negative impacts on the environment generated by the linear economy are already been verified, both academically and professionally. It is essential to convert the linear production into circular, providing the possibility of achieving net sustainability. The state of the art of Economy has been modeling itself into a sustainable *umbrella concept*, which must be used to generate wealth and protect the environment. Economy and Circularity are aspects of social relationship that have been together since the beginning on macro, meso and micro-levels. This study has created an analysis tool for the Circular Economy based on the economic analysis tool of the IS-LM curves. This tool makes it possible to identify the Sustainability Margin Point, from the intersection between the curves of Governmental Protective Measures and Protective Postures of Citizens and Governments. Such analysis allows a better understanding and planning of the actions of each of the economic agents: citizens, companies, and governments.

Keywords: Circular Economy, Sustainability, Umbrella Concept.

1 Introduction

The relationship between Economic Science and Circularity goes deeper than a synergistic connection. It is a relationship where the vitality of the economy in a society invariably generates circularity in the coexistence between its individuals, as the simple fact that there is no purchase without selling, or selling without purchase. Such circularity between people inevitably causes several economic impacts, making the vitality such of the economy as of the circularity a symbiotic relationship.

The Circularity subject is presented by Leontief [1] as a grounding for the economic process, where the use of resources is reproduced endlessly times to reach the consumption arising for human demands. To Parkin [2], the economic cycles show themselves to the economy in the connection between GDP and aggregate demand, where the variation of these macro agents is influenced. Both perspectives are connected to the economy definition by Robbins [3], which exalts the relationship between unlimited needs and limited resources. Both the subject of reproduction as the relationship of economic cycles occur in a continuous process to reach human demands. As pointed by Georgescu-Roegen [4], nature imposes limits on economic growth.

This article aims to present a logical structure for the scope of the Circular Economy (CE), using the analogy between its premises as an *umbrella concept* of sustainability, divided into macro, meso, and micro levels, through an economical tool called IS-LM. Based on articles of high academic and professional value, and books that are extremely relevant to the current days, this study is structured with the first section introducing what leads to the perception of the symbiosis between economy and circularity. The second section presents a previous analysis of the state of the art of the Circular Economy and it is subdivided into 3 more parts. The first one will present the importance of the macro-level and governments actions; the second one will regard the transformation of supply chains into eco-industrial parks (EIP), and the synergistic activities between industries; the third subsection presents the micro-level and the purchase and sales relationship between companies and customers. In the third section, the logic of the symbiotic structure between economy and circularity is presented graphically, and finally, in the fourth section, the conclusion and discussion are exposed.

2 The Circular Economy

The state of the art of the Circular Economy portrays a huge concern, both from the academic and professionals, in delimiting the parameters that guide such science, but also to outline its definition with maximum clarity.

The importance of decreasing the impacts of human production is an aspect that recurs frequently in the CE, whether through the elimination of waste materials or reduction in the emission of pollutants, it is essential to confirm the net sustainability achieved [5], making it possible to confirm the environmental benefits from businesses with a perspective on the CE [6-7,8]. To reach this result, the participation of the whole society in its various spheres is fundamental, mainly understanding that the consumption, be of energy, primary resources, finished products or services, needs to be aligned with the premises of sustainability [5,9]. This context is connected with the three dimensions presented by WCED [10]: economic, environmental, and social. These dimensions represent individuals and institutions, which are responsible for preserving nature, guaranteeing a healthy future for the environment. Individually these actors (citizens, governments, and companies) are unable to fully organize the transformation from the linear model to a new circular model. It is necessary to divide the activities by levels of macro, meso, and micro [11-12,13].

The combination of the actions of each one will stimulate sustainable results. This study proposes that the division of these levels in the CE can be compared to the active participation of these players in the Economy. In this similar organization, governments operate on macro issues, the supply chains operate at the meso level, and companies with consumers, operate at the microeconomic level [14], as we will propose in this study.

2.1 Macro-level and Government's activities.

Among these players, the only ones that can impose rules and acts as mediators are governments. Regardless of the political characteristics of countries, the role of mediator and promoter of policies is an essential characteristic of governments. To reach the implementation of the CE, governments must realize their important role in informing and disseminating what is not allowed, and never imposing what to do [15]. Impositions on ventures and businesses discourage and reduce the expectations of the enterprising class, which must decide where to invest its resources in [11].

The role of governments at the macro-level for the promotion of CE is characterized reactively, with fines and fees, limiting what is not acceptable and harmful to the environment, and proactively with public policies for financing projects, culture, information and education [16], created from the concepts in the CE, which in turn, should be seen as an *umbrella concept* of sustainable strategies [7]. Governments see the economic system from a macroeconomic perspective, with capable tools to conduct a global analysis. For the perception of symbiosis in the CE, it will be essential to create analogies between the analytical tools of macroeconomics and sustainability [6]. An important tool for macro analysis is the IS-LM curves, which list fundamental economic agents, such as interest rates, demand for money, fiscal and monetary policies with the evolution of income [2], where the intersection of the curves informs the possible result to be reached, given the margin of adhesion of the actions taken.

By definition IS - investment saving, and LM - liquidity preference money supply. The choice for this tool is justified because its structure requires an analysis of the actions of the three agents. Therefore, it will be presented in this subsection, but it represents the actions of all the agents.

The proposed analogy is expressed in Figure 01, where the "y" axis represents human production, the "x" axis represents the negative impacts of human production on the environment, the negative slope curve represents the government's protective measures (GPM) where assertive measures (consistent penalties and eco-business's financing) increase production and reduce impacts. The positive slope curve is divided between what is in line with government policies (below the protective measures curve) and actions that are irregular to public guidelines, that is, it is divided between a protective stance and a negligent attitude, of citizens and organizations.

The intersection between the curves is the possible result of production and its impact on the environment, or the point referring to the Sustainability Margin (SM), which is a reference to how much the impact on the environment has been increased or decreased due to the sum of government measures with the adjustments absorbed by society. The displacements of the curves must also be observed, with the dis-

placement of both the Government Protective Measures curve as the Posture curve of Citizens and Organizations must always move upwards, raising sustainability in line with increased productivity.

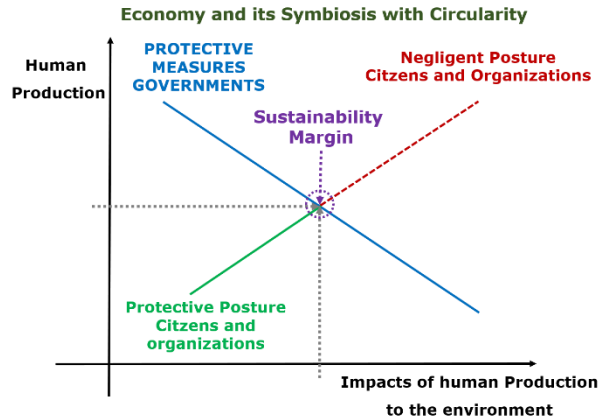


Fig. 1. Analogy between the macro tool IS-LM, which analyzes the possible results of government measures with income, with the CE. Source: the authors.

For the displacement to occur in this direction, it is necessary that government tools, fines, and fees, investment and financing, culture and education, are working harmoniously, and companies and citizens absorb these changes completely.

Figure 02 shows a real gain in combating the negative impacts caused by human production, where the SM point rises to its previous condition and decreases both the percentage of impact per unit and the impact on its global relationship. This scenery can occur both by maximizing the efficiency of all public policies, which lead to the readjustment of institutions and people, cause we live the future today when we guarantee the means for life tomorrow [10].

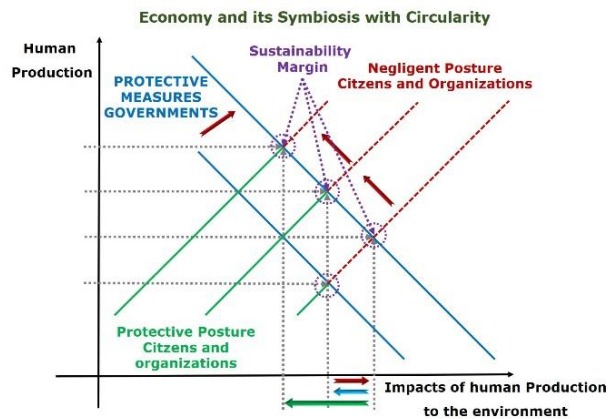


Fig. 2. Displacement of curves, both for Protective Measures and for Posture upwards, generating a context of increasing the sustainability margin. Source: the authors.

This figure shows that the SM point moves three times, once for each displacement of the curves. First, it moves down and to the right, with the elevation of the Measures curve, then it moves for its maintenance returning to the initial point of Impact, with the shift of the Posture curve upwards, and finally, it moves to the left and upwards with another readjustment of the Posture curve, and at this point, we have a gain at the Sustainability Margin.

2.2 Meso-level and the formation of Supply Chains in the CE

The executing actors of this operation, in the productive activities, are citizens and companies, these, in turn, should foster partnerships that guarantee current business and enable new business. Currently, competition between companies has taken on a much greater proportion, making the competition not just between them, but between supply chains [17].

At the meso level, it can be found the largest individual industries producers of impacts on the environment and transforming these negative impacts into new businesses causes the creation of new added and financial values, uniting the common interests of organizations [11,18]. It is based on new product engineering, new modeling, and new designs, where companies can redesign their businesses, linking a consumer network to a large part of the surplus from their production process [12,19]. By consuming these surpluses, the companies' networks foster their interests while reducing the impact of their activities. This corroborates the construction of EIPs, which, when they become closed circuits, fail to expose a large part of their resources to the environment, which in another business structure would reach the end of their useful life, not returned to the production process [20]. EIPs arise to close the surplus production circuits, extend the useful life of the residues of the production processes in new productions in a closed supply chain. It creating a park where industries generate environmental and financial values by consuming surplus from other [11,21].

The actions of companies at the meso level must be connected with regional public policies, but mainly meet the perception of revenues of private entrepreneurs, because this factor is decisive to keep private investments directed to eco-business. It is, in this context, that productive companies redesign their processes and products, create businesses and partners [22]. Consequently, meso level activities contribute socially, so that all the Supply Chain may achieve sustainability.

2.3 Micro-level and relationship between companies, consumers and the environment.

At the micro-level, we can see the relationship between companies and consumers. A society without rules in defense of the environment, without policies to promote culture and education on sustainability, creates a shallow understanding of this obligation with nature [23].

It is essential that the activities generated by the CE businesses produce results in favor of net sustainability [5]. It is also crucial that profit is not considered the only purpose. One way to guarantee these results is to think about new product designs and

projects, planning the extraction and disposal of the resources that will be used and disposed of [24]. For that, we can use eco-efficiency strategies, like the cradle-to-cradle concept [20], as well as planning to replace natural products with synthetic resources. Promoted by governments, these actions must be absorbed by consumers, who must rethink their consumption posture [25]. This synergistic strength between governments and consumers should lead companies to promote new sustainable businesses in their supply chains [26, 27], as the creation of eco-industrial-parks, where productivity is connected to environmental protection [11]. This umbrella concept will form a structure that will help to reduce the extraction of scarce natural resources [8], giving time for the rehabilitation of the environment, ensuring conditions for a sustainable future.

In this context, the micro-level is directly related to what companies produce and is accepted by consumers, as well as the destination of their packaging and products at end of service life [18]. A change of posture in the structure of governments and institutions influences their citizens to be informed and to become more critical, reducing the trade of products with unknown origin and destination. Until the culture and critical position reach most people, the global transformation to a fully sustainable economy will be largely in the hands of governments and institutions.

3 Link between the three players in the CE

The link between citizens, companies, and governments in the symbiosis between economy and circularity is an infinite spiral link, where the actions of its agents are exponential capacity tools for the transformation of the reality in which they live.

Figure 03 demonstrates how the macro-level involves the whole society, the meso-level involves the entire supply chain and its evolution in EIP's, and the micro-level involves the relationship between company and customers.



Fig. 3. Connection between agents in the symbiotics of the Circular Economy and the performance of the macro, meso and micro levels. Source: the authors.

This relationship among the actors makes it possible to see graphically how each one relates and is positioned in the symbiotic environment of the Circular Economy,

and emphasizes that the economic life of agents is made up of well-defined links, and mainly bilateral, with no purchase without selling, or selling without purchase. There is no economy without circularity or society without the environment.

4 Conclusion and Discussions

The Circular Economy can be observed as the *umbrella concept* of sustainability, which uses the organization of macro, meso, and micro-levels to direct its path towards net sustainability. In this organization, the macro-level is composed of reactive public policies (taxes and fines), and proactive through financing and investment in ecological industrial parks, culture and education. The meso-level encourages the wealth production and the reduction of negative impacts on the environment, from the reengineering of its products, which enables new partnerships and businesses. At the micro-level, companies and customers exchange with each other products with origin and destination linked to net sustainability. This structure can be analyzed by analogy, using already consolidated tools, such as the IS-LM curve.

Despite strongly presenting its proposals, the present study leaves open empirical data that can corroborate its valuation with the academic and professional environment, as well as it lacks the fundamental depth at each level (macro, meso, and micro). It is also welcome more concrete discussion on solutions for the needed reforms to achieve sustainability, emphasizing the desire to deepen this theme in future studies.

We can't repeat the mistakes made by Linear Economy, where the world economy generates wealth and wonders, together with hunger, social exclusion and aggression to the environment. We can no longer claim ignorance of this path that went wrong.

References

1. Leontief, Wassily. Die wirtschaft als kreislauf. Laupp, (1928).
2. Parkin, Michael. Economy. ed 8°. Translation: Cristina Yamagami. Pearson. São Paulo (2009).
3. Robbins, Lionel. An essay on the nature and importance of Economic Science. Editora Saraiva. São Paulo (2007).
4. Georgescu-Roegen, N. The Entropy Law and the Economic Process. Harvard University Press, Cambridge, MA (1971).
5. Korhonen, Jouni; Honkasalo, Antero; Seppälä, Jyri. Circular economy: the concept and its limitations. Ecological economics, v. 143, p. 37-46 (2018).
6. George, Donald AR; Lin, Brian Chi-ang; Chen, Yunmin. A circular economy model of economic growth. Environmental modelling & software, v. 73, p. 60-63 (2015).
7. Blomsma, Fenna; Brennan, Geraldine. The emergence of circular economy: A new framing around prolonging resource productivity. Journal of Industrial Ecology, v. 21, n. 3, p. 603-614 (2017).
8. Murray, Alan; Skene, Keith; Haynes, Kathryn. The circular economy: an interdisciplinary exploration of the concept and application in a global context. Journal of business ethics, v. 140, n. 3, p. 369-380 (2017).

9. Frosch, Robert A.; Gallopoulos, Nicholas E. Strategies for manufacturing. *Scientific American*, v. 261, n. 3, p. 144-153 (1989).
10. WCED, Special Working Session. World commission on environment and development. *Our common future*, v. 17, p. 1-91, Berlin (1987).
11. Sakr, D. et al. Critical success and limiting factors for eco-industrial parks: global trends and Egyptian context. *Journal of Cleaner Production*, v. 19, n. 11, p. 1158-1169 (2011).
12. Jackson, Melissa; Lederwasch, Aleta; Giurco, Damien. Transitions in theory and practice: Managing metals in the circular economy. *Resources*, v. 3, n. 3, p. 516-543 (2014).
13. Kirchherr, Julian; Reike, Denise; Hekkert, Marko. Conceptualizing the circular economy: An analysis of 114 definitions. *Resources, Conservation and Recycling*, v. 127, p. 221-232 (2017).
14. Ghisellini, Patrizia; Cialani, Catia; Ulgiati, Sergio. A review on circular economy: the expected transition to a balanced interplay of environmental and economic systems. *Journal of Cleaner production*, v. 114, p. 11-32 (2016).
15. Schulze, Günther. *Growth Within: A Circular Economy Vision for a Competitive Europe*. Ellen MacArthur Foundation and the McKinsey Center for Business and Environment, p. 1-22 (2016).
16. Geels, Frank W. Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Research policy*, v. 39, n. 4, p. 495-510 (2010).
17. Corrêa, Henrique Luiz. *Supply chain management: integrating supply chains in the globalized world*. ed 1°. Editora Atlas SA, São Paulo (2000).
18. Zhu, Qinghua; Geng, Yong; Lai, Kee-hung. Circular economy practices among Chinese manufacturers varying in environmental-oriented supply chain cooperation and the performance implications. *Journal of Environmental Management*, v. 91, n. 6, p. 1324-1331 (2010).
19. Lacy, P. et al. *Circular advantage: innovative business models and technologies to create value in a world without limits to growth*. Accenture, Chicago (2014).
20. Braungart, Michael; McDonough, William; Bollinger, Andrew. Cradle-to-cradle design: creating healthy emissions—a strategy for eco-effective product and system design. *Journal of cleaner production*, v. 15, n. 13-14, p. 1337-1348 (2007).
21. Fang, Yiping; Cote, Raymond P.; Qin, Rong. Industrial sustainability in China: practice and prospects for eco-industrial development. *Journal of environmental management*, v. 83, n. 3, p. 315-328 (2007).
22. Gibbs, David; Deutz, Pauline. Reflections on implementing industrial ecology through eco-industrial park development. *Journal of Cleaner Production*, v. 15, n. 17, p. 1683-1695 (2007).
23. Melosi, M. *Garbage in the cities: Refuse, reform and the environment*, revised ed. University of Pittsburgh Press (2005).
24. Reh, Lothar. Process engineering in circular economy. *Particuology*, v. 11, n. 2, p. 119-133 (2013).
25. Zhijun, Feng; Nailong, Yan. Putting a circular economy into practice in China. *Sustainability Science*, v. 2, n. 1, p. 95-101 (2007).
26. Macarthur, Ellen et al. Towards the circular economy. *Journal of Industrial Ecology*, v. 2, p. 23-44 (2013).
27. Zeng, Huixiang et al. Institutional pressures, sustainable supply chain management, and circular economy capability: Empirical evidence from Chinese eco-industrial park firms. *Journal of cleaner production*, v. 155, p. 54-65 (2017).