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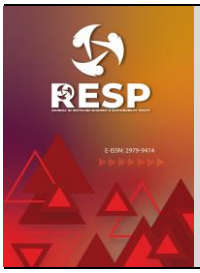

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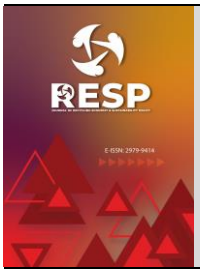

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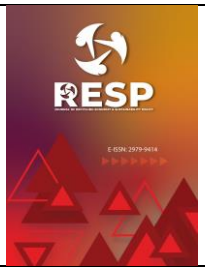

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Araştırma Makalesi ● Research Article

Circular Economy Strategies for Sustainable Waste Management in the Food Industry

Gıda Endüstrisinde Sürdürülebilir Atık Yönetimi için Döngüsel Ekonomi Stratejileri

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ANAHTAR KELİMELER

Gıda israfı
Kompostlama
Döngüsel ekonomi
Katı atık
Sürdürülebilir kalkınma hedefi

ÖZ

Gıda endüstrisi, atık oluşumuna ve doğal kaynakların tükenmesine önemli bir katkıda bulunmaktadır. Bu zorlukların üstesinden gelmek için döngüsel ekonomi yaklaşımı, gıda endüstrisinde sürdürülebilir atık yönetimi için umut verici bir çerçeve sunuyor. Bu makale, atık azaltma, yeniden kullanım, geri dönüşüm ve kaynak geri kazanımı dahil olmak üzere döngüsel ekonomi stratejilerini gözden geçirmekte ve bunların gıda endüstrisinde çevresel etkileri azaltma ve ekonomik faydaları artırma potansiyellerini araştırmaktadır. Makale ayrıca düzenleyici engeller, tüketici davranışı ve pazar talebi dahil olmak üzere gıda endüstrisinde döngüsel ekonomi stratejilerinin uygulanmasıyla ilgili zorlukları ve fırsatları tartışıyor. Son olarak, makale, en iyi uygulamaları ve öğrenilen dersleri vurgulayarak, gıda endüstrisindeki döngüsel ekonomi girişimlerinin vaka incelemelerini sunuyor. Döngüsel ekonomi stratejileri, gıda endüstrisinde sürdürülebilir atık yönetimine kapsamlı ve entegre bir yaklaşım sunar ve bunların başarılı bir şekilde uygulanması, gıda değer zinciri boyunca işbirliği ve yenilik gerektirir.

KEYWORDS

Food waste
Composting
Circular economy
Solid waste
Sustainable development goal

ABSTRACT

The food industry is a major contributor to the generation of waste and the depletion of natural resources. In order to address these challenges, the circular economy approach offers a promising framework for sustainable waste management in the food industry. This article reviews circular economy strategies, including waste reduction, reuse, recycling, and resource recovery, and explores their potential for reducing environmental impacts and increasing economic benefits in the food industry. The article also discusses the challenges and opportunities associated with implementing circular economy strategies in the food industry, including regulatory barriers, consumer behaviour, and market demand. Finally, the article presents case studies of circular economy initiatives in the food industry, highlighting best practices and lessons learned. Circular economy strategies offer a comprehensive and integrated approach to sustainable waste management in the food industry, and that their successful implementation requires collaboration and innovation across the food value chain.

1. Introduction

The food industry is one of the most significant contributors to global waste generation. The production, processing, and distribution of food items result in a considerable amount of waste, including food waste, packaging waste, and processing waste. The challenge of waste management in the food industry has become a critical issue, as it not only affects the environment but also has economic and social implications (Torres-León et al., 2018).

The food industry is facing several challenges when it comes to waste management. The first challenge is the sheer volume of waste generated (Marchant, 2021). According to the Food and Agriculture Organization (FAO), about one-third of the food produced in the world for human consumption is lost or wasted each year, which amounts to about 1.3 billion tons (FAO, 2011). This waste has a significant impact on the environment, contributing to greenhouse gas emissions, land degradation, and water pollution. The second challenge is the cost of waste management. The disposal of waste requires significant resources, including transportation, processing, and landfill

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or incineration facilities. These costs are often passed on to consumers, who end up paying higher prices for food products (Abdel-Shafy & Mansour, 2018). The third challenge is the social impact of waste. Food waste has a significant impact on food security, as it reduces the availability of food for those in need. Additionally, food waste also contributes to the depletion of natural resources, such as water and land, which affects the livelihoods of communities that depend on these resources (Benton et al., 2021).

To address these challenges, the food industry needs to adopt circular economy strategies for sustainable waste management. The circular economy is an economic model that aims to keep resources in use for as long as possible, by reusing, repurposing, and recycling them. The circular economy model focuses on reducing waste and using resources more efficiently, which can lead to significant economic, social, and environmental benefits (Negrete-Cardoso et al., 2022).

Circular economy strategies for sustainable waste management in the food industry can take various forms. One approach is to reduce food waste at the source by implementing more efficient production and distribution systems, as well as better food preservation techniques (Gonçalves & Maximo, 2022). Another approach is to repurpose waste materials, such as using food waste as animal feed or composting it to create fertilizer (David, 2021). Another circular economy strategy is to redesign packaging to be more sustainable and recyclable. This can include using biodegradable materials, reducing the amount of packaging used, and designing packaging that is easier to recycle (Meherishi et al., 2019). Finally, circular economy strategies can also involve developing new business models that encourage more sustainable practices. For example, some companies are experimenting with circular supply chains, where products are designed to be easily disassembled and repurposed at the end of their lifecycle (Aarikka-Stenroos et al., 2022). Other companies are exploring new revenue streams by turning waste into value-added products, such as using food waste to create bioplastics or biofuels (Tsang et al., 2019).

So, the food industry must address the challenge of waste management to ensure sustainability in the long run. The circular economy provides a framework for sustainable waste management, by promoting resource efficiency, reducing waste, and creating new business opportunities. By adopting circular economy strategies, the food industry can reduce its environmental footprint, lower costs, and contribute to a more sustainable future.

2. Concept of circular economy

The concept of circular economy has gained increasing attention in recent years, as a response to the urgent need for more sustainable waste management practices (Velenturf & Purnell, 2021). The circular economy is an economic system that aims to minimize waste and make the most out of resources by keeping them in use for as long as possible. It is based on the principles of reducing, reusing, and recycling resources and materials to create a closed-loop system, in which waste is minimized and materials are kept in use for as long as possible (US EPA, 2021). This system is designed to promote the efficient use of natural resources and reduce the negative impact of human activities on the environment (Winans et al., 2017). In the food industry, circular economy strategies can offer a range of benefits, from reducing food waste and greenhouse gas emissions to creating new revenue streams and improving brand reputation . This article will provide an overview of the concept of circular economy, its principles, and the advantages of its application in waste management practices in the food industry.

Figure 1. A basic concept of circular economy.

Definition and Principles of Circular Economy

Circular economy is an economic system that is restorative and regenerative by design. This is an economic model that aims to design out waste and pollution, keeping materials in use for as long as possible (Ellen MacArthur Foundation, 2022). It is an alternative to the traditional linear economy, which follows the 'take-make-dispose' approach (Wautelet, 2018). The Ellen MacArthur Foundation, a leading advocate for the circular economy, defines it as "an economy that is restorative and regenerative by design, aiming to keep products, components, and materials at their highest utility and value at all times, distinguishing between technical and biological cycles" (Ellen MacArthur Foundation, 2022). The circular economy aims to close the loop of the traditional linear economy by promoting the efficient use of natural resources, reducing waste generation, and extending the life of products and materials (Kara et al., 2022). It aims to create a closed-loop system, where waste is minimized, and resources are conserved, reused, and recycled (Jørgensen & Pedersen, 2018). The concept is based on three main principles: (1) designing out waste and pollution, (2) keeping products and materials in use, and (3) regenerating

natural systems (Vural Gursel et al., 2022).

The first principle focuses on preventing waste and pollution at the source, by designing products and processes that are more efficient, durable, and recyclable (Geissdoerfer et al., 2017). This principle emphasizes the importance of designing products and systems that are sustainable and environmentally friendly (Velenturf & Purnell, 2021). This involves a shift from the traditional linear model of production and consumption, in which resources are extracted, used, and disposed of, to a more circular model, in which resources are reused and recycled (Garcés-Ayerbe et al., 2019). It involves the use of eco-design, which focuses on the environmental impact of products and systems from their conception to their end of life. By designing out waste and pollution, we can reduce the negative impact of human activities on the environment (Rosen & Kishawy, 2012).

The second principle emphasizes the importance of keeping materials in use for as long as possible, by promoting reuse, repair, and recycling. This involves a shift from a "take-make-dispose" approach to a "reduce-reuse-recycle" approach, in which waste is minimized and resources are kept in use. By keeping products and materials in use, we can reduce the amount of waste generated and conserve natural resources (Kirchherr et al., 2023).

The third principle focuses on the need to regenerate natural systems, by designing processes that are restorative and regenerative, rather than degrading and polluting (Alcalde-Calonge et al., 2022). This involves a shift from a linear model of production and consumption to a closed-loop system, in which waste is minimized and natural systems are restored (Jørgensen & Pedersen, 2018). It involves the use of sustainable practices, such as sustainable agriculture and forestry, to promote the health of ecosystems and ensure their resilience (Wilson & Lovell, 2016).

3. Advantages of Circular Economy Approach to Waste Management in the Food Industry

The application of circular economy strategies in waste management practices in the food industry can offer a range of advantages, including:

3.1. Reducing Food Waste

The food industry is a major contributor to global food waste, with an estimated one-third of all food produced globally being lost or wasted every year (UNEP, 2021). Circular economy strategies can help to reduce food waste by promoting more efficient production and distribution systems, as well as by diverting food waste from landfills and converting it into new products, such as compost or animal feed. This helps to reduce waste by promoting the efficient use of natural resources and extending the life of products and materials. By reducing waste, we can conserve natural resources and reduce the negative impact of human activities on the environment (Rashid & Shahzad, 2021).

3.2. Lowering Greenhouse Gas Emissions

Food waste is also a significant source of greenhouse gas emissions, contributing to climate change (Tubiello et al., 2021). When food waste ends up in landfills, it decomposes and emits methane, a potent greenhouse gas that is about 25 times more effective at trapping heat in the atmosphere than carbon dioxide (Yasmin et al., 2022). According to the United Nations, food waste is responsible for around 8% of global greenhouse gas emissions (Environment, 2021). By implementing circular economy strategies, such as reducing food waste, recovering food for human consumption, and recycling food waste into energy, we can significantly reduce greenhouse gas emissions in the food industry (Ingrao et al., 2018). Additionally, promoting the use of renewable energy sources, such as solar or wind power, in food production, processing, and transportation can also help to reduce emissions (Chen et al., 2022). Overall, taking steps to address food waste and promote sustainable practices in the food industry can play a crucial role in mitigating the effects of climate change (Usmani et al., 2021).

3.3. Creating New Revenue Streams

Implementing circular economy strategies can help businesses in the food industry find new opportunities for revenue generation by identifying value in waste materials and by-products (Poponi et al., 2022). By converting food waste into biogas or biofuels, businesses can create new sources of energy and sell them to customers, thereby generating additional revenue streams. In addition to energy production, businesses can also create new products and services from waste materials (Korbag et al., 2021). For example, food waste can be used to create fertilizers or animal feed, which can be sold to farmers. Alternatively, food waste can be turned into new food products, such as sauces or jams, which can be sold to consumers. These products can be marketed as sustainable and environmentally friendly, providing an additional selling point for businesses (Senanayake et al., 2021). By embracing circular economy strategies, businesses in the food industry can not only reduce waste and improve sustainability, but also unlock new revenue streams and create new opportunities for growth (Barros et al., 2021).

3.4. Improving Brand Reputation

By implementing circular economy strategies, food industry businesses can showcase their commitment to sustainability and environmental responsibility, which can enhance their brand reputation among consumers and stakeholders (Barros et al., 2021). This is particularly important as more and more consumers are becoming environmentally conscious and are actively seeking out products and services from companies that prioritize sustainability. Adopting circular economy strategies such as reducing food waste, implementing sustainable sourcing practices, and using renewable energy sources can help businesses improve their environmental

footprint and demonstrate their commitment to sustainability. This, in turn, can lead to increased customer loyalty, improved brand reputation, and a positive impact on the bottom line (Patwa et al., 2021). In today's business environment, where companies are increasingly expected to operate in an environmentally responsible manner, embracing circular economy strategies can help food industry businesses not only reduce waste and improve sustainability but also enhance their reputation and appeal to customers who prioritize sustainability (Ahmad et al., 2021).

3.5. Conserving natural resources

Circular economy strategies in the food industry can help to conserve natural resources by promoting the efficient use of resources and reducing waste. For example, sustainable sourcing practices can help to reduce the environmental impact of food production by minimizing the use of natural resources such as water and energy. Additionally, reducing food waste can help to conserve resources by ensuring that the resources used to produce food are not wasted (Wunderlich & Martinez, 2018). Circular economy strategies can also promote the reuse and recycling of materials, further conserving natural resources. For example, food waste can be recycled into compost, which can be used as a natural fertilizer for crops. Similarly, materials used in food packaging can be recycled or reused, reducing the need for new materials and conserving natural resources (Peng et al., 2023). By embracing circular economy strategies in the food industry, businesses can help to conserve natural resources, reduce waste, and promote sustainability, ensuring the availability of resources for future generations (Poponi et al., 2022).

3.6. Creating jobs

Implementing circular economy strategies in the food industry can create new job opportunities, particularly in the areas of recycling, repair, and refurbishment (Morseletto, 2020). For example, the recycling of food waste into biogas or biofuels requires specialized equipment and expertise, creating new job opportunities in this sector. Similarly, the repair and refurbishment of food processing and packaging equipment can also create new jobs (Bhatia et al., 2023). Circular economy strategies can also create new job opportunities in the areas of sustainable sourcing and production. For example, businesses that prioritize sustainable sourcing practices may need to hire experts in sustainable agriculture or forestry. Similarly, businesses that use renewable energy sources may need to hire workers with specialized skills in this area (Rizos et al., 2016). By embracing circular economy strategies in the food industry, businesses can create new job opportunities, particularly in local communities, where these jobs are often needed the most. This can have a positive impact on the local economy, promoting sustainable development and enhancing the quality of life for local residents (Kaur et al., 2022).

3.7. Encouraging innovation

Implementing circular economy strategies in the food industry can encourage innovation and the development of sustainable products, services, and business models that are more sustainable and efficient. This can lead to the emergence of new industries and the creation of new jobs, promoting sustainable economic growth and development (Hysa et al., 2020). For example, the conversion of food waste into biogas or biofuels requires innovative technologies and processes, creating opportunities for the development of new products and systems (Hafid et al., 2022). Similarly, the development of sustainable packaging solutions or new food products made from recycled materials can lead to the creation of new business models and industries (Guillard et al., 2018). Circular economy strategies also encourage businesses to think creatively about how they use resources, which can lead to the emergence of new approaches to production and distribution. For example, businesses may explore new ways to reduce waste or to use by-products and waste materials as inputs for other products or services (Awan & Sroufe, 2022).

4. Challenges in the food industry waste management

The food industry generates a significant amount of waste, including food waste, packaging waste, and wastewater. Effective waste management is a critical challenge for the industry due to several factors (Sinha & Tripathi, 2021). Firstly, food waste is a significant challenge for the food industry. This can occur at any stage of the supply chain, from production to consumption, and can result from overproduction, expiration of food products, or inefficient logistics. This can lead to economic losses for businesses and contribute to environmental problems such as greenhouse gas emissions and landfill waste (Jeswani et al., 2021). Secondly, packaging waste is another challenge for the food industry. Packaging is used to protect and preserve food, but it can also result in significant amounts of waste. The disposal of packaging waste can be challenging, and the use of non-biodegradable materials can lead to environmental problems such as pollution and litter (Kakadellis & Harris, 2020). Finally, wastewater management is also an issue for the food industry. Wastewater from food production facilities can contain high levels of organic matter, nutrients, and other pollutants, which can pose a risk to the environment if not properly managed (Shrivastava et al., 2022). Overall, the food industry faces significant challenges in managing waste effectively. Addressing these challenges requires a multi-pronged approach, including reducing food waste, promoting sustainable packaging solutions, and implementing effective wastewater treatment strategies.

4.1. Food waste generation and its environmental impacts

Food waste is a significant problem globally, with a staggering amount of food being discarded every day. It is estimated that nearly one-third of the food produced worldwide, equivalent to 1.3 billion tons, is lost or wasted annually (RESET, 2018). Food waste occurs at all stages of the food supply chain, from production to consumption, with different reasons such as spoilage, damage, and overproduction. The generation of food waste has numerous environmental impacts. First and foremost, it leads to the depletion of natural resources, such as water, land, and energy, that were used in the production of the wasted food. This, in turn, exacerbates the pressure on the environment, leading to soil degradation, water scarcity, and deforestation (Ishangulyyev et al., 2019).

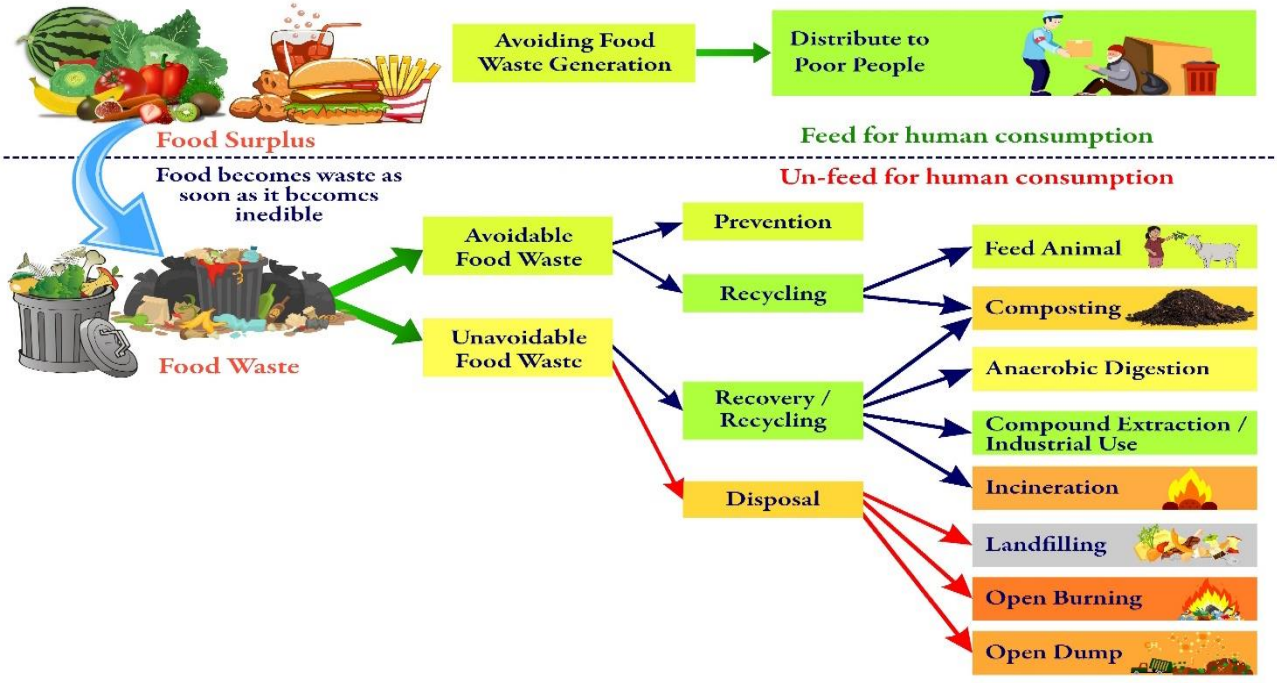
Moreover, food waste emits a significant amount of greenhouse gases (GHGs), contributing to climate change. When organic matter decomposes in landfills, it releases methane, a potent GHG that is 25 times more potent than carbon dioxide. The amount of GHGs emitted by food waste is estimated to be 3.3 billion metric tons of carbon dioxide equivalent annually, making it one of the most significant sources of anthropogenic GHG emissions (Nordahl et al., 2020).

In addition, food waste contributes to the loss of biodiversity. Agriculture, forestry, and fisheries are among the most significant drivers of biodiversity loss, and food waste exacerbates this problem. When food is produced but not consumed, it leads to a waste of the natural resources that were used to produce it, such as water, land, and energy. This, in turn, puts pressure on ecosystems, leading to a decline in biodiversity (Read et al., 2022).

Another impact of food waste is the loss of economic value. When food is discarded, it represents a significant loss of resources and economic value. According to the Food and Agriculture Organization (FAO), the economic cost of food waste is estimated to be $1 trillion annually. This is not only a waste of resources but also represents a missed opportunity to provide food to those in need (Kotykova & Babych, 2019).

Moreover, food waste has social impacts, particularly in developing countries. In many parts of the world, food waste occurs primarily at the production and distribution stages due to inadequate infrastructure and insufficient storage facilities. This leads to a lack of food security and economic losses for small-scale farmers and food producers (Santeramo, 2021).

Figure 2. Various stages of food waste management.



In conclusion, food waste generation has numerous environmental impacts, including the depletion of natural resources, emission of greenhouse gases, loss of biodiversity, and loss of economic value. It also has social impacts, particularly in developing countries, where inadequate infrastructure and storage facilities lead to a lack of food security and economic losses. Therefore, reducing food waste is critical to address the global challenges of climate change, resource depletion, and food security. It requires a concerted effort from all actors along the food supply chain, from producers to consumers, to reduce waste and adopt sustainable practices (Morone et al., 2019).

4.2. Current waste management practices and their limitations

Waste management is the process of collecting, treating, and disposing of waste materials. The current waste management practices vary depending on the country, region, and local context. However, most of these practices have limitations that need to be addressed to ensure sustainable waste management.

One of the most common waste management practices is landfilling. Landfills are sites where waste is buried in the ground, often covered with soil or other materials to reduce odors and prevent the release of contaminants (Siddiqua et al., 2022). While landfilling is a relatively low-cost option, it has several limitations. One of the most significant limitations is that landfills take up valuable land that could be used for other purposes. Additionally, landfills can produce leachate, a liquid that contains contaminants such as heavy metals and organic compounds that can pollute nearby groundwater and surface water (Swati et al., 2018). Landfills can also emit methane, a potent greenhouse gas that contributes to climate change, and other air pollutants that can harm human health (Mar et al., 2022).

Another waste management practice is incineration. Incineration is a waste management practice that involves burning waste to produce energy or dispose of it. While incineration can reduce the volume of waste and generate energy, it also has significant limitations (Rahman & Alam, 2020). One of the most significant limitations is that it emits air pollutants such as dioxins, furans, and heavy metals, which can harm human health and the environment (Tait et al., 2020). Incineration can also be expensive to operate, as it requires high capital investment and maintenance costs. Furthermore, incineration produces ash, which can contain hazardous waste and requires careful disposal to prevent further environmental damage (Shilkina & Niyazov, 2018; Incineration, 2000).

Recycling is another common waste management practice that involves processing waste materials to produce new products. Recycling has many benefits, including conserving resources, reducing energy consumption, and reducing waste (Rashid & Shahzad, 2021). However, it also has limitations. One of the most significant limitations is that not all waste materials can be recycled (Goossens et al., 2019). For example, certain plastics cannot be recycled or can only be recycled a limited number of times. Additionally, the recycling process can be energy-intensive and require significant investment in recycling facilities (Pleissner, 2018). Furthermore, the effectiveness of recycling programs depends on the cooperation of the public, which can be difficult to achieve (Fogarty et al., 2021).

Composting is a waste management practice that involves the decomposition of organic waste to produce compost, a nutrient-rich soil conditioner. Composting has many benefits, including reducing the volume of waste, conserving resources, and reducing greenhouse gas emissions (Ayilara et al., 2020). However, it also has limitations. One of the most significant limitations is that composting requires specific conditions to be effective, such as the right temperature, moisture, and oxygen levels. Achieving these conditions can be challenging, particularly on a large scale (Waqas et al., 2023). Furthermore, composting may not be suitable for all types of organic waste, such as waste containing pathogens or hazardous substances.

Finally, waste reduction and avoidance are waste management practices that aim to reduce the amount of waste generated. This involves minimizing waste at the source, such as through product design and packaging reduction, and promoting sustainable consumption patterns. While waste reduction and avoidance have many benefits, they also have limitations (Ferronato & Torretta, 2019). One of the most significant limitations is that they require significant behavioural and societal changes, which can be challenging to achieve. Furthermore, the effectiveness of waste reduction and avoidance programs depends on the cooperation of multiple actors, including producers, consumers, and policymakers (Whitmarsh et al., 2018).

In conclusion, current waste management practices have limitations that need to be addressed to ensure sustainable waste management. Landfilling, incineration, recycling, composting, and waste reduction and avoidance all have advantages and disadvantages. The choice of waste management practice depends on local context, waste characteristics, and sustainability goals (Ardra & Barua, 2022). Therefore, it is crucial to adopt a holistic approach to waste management that considers the entire waste management system, including waste generation, collection, treatment, and disposal. This requires the cooperation of multiple stakeholders, including government, industry, civil society, and the public, to adopt sustainable waste management practices that protect human health and the environment.

5. Circular economy strategies for sustainable waste management in the food industry

Circular economy strategies for sustainable waste management in the food industry can include several approaches. One is to minimize waste generation by optimizing production processes and reducing losses during transportation and storage. Another is to reuse waste materials as inputs in other industries or products. For example, food waste can be converted into biogas or compost, which can then be used as a source of energy or fertilizer. Additionally, recycling and repurposing of packaging materials can also be effective strategies to reduce waste (Ghisellini et al., 2016). Overall, a circular economy approach can help the food industry move towards more sustainable waste management practices, reducing environmental impacts and generating economic benefits (Rico Lugo et al., 2023).

5.1. Prevention strategies

Prevention strategies are one of the most effective ways to address the issue of waste management in the food industry. By reducing the amount of waste generated in the first place, companies can minimize their environmental impact and save costs associated with waste disposal. Prevention strategies can take many forms, but two of the most common approaches are reducing food waste and minimizing packaging (Lemaire & Limbourg, 2019; Al-Obadi et al., 2022).

Reducing food waste is an important prevention strategy in the food industry. Food waste occurs at all stages of the food supply chain, from production and processing to distribution and consumption. By implementing measures to reduce food waste, such as optimizing production processes, improving storage and transportation, and educating consumers on how to minimize waste, companies can significantly reduce the amount of food waste generated (Martin-Rios et al., 2022). This not only benefits the environment but can also help companies save money by reducing the need for waste disposal and lowering production costs.

Another important prevention strategy is minimizing packaging. Packaging is a necessary part of the food industry to ensure that products are protected during transportation and storage. However, excessive packaging can contribute to waste and environmental harm. To minimize packaging waste, companies can implement measures such as using eco-friendly materials, reducing the size and weight of packaging, and promoting the use of reusable or recyclable packaging materials (Musicus et al., 2022). These measures can help companies reduce their environmental impact and promote a circular economy approach to waste management (Geueke et al., 2018).

So, prevention strategies are a crucial element in the pursuit of sustainable waste management in the food industry. By reducing food waste and minimizing packaging, companies can significantly reduce their environmental impact, save costs, and promote a circular economy approach to waste management (Cristóbal et al., 2018). With the increasing focus on sustainability and environmental responsibility, prevention strategies are likely to become even more important in the future.

5.2. Recycling strategies

Recycling strategies play a significant role in sustainable waste management in the food industry. Recycling can reduce the amount of waste sent to landfills and incinerators, conserve natural resources, and create economic opportunities (Omari et al., 2023). There are several recycling strategies that can be employed in the food industry, including composting, anaerobic digestion, and recycling of packaging materials.

Composting is a recycling strategy that involves the decomposition of organic waste materials, such as food scraps and yard trimmings, into a nutrient-rich soil amendment called compost (Cerda et al., 2023). Composting can help divert organic waste from landfills and reduce greenhouse gas emissions by preventing the decomposition of organic waste in landfills. Additionally, compost can be used as a soil amendment to improve soil quality and support plant growth (Sánchez, 2022).

Anaerobic digestion is another recycling strategy that involves the decomposition of organic waste in the absence of oxygen, producing biogas and digestate (Xu et al., 2018). Biogas is a renewable energy source that can be used to generate electricity and heat, while digestate can be used as a fertilizer (Uddin et al., 2021). Anaerobic digestion can help divert organic waste from landfills, reduce greenhouse gas emissions, and generate renewable energy (Zhang et al., 2017).

Recycling of packaging materials is also an important recycling strategy in the food industry. Packaging materials, such as plastic, paper, and glass, can be recycled into new products, reducing the demand for virgin materials and conserving natural resources (Mahesh Kumar et al., 2016). Companies can implement measures such as using eco-friendly packaging materials, promoting the use of reusable packaging, and implementing recycling programs to reduce the environmental impact of packaging waste (Marsh & Bugusu, 2007).

Overall, recycling strategies are an essential component of sustainable waste management in the food industry. Composting, anaerobic digestion, and recycling of packaging materials can help divert waste from landfills, conserve natural resources, and create economic opportunities. By implementing these strategies, companies can reduce their environmental impact and move towards a more circular economy approach to waste management (Geueke et al., 2018).

5.3. Recovery strategies

Recovery strategies are an important aspect of sustainable waste management in the food industry. Recovery strategies involve extracting valuable compounds from waste materials to create new products, reducing waste and creating economic opportunities. One example of a recovery strategy in the food industry is the extraction of valuable compounds from food waste (Kumar et al., 2017). Food waste is a significant problem in the food industry, and it is estimated that up to one-third of all food produced is lost or wasted. However, food waste contains valuable compounds that can be extracted and used to create new products (Dhua et al., 2022). For example, food waste can be processed to extract bioactive compounds, such as antioxidants, which can be used in the cosmetics, pharmaceutical, and food industries (Panzella et al., 2020). Another example of a recovery strategy in the food industry is the production of animal feed from food waste. Food waste can be processed to create animal feed, which can help reduce the environmental impact of livestock production by reducing the need for feed made from virgin materials (Murugesan et

al., 2021). In addition to these examples, recovery strategies can also include the production of renewable energy from waste materials. For example, food waste can be used to produce biogas through anaerobic digestion, which can be used to generate electricity and heat (Hamad et al., 2014).

Overall, recovery strategies play an important role in sustainable waste management in the food industry. By extracting valuable compounds from food waste, companies can reduce waste, create economic opportunities, and promote a more circular economy approach to waste management (Scarano et al., 2022). As the food industry continues to focus on sustainability and environmental responsibility, recovery strategies are likely to become even more important in the future.

6. Case studies of circular economy strategies in the food industry

Circular economy strategies have gained traction as a critical approach to sustainable waste management in the food industry. Companies are adopting circular economy strategies to reduce waste, conserve natural resources, and create economic opportunities. Successful implementation of these strategies requires an understanding of the benefits and challenges they present. In this article, we will review some case studies of circular economy strategies in the food industry and explore the benefits and challenges of these strategies (Scarano et al., 2022).

Case Study 1: Starbucks is a multinational coffee company with a commitment to sustainable waste management. The company has adopted circular economy strategies to reduce waste and create economic opportunities. One of the most successful circular economy strategies that Starbucks has implemented is the recycling of coffee grounds. Starbucks recycles used coffee grounds to create a nutrient-rich compost that is used to grow coffee, tea, and other plants. This circular economy approach has reduced waste, conserved natural resources, and created economic opportunities for Starbucks (Eshelman, 2022). The company has also partnered with other organizations to promote sustainable waste management practices, including composting and recycling. Some of the benefits include reduced waste, conserved natural resources, new economic opportunities, improved environmental sustainability, and enhanced corporate social responsibility. Some of the challenges include difficulty in implementing composting and recycling programmes, a lack of consumer awareness about composting and recycling, and limited infrastructure for composting and recycling (Tsai et al., 2020).

Case Study 2: Nestle, a multinational food and beverage company, has implemented circular economy strategies to reduce waste and conserve natural resources. One of the most successful circular economy strategies that Nestle has implemented is the recycling of plastic packaging (Espinoza-Orias et al., 2018). Nestle has committed to using 100% recyclable or reusable packaging by 2025. The company has also invested in the development of new recycling technologies to reduce waste and conserve natural resources (Meier, 2018). Additionally, Nestle has partnered with other organizations to promote sustainable waste management practices and reduce the environmental impact of its operations (Eugénio et al., 2022; Galli et al., 2020).

Case Study 3: Danone, a multinational food and beverage company, has implemented circular economy strategies to reduce waste and conserve natural resources. One of the most successful circular economy strategies that Danone has implemented is the use of recycled plastic in its packaging. Danone has committed to using 100% recycled plastic in its packaging by 2025 (*Circular Economy Model - Danone*, 2019). The company has also partnered with other organizations to promote sustainable waste management practices and reduce the environmental impact of its operations. Additionally, Danone has implemented innovative packaging solutions to reduce waste and improve the recyclability of its packaging (*Water Stewardship - Danone*, 2019).

India has a large and diverse food industry, and circular economy strategies have been implemented by companies across the sector. Here are a few Indian case studies of circular economy strategies in the food industry:

Case Study 4: Mother Dairy is a leading milk and dairy products company in India. The company has implemented circular economy strategies to reduce waste and create economic opportunities (Livemint, 2022). One of the most successful circular economy strategies that Mother Dairy has implemented is the conversion of milk waste into biogas. Mother Dairy has installed a biogas plant at its milk processing facility in Ghaziabad, Uttar Pradesh, which converts milk waste into biogas. The biogas is then used as fuel for the company's operations, reducing its reliance on fossil fuels. This circular economy approach has reduced waste, conserved natural resources, and created economic opportunities for Mother Dairy (Casallas-Ojeda et al., 2021). But the main challenges include the high capital investment required for installing a biogas plant and the difficulty of sourcing raw materials for biogas production.

Case Study 5: ITC Limited is a leading food and beverage company in India with a commitment to sustainable waste management. The company has implemented circular economy strategies to reduce waste and create economic opportunities. One of the most successful circular economy strategies that ITC Limited has implemented is the use of agricultural waste as a raw material for its operations (*Sustainability at Itc*, 2022). ITC Limited sources agricultural waste, such as rice husk and wheat straw, from farmers in its supply chain and uses it as a raw material for its operations (*Itc's Agri Commodities and Rural Services*, 2022). This circular economy approach has reduced waste, conserved natural resources, and created economic opportunities for farmers and ITC Limited (*Itc Intensifies Its 360-Degree Interventions towards Waste Management*, 2022; *Itc Raw Materials & Products*, 2022).

Case Study 6: Chintan Environmental Research and Action Group is an Indian non-governmental organization that works on waste management and environmental sustainability. The organization has implemented circular economy strategies to reduce waste and create economic opportunities in the informal waste sector (Chintan, 2023). Chintan has implemented a project called "Kabad se Jugad" (From Waste to Innovation) in Delhi, which involves training waste pickers to create new products from waste materials, such as paper, plastic, and metal. The products are then sold to consumers, creating economic opportunities for waste pickers and reducing waste. But the main challenges include limited infrastructure for waste collection and management in some regions and limited consumer demand for recycled products (*Beat Plastics Pollution*, 2018).

Overall, these case studies demonstrate that circular economy strategies can be successfully implemented in the food industry. These strategies have a range of benefits, including waste reduction, conservation of natural resources, economic opportunities, and enhanced corporate social responsibility. However, implementing circular economy strategies can also present challenges, including difficulty in implementing composting and recycling programs, lack of consumer awareness, and limited infrastructure for composting and recycling. To address these challenges, companies can collaborate with other organizations, invest in innovative technologies, and educate consumers about the benefits of circular economy strategies (Kumar et al., 2022; Nattassha et al., 2020). By adopting circular economy strategies, companies can reduce their environmental impact, promote sustainable waste management practices, and create economic opportunities.

7. Conclusion

Circular economy strategies are crucial for sustainable waste management in the food industry. The food industry generates a significant amount of waste, including food waste, packaging waste, and other materials, which can have negative impacts on the environment, human health, and the economy. Implementing circular economy strategies can help reduce waste, conserve natural resources, and create economic opportunities. The importance of circular economy strategies for sustainable waste management in the food industry cannot be overstated. The food industry is a significant contributor to global waste and environmental problems, and it is essential that companies take responsibility for their waste and implement strategies to reduce it. By adopting circular economy strategies, companies can reduce their environmental impact, conserve natural resources, and create economic opportunities.

Future research directions in this area include:

Developing more efficient and effective circular economy strategies for sustainable waste management in the food industry. There is still much room for improvement in terms of waste reduction, recycling, and recovery.

Conducting more research on the economic benefits of circular economy strategies for the food industry. While circular economy strategies can be costly to implement initially, they can also create economic opportunities in the long run.

Increasing consumer awareness and education about the benefits of circular economy strategies. Consumers play an important role in waste reduction and recycling, and it is important to educate them about the benefits of circular economy strategies.

Encouraging more collaboration and partnerships between companies, governments, and non-governmental organizations to promote circular economy strategies in the food industry. Collaboration can help overcome the barriers to implementation and create more effective and sustainable strategies.

In conclusion, circular economy strategies are essential for sustainable waste management in the food industry. These strategies can help reduce waste, conserve natural resources, and create economic opportunities. While there are still challenges and barriers to implementation, the benefits of circular economy strategies are clear. As the food industry continues to focus on sustainability and environmental responsibility, circular economy strategies are likely to become even more important in the future.

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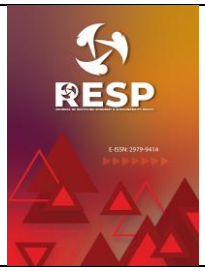

RESP

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AraştırmaMakalesi ● Research Article

On Digital Money

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ANAHTAR KELİMELER

Para döngüsü
Bir para ücretli emek standardı
Güvenlik duvarları

ÖZ

Dünya çapındaki yatay çıktı ve istihdam trendleri ve özel ve kamusal alandaki sanal para birimlerine odaklanan hareketli tartışmalar bağımsız konulardır. Bu çalışmada, bu iki unsuru birbirine bağlamaya çalışıyoruz. Parasal döngü süreci modeli, bir Merkez bankasının üretime yatırım yapmak için bir ücret faturası avansı şeklinde bir hesap oluşturarak faaliyet başlatması durumunda kullanılmaktadır. Bundan sonraki süreçler döngü sürecinin baskısıyla ayrı hesaplara kaydedilmelidir. Kapitalistler ve işçiler zamana göre risk-getiri ödemelerini optimize etmek için finansal piyasaları kullanmakta özgürken, biz kapitalistlerin ve işçilerin para ihtiyaçlarını yönetmek için dar bir merkez bankası hesabını, yöneticilerin ve rantiyelerin özsermaye hedeflerini izlemek için bir merkez bankası yatırım bankası hesabı öneriyoruz. Spesifik olarak, S.C. Goueviavd. (2017) dört senaryosunu kendi vakamızı geliştirmek için modifiye ediyoruz.

KEYWORDS

The monetary circuit
A money wage-labour standard
Firewalls

ABSTRACT

The flat output and employment trajectories worldwide and the animated discussion surrounding virtual currencies, private and public, are independent topics. We attempt to connect the two elements. The circuit model of the monetary process is used to make the case for a central bank initiating activity by creating an account in the form of an advance of a wage bill to invest in production. Processes thereafter must be recorded in separate accounts as the circuitistes insist. We make the case for a narrow bank account of the central bank managing the money needs of capitalists and workers, of the investment bank account of the central bank monitoring the equity objectives of executives and rentiers, while capitalists and workers are free to use financial markets to optimize their risk-return payoffs over time. Specifically, we modify the four scenarios of S.C. Gouevia et al. (2017) to develop our case.

1. Introduction

The empirical fact continues to be the numbness of economic activity of a scale and colour (green) fit to generate employment for millions of people in non-environmentally-debilitating jobs across the developed and developing world. The traditional response would be massive government expenditures across the gamut of physical and social infrastructure. However, since the other side of the State balance sheet, steeply progressive income and wealth taxation in a society polarised along those dimensions, has been universally abandoned by the economic policy establishment, the old policy intrusion does not pass academic muster. Ricardian equivalence, despite lack of unequivocal support, continues to rumble under the surface of academic discussion. Any goodies enjoyed by present generations will have to be paid for by generations to come goes the refrain. The sword of Damocles has always hung over quantitative easing programmes in the US and Europe and elsewhere at sessions of parliaments as politicians across the board fret about budget balance. We need to be reminded that all the propositions above, implicit and explicit, are theorems proved from the set of assumptions of a specific model. Other models exist.

We offer the circuit approach to monetary macroeconomics as an original approach to the theme that joins the monetary and the real in a novel theoretical structure. Starting from a clean slate, a sophisticated structure is built up from the creation of bank money. It turns out that the Schumpeter

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proposition "loans create deposits" and therefore money has been supported by scholarship at the Bank of England, the IMF, and other mainstream schools. Since the structure is purely analytical, the motive force driving bank and entrepreneur and workers together is not addressed. Given the endurance of the current milieu we will make the case in logic and history that it is natural to append central to the bank Coming to the present and the theme of the paper, Dirk Niepelt (2018) has offered a neutrality theorem, that the substitution of central bank "reserves for money" for inside money is painless. The view that disaggregated information at the hands of private banks and their clients cannot be aggregated to statistics to be conveyed to central banks can also be countered. Records can be stored in decentralised private-banking systems and centralised central-banking systems as well. What about the Hayekian notion that knowledge of the "particularities of time and place" are the privilege of local borrowers and lenders. Here again, there is no reason to dispute the other Hayekian notion that in markets prices convey the same information to central bankers as they do to private bankers.

In what follows, we extend the connection with nonmainstream macroeconomics by providing our own balance-sheet segregations across financial entities. The next section begins with the kickstarting of the 'first moment' of circuit theory which is the birth of bank money in the form of a loan for productive purposes. The loan is the outlay on wages to workers. The following subsection is the 'second moment', the playing out of actions thereafter as firms and workers consume and save, the former also paying back the interest and eventually the principal on the loan. Secondly, we record the decisions of firms to issue shares to workers to fund fresh capital investment. Finally, the risk attributes associated with a machine delivering a stream of services over time can be minimized by recourse to derivatives and more elaborate devices offered by financial intermediaries. The 'third moment' is the closing of the accounts or terminal value conditions as debts are repaid and individuals conclude their lifetime plans.

2. The monetary circuit in a digital age

2.1. The 'first moment'

We whet the appetite for a modern treatment of the subject by providing a nonstandard treatment of standard Macro 101. The source is Godley & Cripps (1983), one of the most elegant books on macroeconomics of all time in its care for measurement issues and its defining characteristic of macroeconomic theory as a subject in its own right distinct from microeconomics. The connection with national income aggregates is intimate but the sub aggregates are rearranged to reflect the problems on hand. Thus, consider one such familiar arrangement respecting the axioms of arithmetic according to which total national income Y equals total national expenditure E.

$$E \equiv Y \tag{1}$$

Sub aggregating, there will be those whose income is in excess of expenditure and who, therefore, will be accumulating financial assets. As an initial institutional condition, we must assume that the only avenue available is a deposit in a bank, ΔFA. However, by the discipline imposed by equation 1, if some citizens are accumulating assets it must be the case that other citizens are accumulating debts, ΔD. In brief,

$$FA \equiv D. \tag{2}$$

We disentangle final expenditures into actual sales FE (C for the private sector of an economy and $C + G$ in an economy with government.) and inventory activity ΔI, goods in transit between storage bins and retail stores. Delta can be positive or negative reflecting inventory accumulation or drawdown. Also, working capital expenditures need to be incurred before final sales. We have

$$Y \equiv E \equiv FE + \Delta I. \tag{3}$$

Coming in from a different end, denoting total profits by Π and the wage bill, the product of the average wage and the number of people employed by WB,

$$\Pi \equiv FE - WB + \Delta I. \tag{4}$$

Combining equations 3 and 4, we have the known

$$Y \equiv \Pi + WB. \tag{5}$$

The most natural introduction to banks takes place at this juncture. Firms will perforce have credit lines open with their local or community banks so as to support inventory holdings. Coming to working capital requirements, Arthur Okun, one of the venerable sages of the macroeconomics of yesteryear, was especially eloquent on firms not terminating contracts during a downturn, seeking to retain the capital embodied in employees so as torealise the returns on their indivisible and dedicated skill sets once the upturn sets in in a few years. Old hands will stay on, metaphorically washing windows to finessing office records to monitoring stock movements in warehouses, at token stipends. Note that I, the more familiar symbol for investment, has not appeared because the context is one of extreme pessimism and the positive numbers backing projections like MEC schedules are not to be found. Production and ancillary activities are distinguished from the accumulation of capital. Denoting bank loans by LI, we have $\Delta LI \equiv \Delta I$. Or,

$$LI \equiv I \tag{6}$$

With $LI \equiv FA$, the circuit is complete. The direction of the causal arrows is paramount. In the rare event of income equalling expenditures and equation 2 becoming redundant, equation 6 would define a deposit for accounting purposes. In addition, modern extensions of stock-flow-consistent models have embraced the ecological dimensions of balance-sheet accounting (Dafermos, Nikolaidi and Galanis, 2017). Thus, the production process is defined to include the extraction of materials from the ground as well as, in our case, the recycling of produced economic stocks.

Coming to modern times, it is sufficient but not necessary to begin to make our case using the panoply of elements surrounding electronic money. One objective is to situate our discussion within society and outside bits and pulses between banks. Thus, bitcoin and other devices are founded on the idea of money as a 'thing'. It must be separate from the life of the community in general and the machinations of banks in particular (Dodd, 2017). It turns out, though, that the currency depends on a complex division of labourin order to be produced and disparities in wealth and power not different from the visible strata of finance capital are reproduced within. In addition, its adoption is seen as akin to a return to the gold standard (Heller, 2017). There is no mechanism to dampen price volatility on the occasions of sharp demand spikes and supply falls. Central banks will always dominate with their superiority in stabilising economies overall. Money must serve as a unit of account, a numéraire, in which prices and wage contracts are measured. All virtual currencies fail to meet the measure of money laid down by Stanley Jevons (Dabrowski and Janikowski, 2018). Wages are not paid in virtual currencies nor does any government accept them as legal tender. Money is bank money and that proposition leads immediately to problems of information asymmetry and adverse selection. The problem is best addressed by the institution of sovereign money. Indeed, free banking is likely to lead to credit rationing. High-risk borrowers will be screened in and blue-eyes borrowers fail to secure credit. Bitcoin fails this desideratum. At the same time, it is allegedly responsible for pioneering the use of distributed ledger (DL) technology which allows transfers of money at negligible cost.

Many central banks are looking to the technology of DLs to support central bank digital currencies (CBDCs) to widen their policy space albeit under potentially radical subversion of the assumptions underlying central bank and commercial bank monies. There is some pro and con but net a consensus seems to be emerging supporting central bank issuance of digital money (Fung and Halaburda, 2016; Engert and Fung, 2017). The possible scenarios are still being written and we add our model to the literature engaging both axioms and theorems (Gouveia et al, 2017). For instance, a 'digital fiat currency' (DFC) has been proposed which will be determined endogenously by banks not by the central bank thereby retaining the social welfare-enhancing practice of localised lending (Dow, 2018). Not dissimilarly, an 'account-based CBDC' has been worked out wherein accounts would be held directly at the central bank and access would be made available through public-private partnerships (Bordo& Levin, 2017). During a recession, the CBDC would operate the money-financed fiscal deficit that would follow. The stimulus funds would be deposited directly into the accounts of low-income households. It was Friedman who voiced the coordination of monetary and fiscal policy under such extenuating circumstances. The payments system operated in DFC controlled by the state would be separated from the ordinary business of banking. Banks would lend with due diligence but borrow DFC with the loans as collateral so that the supply of money would grow coterminously with the supply of credit. Indeed, we modify the conventional monetary economics foundations of the survey of Gouveia et al along accounting tracks to propose a coherent alternative which is a combination of their four scenarios proposed. Thus, we reconstruct option A root and branch as the first step of circuit theory in which blockchain technology is used for wage payment systems. Here, the CBDC would be held by central banks or nationalized banks mediating with employers and employees. Our simple reason is that that nowhere in these scenarios is any room left for banks underwriting projects and supporting employment.

Elaborating on Option A, the CBDC is restricted to employers accepting the government portmanteau of projects and workers employed on the projects. Ecological stock-flow-consistent economics referred to can be deployed to specify a green corporate bonds purchase by commercial/central banks in a global green quantitative easing (QE) programme. Dafermos et al calibrated a model with central banks all over the world and found salutary effects in 2020 in the scenario of a global commitment to the purchase of an unchanging share of 25% of outstanding green bonds. The set of banks would need to be extended to include small and local banks which would now possess a central bank settlement account. On this front, Farley Grubb has been waging a heroic battle against the quantity theory of money approach to modelling money in favour of the evidence that money originated as a zero-coupon bond (Cutsail& Grubb, 2017). The case in point was the emission by the British North American colonies of large amounts of paper money called bills of credit. Details about North Carolina's paper money emissions have been collected so as to determine the market value of the paper over its entire history. North Carolina's bills were structured as zero-coupon bonds which had legally-mandated maturities when they were paid off or paid in face value in specie to the government. They could be redeemed at face value any time after emission in payments of taxes. The paper money was not unlike a bearer bond that required an explicit redemption exercise to extinguish the principal on the face of the bill, information that was common knowledge. The Grubb present value formulation, a theme which will revisited below, is as follows with r the riskless discount rate, APV standing for expected real-asset present value, RED_t the face value of the quantity of North Carolina bills retired in year t, $M_j$the face value of the amount of North Carolina paper money outstanding in year j,

$$APV_j = \sum_{t=j}^{N} e^{-rt} \left(\frac{RED_t}{M_j}\right) \tag{7}$$

and

$$\sum_{t=j}^{N} \left(\frac{RED_t}{M_j}\right) = 1 \tag{8}$$

In short, the bonds were real barter assets. They has a

miniscule "moneyness' quality to them. Citizens paid a small premium above the *APV* to acquire bills because they were a more convenient medium of exchange in comparison with the next-best barter alternative.

The CBDC would not be anonymous. The nodes of the DL system and their wallets would be common knowledge. Our option A moves in the direction opposite to that of option A of the article in that it *brings to identity* the credit and payments aspects of the financial system. Option A is designed to write up the latter in terms of goods and services in the interest of earning profits in the real circuit. Sharing DLs with other countries allows the home central bank real-time information about foreign direct investment meeting the open-economy criteria of the monetary circuit. Dynamic monitoring of home-grown and as well as imported employment-generating activities aborts systemic crises on this account.

Connecting with Option C, CBDC as a new policy tool, the CBDC would be a *wage-backed currency*. Our option upturns the criticism of option C that the 'unit of account' property of money is brought into question under the scheme. In our interpretation, central bank money is a numéraire precisely because it underpins the wage rate.

In sum, the wage bill supporting the 'first moment' is $w_tN_t$where $t$is the present point in time, w_t a 'dignified wage' wage promulgated by the authorities say by ILO standards in the same period, and $N_t$is the number of workers able and willing to offer their services for 'decent work'. In that case, the liability side of the CBDC is given and the 'second moment' consists of workers spending their incomes and sales having beingrealised, capitalists consuming/saving theirs. At the same time, the bank must recover over time, albeit with hiccups, the initial wage bill disbursed as a loan to support the 'variable cost' posed by w_tN_t. The equation connecting it all, mainstream and non mainstream is the definition of profits:

$$\Pi = PS - w_tN_t - rL \tag{9}$$

The unsubscripted elements in the equations denote their realisation in the future, in the analytics of the second moment. Sales *S* would include sales to government, the *G* in a model which included the fiscal authority but here only consists of *C*, private consumption with the consumer price level *P*. Consumption, by definition, is consumption of both capitalists and workers over time. Likewise, while a loan, *L*, to defray the wage bill is taken out today, *t*, the repayment of interest, *r*, and principal, subscripted appropriately, will take place from *t*+1 onwards. The interest rate may be time-varying and the asset may turn out to be 'non-performing' taking a positive value in equation 7 mirrored in a negative value on the asset side of the bank balance sheet. We are in a position to distinguish between money as a productive asset and cryptocurrency as a speculative asset whose value exists in capital gains only (Claeys et al, 2018). In models of the latter, the characterisation of lending, as we see, does not appear. Either individuals would have to screen and audit projects themselves or the entities that emerge to monitor loans would be investment funds and not banks as their liabilities in cryptocurrencies would be equity not deposits.

2.2 The "second moment"

We assume that all classes will want a portion of their incomes failure- or risk-free.

Since consumption and savings and repayment of loans taken in the present can be realised over an infinite horizon as per life cycle considerations, we rewrite equation 9 separating out our anchor in the present in the form of the wage bill.

$$w_tN_t = \sum_{i=t}^{\infty} P_iC_i - \sum_{i=t}^{\infty} \Pi_t - \sum_{i=t}^{\infty} r_tL_t \tag{10}$$

The first term on the right-hand side can be divided into the consumption of Basics and the consumption of Luxuries. The subscripts *B* and *L* will distinguish the categories. Great store should not be laid on the categorisation. The rich menu of financial assets are options available to both capitalists and workers. We need to distinguish between the primary share issue of firms and workers obliging by purchasing these shares and both responding enthusiastically to constant innovations in financial markets. Superscripting the narrow bank account in the central bank as *NB*, the investment bank account in the central bank as *IB* and the cornucopia of items available in financial markets as *FM* and separating them on accounting principles, we arrive at

$$[(w_tN_t - \sum_{i=t}^{\infty} P_iC_{Bi}^{NB}) + \sum_{i=t}^{\infty}(\Pi_i - P_iC_{Li}^{NB})] = [(-w_tN_t + \sum_{i=t}^{\infty}(P_iC_{Bi}^{IB})) + (-w_tN_t + \sum_{i=t}^{\infty}(P_iC_{Bi}^{FM}))] + [\sum_{i=t}^{\infty}(-\Pi_i + P_iC_{Li}^{IB}) + \sum_{i=t}^{\infty}(-\Pi_i + P_iC_{Li}^{FM})] - \sum_{i=t}^{\infty} r_tL_t \tag{11}$$

The left-hand side is the liability side in our narrow bank account and the extreme right-hand side term on the other side is the asset term in the account. In the standard accounting framework of 100 percent reserve banking, the asset like the liability is near-money, an asset that can be liquidated at short notice without cost. While the latter is usually taken to mean government paper of short duration epitomising perfect liquidity, since the institution is the central bank of the country in the discussion below we suggest that government bonds backing real assets could provide an equivalent run-free portfolio. Even on their own terms, the selected projects will be at one end of the low-risk-high-return spectrum so the umbrella bank under which they are sheltered is a relatively failsafe organisation. In our categorisation, the option of relevance is D in which the CBDC is "non-anonymous and universal". The CBDC here is the same as making a deposit with a central bank. We note that by the criteria of the authors, option A is the least disruptive and option D the most disruptive. Betwixt is option C where the distinction between monetary and fiscal policy drops, the central bank balance sheet is all of a piece with the balance sheet of the treasury.

In nonmainstream economics, 'bringing the future to the

present' has come to occupy pride of place in calculations. Post Keynesians are ambitious of present value calculations for synthesising State and Credit Theories of Money. Compare, for instance, our equation 7 with the well-known nominal value of any asset (Tymoigne, 2017).

$$P_t = \sum_{n=1}^{N} \frac{E_t(Y_n)}{(1+d_t)^n} + \frac{E_t(FV_N)}{(1+d_t)^N}$$

The first term above denotes the stream of expected returns that might ensure over a horizon *N* where *N* could be infinity as in the case of a perpetuity. The second term is the face value of the bond at the terminal date, all values being capitalized by d_t, the current discount rate. In principle, the two expressions compare and the connection with a consol will become clearer in the next section. Even more ambitiously, an elaborate theory of value based solely on the calculus of discounting is the capital-as-power theory of value (Bichler and Nitzan, 2016; Cochrane, 2016). Different valuations by market participants are made commensurate by capitalization. The quantitative translation is carried on all the time. Both government expenditure and private consumption can be identically treated. The mysteries of the unfolding future can be reduced to a single number. In a nutshell, capitalization is the primary formality of capitalism.

A tributary flowing in the 'second moment' is firms financing capital acquisitions through the sale of shares. The other option to that end is retained earnings which used to be the main mode of financing in parts of the world. That fund for realising real investment plans has emptied under the sway of shareholder value maximization. In addition, the firm can approach the bank for a requited loan for the purpose but note that the sum disbursed would not be money originating in the 'first moment'. Workers can only buy shares from incomes earned therein and by our typology this purchase-sale is a financial transaction. So as not to mix categories and to separate out influences using the device of balance sheets we confine ourselves to the period after the 'first moment' and consider shares sold by firms to workers first. The income of the latter now includes a rentier portion which is the product of price r_E and quantity $E_F$where the latter stands for the quantity of equity issued by the firm. Ignoring the terms summing to an infinite horizon we have the following decomposition of the terms superscripted by *IB* on the right-hand side of equation 9. Recall that the term is the one part of the residual from wages and profits after the preferences for 'risk-free' assets are realised on the left-hand side of the equation. The balance sheet of the 'investment bank' sub matrix section of the central bank balance sheet would appear as follows.

Asset	Liability
$(w_t N_t + r_{Et+1}E_{Ft+1})$	$(\Pi_{t+1} - r_{Et+1}E_{Ft+1})$

The rentier income of the worker is matched by the liability of the firm and, consequently, the transaction is 'on balance sheet'. The 'investment bank' division of the central bank would track the 'second moment' of the originating 'first moment' of the project. While the accounts are aggregative, in the case of a particular firm the arithmetic is consistent with the institution of profit sharing or even quasi worker-controlled managements.

The argument for separating out the two sides of the balance sheets of the traditional bank was to protect deposits from the vagaries of returns on capital. So-called investment banks would have to issue equity to underwrite their projects and accordingly, the argument went, would be duly diligent in the selection of companies whose shares were on offer. In addition, workers might be unwilling or unable to fund the projects pushing firms to markets. Furthermore, given the sometimes unquantifiable uncertainties associated with the purchase of large capital equipment, firms will be inclined to turn to the market for futures and options designed precisely to price and buy/sell products to ameliorate these risks. The route taken by these instruments might take on complicated trajectories as they are mixed and matched across risk categories and hyperactively traded. However, the essential point must not be forgotten that in the end their market value must correspond with the present value of the stream of returns realised on the factory or the set of machines. We define the price and quantity of financial market equity backing firm equity by r_{FM} and E_{FM} respectively. In that case, we have the following balance sheet of a financial intermediary.

Asset	Liability
$r_{Et+1}E_{Ft+1}$	$r_{FMt+1}E_{FMt+1}$

Both items can be extended into liability-asset chains as the pulls and pushes of competition put pressures on margins. Indeed, the chains can interlock with the 'firm' being effectively a financial institution issuing debt to avail of the dominating returns offered in the financial circulation. We are 'off balance sheet' (of the central bank) or into the realm of 'shadow banking' or 'shadow finance'. The institutional contrast with the earlier balance sheet is complete. The present account is an offshoot of shareholder value maximization on the part of management. Short termism is the incessant hunt for money managers to hold the shares of companies to boost their market valuation. The metric moves in the direction opposite to the production of goods and services and in-house innovations to boost productivity and, thereby, the remuneration of workers.

With Option D, money is a store of value because it is identified. The central bank is a narrow bank. Deposits are perfectly safe unlike deposits with commercial banks that are subject to credit risk. The central bank would secure the deposits of its citizens by backing them by government bonds as illustrated in the next section. In our formulation, we strike an equivalence between government bonds and work and production in what can be called a Real Bonds Doctrine. The central bank would have direct control of credit. The monetary authority would have the mandate of reaching credit and employment targets. Once the objectives

are specified, criteria would have to be set to provide funds to banks, specifying acceptable credit risk ranges, the collateral requirements to be expected of borrowers and so on. The tracking of monetary transactions would reduce the possibility of evasion. Chosen transactions can be enforced or discontinued. Blockchain technology can be used to introduce smart contracts, algorithms that enact the terms of contracts. For instance, the CBDC can be programmed to allow real estate transactions within 'bubble/crash bounds' or for the automatic payments of loans. A deep link in the connection between bank and central bank is trust (Tymoigne, 2017). Trust in government is the ability of the latter to impose and collect taxes. That power is credible as long as the government, through the instrumentality of the central bank, supports the emission of wage income to enable workers to pay their income taxes. For banks as well, trust rests in the ability to impose their debt on others. The Post Keynesian meeting ground between the State and Credit views alluded to rests on the monopoly of debt issue and destruction of both banks and central banks. To that end, counterfeiting cannot be countenanced.

2.3 The "third moment"

The "third moment" is the closing of accounts. Infinite planning horizons are a heuristic device. Individuals plan to maximize their utilities over their lifetimes. In mainstream macroeconomics, a transversality condition would be added to the expressions in our equations. As time tends to infinity, savings with the central bank and returns on outstanding loans would tend to zero. It would be more appropriate to use the roughly equivalent expression 'No Ponzi Games' to characterise the terminal value condition of the *FM* expressions on the right-hand side of equation 11, a catchall for company shares at one end to options, futures and the like, plain vanilla and exotic at the other. The only salient feature about the overall arrangement is that a Chinese wall separates this term from the others. Bubbles and crashes will have no impact on the narrow banking or investment banking segment nor will they fall under the responsibility of government in the form of insurance or bailouts. Martin Shubik, the founder of "mathematical institutional economics", a structural process language different from General Equilibrium models has proposed default algorithms members of society could be party to (Qin, Quint and Shubik, 2017). Government is another player in the market game with the ability to set bankruptcy penalties. For instance, if a calibrated penalty is set, strategic default will be avoided. Trust also arises in the need for a centralised ultimate auditor rather than completely decentralised clearing arrangements (Aaron, Rivadeneyra and Sohal, 2017). Central banks are naturally positioned to provide finality, the certainty of settlement, and the stable value of money. Unlike other systems, central banks would be able to maintain the value of their tokens via the conduct of monetary policy.

3. The circuit in time

Since central banks were singled out as the best from among the rest of banks, the direct association of central banks with cherry picking projects should not be surprising. Indeed, their special status is underscored when banks are paralysed by Keynes' "dark forces of time and ignorance" that are implacable during a great recession. Already referred to, problems of private information plague borrower and bank and one possibility is the inefficient outcome of blue-eyed borrowers being rationed and dud projects being selected. Central banks can at least commandeer large, green projects employing millions of hands which in any event would have been outside the calculus of consortia of banks being high risk-low return. A protracted recession is akin to an extraordinary event like a war which has always been the launching pad for the takeoff of central banks. Antipa&Chamley (2017) have hand collected data on the French Wars (1793-1815) to depict the pivotal role played by the Bank of England then. It purchased large quantities of both private and public debt so as to grant sufficient liquidity to the system. The expansion in its balance sheet on the first account has been called the Real Bills policy. Thus, discounted bills backed goods in process unlike the subsequent discounting of government securities that were backed by future taxes. At some point in the period, in contrast to bills issued, bills purchased were not connected with specific taxes. The Bank was sensitive to systemic risk by ensuring that the sum of bills issued and purchased equalled the total number of bills permitted by Parliament and therefore backed by future taxes. The goods were produced and sold and the demand for credit correspondingly decreased, the notes and discounts falling *paripassu*. Such a dispensation could not be inflationary. The low level of prices in contrast to the quantum of Bank notes outstanding reflected the veracity of the Real Bills doctrine. To repeat, Bank notes represented goods and services produced by the private sector or taxes collected by the government. Prices increased only when the fiscal balance deteriorated after 1808. Symmetrically, prices fell with the fall in war-related government expenditures well before the quantity of notes in circulation declined. The balance sheet of the Bank hugely increased but the composition mattered more than the magnitude. England's first income tax to the extent of 60% was inaugurated then, signalling the commitment to an eventual fiscal equilibrium. All citizens believed they were contributing to the war efforts. Recall that the Bank of England was not a central bank in the sense understood today. It was created in 1694 to protect business interests in general and bondholders in particular. Carlin and Mann (2017) have painstakingly collected physical data on variations in output across counties in the US during the 1920s. When the Federal Reserve began operations in 1914, national banks were required to join. State banks were not required to and, indeed, most demurred as the benefits of the discount window operations were believed to be more than compensated for by the reserve ratios and the requirement to hold stock in the Fed. The scholars focus on agriculture in Illinois in the early 20th century. They discover a Fed credit

channel separate from any effects of the money supply. Counties with higher Fed membership experienced higher relative growth during 1920-1926.

Coming to the present, a fillip from Europe is provided by Cesaratto (2017) who avails of macroeconomic truisms to note that the plan for Greece to depend on domestic rather than foreign savings and, thereby, escape from the grip of foreign indebtedness must mean a strategy to avail of domestic savings which, in turn, implies a regime of financial repression. A government-led movement out of the pit of a recession would include a proactive industrial strategy that would have to be complemented by State control of the banking system.

Our proposal can be interpreted as a flip of the "single-circuit sovereign monetary system" proposed by Huber (2017) where, in the spirit of asset–based reserve requirements, the central banks would operate with the assets side of banks' balance sheets where the latter intermediate, at best, the electronic transfer of wages to the accounts of workers. There would be narrow banks confined exclusively to payments services. On the other hand, the motor force for bank money would be the nexus between banks, firms, and workers able and willing to assume asset-debt positions as the central bank would be willing to create primary credit. This Chinese Wall would be of benefit to narrow banks untrammelled by the risks attendant on the other side of their balance sheets. The following incentive would be attenuated. It has been pointed out that the Fed's official monetary aggregates did not account for the effects of the computerized sweep programs in the 1990s by means of which banks reclassified their customers' demand deposits as funds held in the form of highly-liquid assets so as to escape statutory reserve requirements (Belongia and Ireland, 2017). Customers were none the wiser.

4. Conclusion

We provide a nonstandard but consistent account of the construction of a firewall between virtuous and potentially vicious circuits of economic activity. The base and the apex of the system is the central bank of the country which simultaneously ensures liquidity at all times and assumes large social risks beyond the ability of financial and non-financial entities to bear. Accordingly, the familiar unravelling of arrangements in the past does not apply. Glass-Steagall and other walls crumbled as participants on the 'long' side dreamt wistfully of the greener grass on the other side of the wall, the 'short' side. The arbitrage principle cannot be escaped. Secondly, hemmed in by rate restrictions on their own turf, commercial banks soon turned out to be loss-making entities. The central bank is not in the business of making profits. At the same time, a profound accounting principle applies inexorably. Central banks cannot write off non-performing loans with the stroke of a pen. Money backs the wage in the 'first moment'. The objective is regular employment at an average wage from a regular stream of hand-picked projects. Thereafter, as the closing of accounts in the 'third moment' is approached, the originators, the central bank and the firm and the workers, will need to get into a huddle to decide on termination conditions. Moral hazard and other disincentives will have no bearing on the process as the switching on of another circuit is an independent act. Concluding as we began, with digital currencies, a touted merit of bitcoin has been the absence of the need of a clearinghouse, known or virtual. Indeed, the identity of the founder Satoshi Nakamoto was never known and he/she/they are regarded as moving in 2011 to other pastures. We regard this 'black hole' as a fundamental flaw in the arrangement as it ignores the past and present of all monetary arrangements. Even extreme advocates of free banking asked for no more than the central bank to clear accounts at the end of the day. Schemes like Keynes' International Clearing Union retain their appeal because of their 'doability'.

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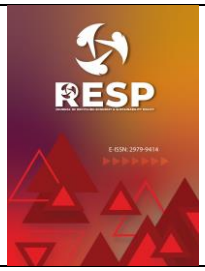

RESP

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Araştırma Makalesi ● Research Article

Freight Rate as A Determinant Factor of Ship Recycling Volume

Gemi Geri Dönüşüm Hacminde Belirleyici Bir Faktör Olarak Navlun Oranı

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ANAHTAR KELİMELER

Baltık Kuru Yük Endeksi
Nedensellik
Gemi Sökümü
Kuru Dökme Yük Piyasa

ÖZ

Gemi geri dönüşüm sektörü hem denizcilik piyasası hem de çelik piyasası için önemlidir. Dolayısıyla dinamiklerini anlamak, birçok sektör paydaşına katkı sağlamaktadır. Bu çalışmada kuru yük piyasasında navlun oranı ile geri kazanılan tonaj arasındaki ilişkiyi incelemek için Baltık Kuru Yük Endeksi (BDI) ve Geri Dönüştürülmüş Kuru Dökme Yük Gemisi Tonajı (RBT) değişkenleri tercih edilmiştir. Verilerimiz, 1985 yılının ilk çeyreğinden 2023 yılının ilk çeyreğine kadar olan dönemi kapsayan 153 gözlemden oluşmaktadır. Uygulanan Granger nedensellik analizi, navlun değişimlerinin geri dönüşüme gönderilen tonajı etkilediğini, navlunlarda beklenmeyen pozitif bir şokun tonaj üzerinde negatif etki oluşturduğunu ve bu etkinin üç dönem sonra etkisini kaybettiğini göstermiştir.

KEYWORDS

Baltic Dry Index
Causality
Demolition
Dry Bulk Market

ABSTRACT

The ship recycling sector is important for both the maritime market and the steel market. Therefore, understanding its dynamics contributes to many sector stakeholders. In our study, we preferred Baltic Dry Index (BDI), and Recycled Bulker Tonnage (RBT) variables to examine the relationship between freight rate and recycled tonnage in the dry bulk market. Our data consists of 153 observations covering the period from the first quarter of 1985 to the first quarter of 2023. Applied Granger causality analysis showed that changes in freight affect the tonnage sent for recycling, an unexpected positive shock in freights generates a negative effect on tonnage and this effect loses its effect after three periods.

1. Introduction

The ship recycling industry basically undertakes the task of dismantling old or obsolete ships and bringing them back to the economy. Although the ship recycling industry is not a prominent sector and often comes to the fore with the damage it causes to the environment, it has very important functions for the global trade, the global fleet, the ship owners, the environment, and the countries where recycling is made.

Although the recycling of old ships and the continuation of younger ones to operation in the sector reduce the supply in the short term, leading to an increase in freight rates, it becomes possible to carry out more efficient and low-cost trade with a renewed fleet in the long term. This is because new ships are starting to enter the market due to the decreasing supply and increasing freight rates. Thus, both the global fleet is renewed, and international trade is supported. There are also environmental benefits to the industry as it is an area where old ships are dismantled relatively safely, thus old ships do not have to be sunk or abandoned at sea. Although there are big question marks about the environment and worker safety in the countries where the dismantling process is carried out, it also generates a significant source of income and job opportunities for those countries.

There are many factors affecting the ship recycling industry. These can be listed as freight rates, second-hand ship prices, interest rates, steel prices, policy changes, market expectations, herd behavior, and international relations between countries. But the basic and most important factor

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is freight rates. For example, when renewing the ship considering the interest rates, the freight rates in the market will be taken as the basis for the payments. On the other hand, when steel prices rise, the shipbreaking industry will be more ambitious, but if the market freight rates are satisfactory, fewer ships will be sent for recycling. After market expectations are formed regarding freights, the ship will not be sent for recycling if an increase is expected, but the old ship will be sent for recycling as soon as possible if a decrease is expected. There are also trade embargoes between countries in some periods. In the former situation, smaller ships are preferred if transportation is carried out at shorter distances. However, if cargo needs to be transported further away due to the embargo, the demand will shift to larger ships. In this case, as the demand for smaller ships drops, their freight will also decrease, so they are more likely to be sent for recycling if they are old. On the other hand, a regulation related to the standards of ships may prevent certain types of ships from doing business in certain regions. For example, the banning of single-hull tankers in Europe. Thus, as the demand for this type of ships decreases, their income will decrease, and they will be sent for recycling. As can be seen, it is the freight rates in the market that also affect other factors. For this reason, studies that will facilitate understanding the mechanism between freight and recycling behaviors are valuable.

We discussed the relationship between freights and ship tonnage going to recycling with the causality approach in this study. The advantage of this approach is that it makes it possible to determine the direction of information flow and it can be analyzed how the shocks in the variables progress in the system. Since the relationship between variables cannot always be instantaneous, it is important to consider the lasting relationship as well. Similar studies have been done in the literature. In general studies on ship recycling, freight rates (Açık and Başer, 2017), general scrap prices (Alizadeh et al., 2016; Xiarchosa and Fletcherb, 2009; Kagkarakis et al., 2016), steel prices (Tunç and Açık, 2019), market conditions (Yin and Fan, 2018), ship recycling prices (Knapp et al., 2008), exchange rates (Karlis et al., 2016), volatility between demolition prices (Totakura et al., 2021), environmental effects (Hossain et al., 2016; Choi et al., 2016) were discussed. However, our study stands out because of the high frequency of the dataset, its focus on a specific maritime market, and its long-term coverage.

In the second part, after providing general information about the ship recycling market in the world, the relevant literature is summarized. In the third part, the data set used in the study was examined and the method was presented. In the last part, the findings obtained from the applied method are presented.

2. Ship Recycling in The World

The list of countries actively working in the ship recycling sector in the world is presented in Table 1, sorted according to their shares in 2021. The first thing that stands out is that the main countries in the sector are South Asian countries. The main reasons for its location in these countries are cheap labor, high demand for scrap metal and low regulatory regime. Bangladesh is in the first place with a share of 52% and it has been maintaining this first place for many years. The total market share of Bangladesh, Pakistan and India constitutes a huge amount with 89.5%. So to speak, almost 9 out of 10 ships were recycled in this region (UNCTAD, 2023). In these countries, dismantling activities are carried out by the beaching method (Galley, 2014:14). These countries also host approximately 23% of the world's population (World Bank, 2023). Because there is a large population and job opportunities are insufficient, they work in such unhealthy and dangerous jobs in bad conditions (Engels, 2013:19). Since 2009, 440 workers in South Asian countries have lost their lives during shipbreaking activities and many of them suffer from various cancer diseases in the long term because they work without protective measures. Finally, the environmental damage it does is invaluable. Due to insufficient legal inspections, toxic cargoes are sent to South Asian countries. 60,000 mangrove trees were cut down in Bangladesh alone to open a dismantling area and an area of 19 km on the coast was allocated for harmful shipbreaking activities (NGO, 2023).

After the South Asian countries, the most important actor in the market is Türkiye with a share of 6.8%. The shares of the remaining countries are not significant. China was also one of the important actors in the ship recycling industry. In 1993, nearly half of all ships in the world were recycled in China (Engels, 2013:27). However, due to environmental concerns and the country's policies for sustainable development, it quickly left this sector and its share decreased to 0.9%.

Table 1. World Ship Recycling Ranking (Gross Tonnage)

Country	2018	2019	2020	2021	Share 2021
Bangladesh	8,638,560	6,689,663	6,995,977	7,991,594	52.1%
Pakistan	3,985,841	327,828.2	3,099,877	3,027,959	19.8%
India	4,649,456	3,278,064	5,026,416	2,699,541	17.6%
Turkey	782,124	1,103,934	1,600,783	1,036,168	6.8%
China	465,710	343,112	195,486	140,112	0.9%
United States of America	63,889	64,471	35,298	76,566	0.5%
Denmark	16,352	3,838	17,207	70,441	0.5%
Canada	35,632	6,729	-	61,053	0.4%
Norway	1,939	4,739	68,423	29,514	0.2%

Korea, Republic of	2,649	7,100	27,993	27,230	0.2%
Venezuela	-	-	-	22,073	0.1%
Others	302,430	201,831	140,378	146,461	1.0%
World	18,944,582	12,031,309	17,207,838	15,328,713	100%

Source: UNCTAD (2023).

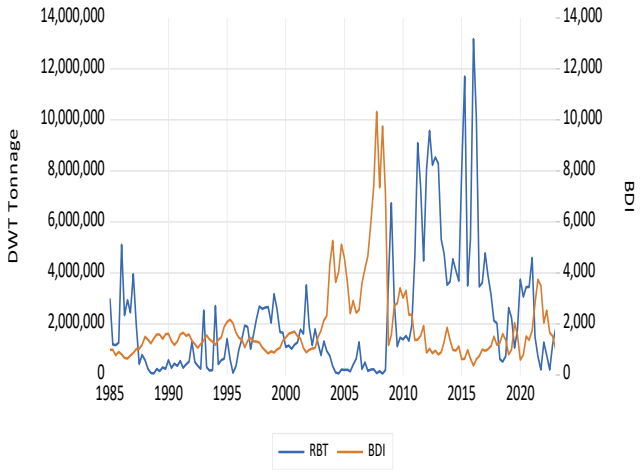
While ships are sent for recycling, a price per light tonnage is suggested by the shipbreaking centers and the ship owner decides in which country to deliver according to this price. Or there are intermediaries in this sector and the ship owner only deals with this intermediary. Offered prices for ships may differ between countries. For instance, as of April 2023, suggested prices for dismantling bulker ships are $585 in Bangladesh, $565 in India, $545 in Pakistan, and $335 in Türkiye (Athenian S.A., 2023). Due to tight controls, environmental measures, high labor costs, and high transportation costs in Türkiye, the prices paid by the recycling centers to the ships are much lower because the recycling center also has to make a profit by selling the scrap metal to the market (Engels, 2013:221).

3. Data and Methodology

In our study, we preferred Baltic Dry Index (BDI) (Capital Link, 2023), and Recycled Bulker Tonnage (RBT) (Braemar, 2023) variables to examine the relationship between freight rate and recycled tonnage in the dry bulk market. While the unit of BDI variable is index, the unit RBT variable is deadweight tonnage (DWT). Our data consists of 153 observations covering the period from the first quarter of 1985 to the first quarter of 2023. While converting BDI to quarterly, daily values are averaged quarterly. In the RBT variable, monthly recycled tonnages are summed up.

The movements of the variables in the period under consideration are presented in Figure 1. Visually, it can be said that they generally move in the opposite direction. When the correlation was examined, there was a significant correlation of -0.38. Decreased freights in the market cause old ships with high average transportation costs to be unable to do business and to be sent for recycling. Rising freight rates cause even old ships to become operational and remain in the market. Thus, theoretically, there is a negative relationship between the variables. In the BDI variable, it could not be caught again after the historical peak seen before the 2008 global economic crisis. The increasing demand could not be met due to the long construction times of the ships, and this shortage caused the freight to increase rapidly before the crisis. Ship orders placed in the bright period also formed an excess supply in the market in the following periods and the freights could not see the former high levels again. It is seen that the number of ships sent for recycling in the period when the freights broke the record decreased a lot. Even older ships were able to be operated profitably in commercial operations. However, it is seen that an incredible amount of tonnage was sent for recycling after the freight was crashed. The large number of new ships entering the market has increased the recycling traffic by causing old ships to become inoperable in a low freight environment.

Figure 1. Historical Movement of the Raw Variables



Source: Capital Link (2023), Braemar (2023)

Descriptive statistics of the variables in our study are presented in Table 2. In the period under consideration, an average of 2.1 million DWT ships were sent for recycling quarterly. The maximum date of the ship sent for recycling with 13.1 million DWT was the 2016 Q1 period. The period with the lowest DWT value was 2008Q2. There was a time when dry cargo ships had a very high utilization rate and almost no empty ships were left in the market. Therefore, very few ships were sent for demolition. While the average BDI value was 1881 points, the highest quarterly index average was reached in the 2007 Q4 period. This period, also called the China boom, is the period when China demanded very high raw materials and skyrocketed the dry cargo freight rates. The period with the lowest index was 2016Q1 coinciding with the period of the highest recycling volume.

When the log return series are analyzed, it is seen that the shipbreaking tonnage is much more volatile in terms of risk, because its standard deviation value (0.82) is much higher than that of the BDI (0.30). When we look at the quarterly maximum increases, it is seen that it is 71% for BDI and 298% for RBT. For maximum decreases, 180% for BDI and 213% for RBT are determined. This shows that both markets and especially the recycling market are very volatile, in parallel with the standard deviation values. The reaction of recycling tonnage to the change in freights is higher. The high skewness and kurtosis values also indicate that the distributions of the variables are fat-tailed. As can be seen from the skewness values, while the effect of negative shocks was greater in BDI, positive shocks were more effective in RBT.

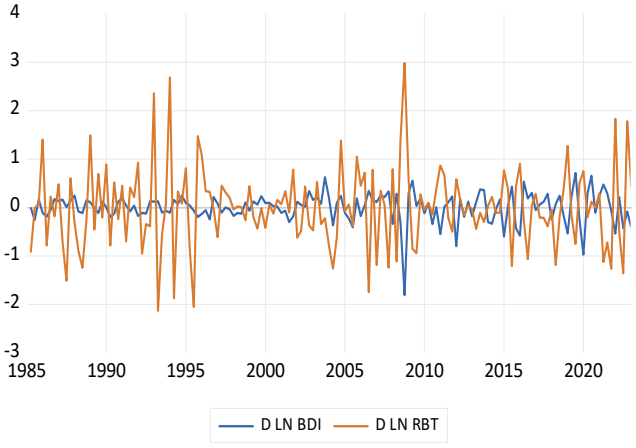
Table 2. Descriptive Statistics of the Variables

	BDI	RBT	ΔLN BDI	ΔLN RBT
Mean	1881.445	2187684.	0.000156	-0.003368
Median	1380.607	1313124.	0.039842	-0.021592
Maximum	10318.05	13168330	0.713100	2.983906
Minimum	358.4032	46620.00	-1.807005	-2.133672
Std. Dev.	1583.831	2470288.	0.300776	0.827155
Skewness	2.926207	2.000152	-1.684415	0.436503
Kurtosis	12.96969	7.270219	11.18315	4.459229
Jarque-Bera	851.9898	218.2622	495.9816	18.31276
Probability	0.000000	0.000000	0.000000	0.000106
Observations	153	153	152	152

Source: Capital Link (2023), Braemar (2023)

The graph of the log return variables is presented in Figure 2. The negative relationship between the variables can be clearly seen. When the correlation between them was examined, a significant negative correlation of 0.40 was determined. In addition, the RBT variable has wider volatility and carries greater risks.

Figure 2. Historical Movement of the Log-Return Variables



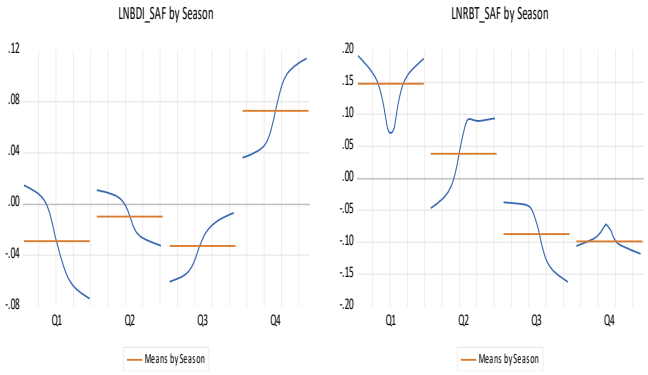
Source: Capital Link (2023), Braemar (2023)

Another important factor to be considered in time series analysis is that the series can exhibit seasonality. In order to obtain healthy results, the series should be examined and if there are seasonal effects, they should be removed from the series. For this reason, STL (Seasonal and Trend decomposition using LOESS) decomposition was applied to logarithmic BDI and RBT variables and seasonally adjusted series were obtained. The STL method separates the series into season, trend and remaining parts.

It is likely to have seasonal effects, especially since dry bulk cargo transport is heavily used for the transport of products such as grain and coal. Coal trade may vary according to the season, increasing in winter and decreasing in summer. Consumption in homes for heating purposes and consumption in power plants may increase during the winter months. In addition, since agricultural products are harvested in certain seasons, the demand for ships may increase at that time. Because these factors affect the demand for ships, they can also have a direct impact on freight levels in the market. The ship recycling sector, on the other hand, is likely to have seasonal effects as they are directly affected by freight.

The quarterly status of seasonal factors obtained as a result of STL decomposition is presented in Figure 3. The results show that the BDI variable increases seasonally in the fourth quarter, namely in October, November and December. This situation can be interpreted as the increase in demand for dry bulk ships by the harvested agricultural products and the coal stored for winter preparation. As a result, the seasonal effect turns negative in the following first quarter. On the other hand, in the amount of recycling, seasonality has a positive effect in the first quarter and a negative effect in the last quarter. This situation coincides with the situation in the freight market. Due to the increase in demand for ships in the last quarter, freight rates increase and ships can be operated profitably, thus reducing the amount of ships going for recycling. However, in the first quarter, since the demand and freight rates have decreased, the older ships cannot continue their profitable activities and they are sold for recycling. This negative relationship is also supported by the 0.50 negative significant correlation between seasonal adjustment factors.

Figure 3. Seasonal Characteristics of the Variables



The Granger (1969) causality test is concerned with whether the past values of one variable contribute significantly to explaining the future values of the other variable. When analyzing causality between variables X and Y, two models are estimated structurally. In one of the models, only the historical values of the X variable are included, while the other includes the historical values of both X and Y variables. If the Y variable improves the explanatory power of the model for variable X in the model in which the past values of two variables are included, it can be said that variable Y is the Granger cause of variable X (Yu et al., 2015). However, unlike its name, Granger causality analysis should not be interpreted as direct causality. It can be interpreted that there is an information flow from the past values of the variables to the current and future values (Kirchgässner and Wolters, 2007:103-120).

As a result of estimation, there may be no, unidirectional or bidirectional causal relationships. An example VAR model

with 2 variables and 1 lag can be represented as in Equations 1 and 2:

$$y_t = \beta_{10} + \beta_{11} y_{t-1} + \propto_{11} x_{t-1} + u_{1t} \quad (1)$$
$$x_t = \beta_{20} + \beta_{21} x_{t-1} + \propto_{21} y_{t-1} + u_{2t} \quad (2)$$

The result of causality analyzes are sensitive to the fact that they contain unit roots and act together in the long run, and the results may be biased if these situations occur (Nazlioglu, 2019: 389). For this reason, unit root analyzes should be applied to the series and if the series are non-stationary, they should be made stationary by difference taking before the VAR analysis (Brooks, 2014:330). While estimating the models, it should be decided which delay is more appropriate according to the information criteria. The lag value that minimizes the appropriate information criterion value is considered optimal for the VAR model (Kočenda and Černý, 2015:151). Information criteria basically measure the balance between model fit and complexity. Too many lags can increase the explanatory power of the model, but it can produce too many parameters, and this can complicate the model. Therefore, information criteria are preferred to find the optimum balance between model fit and complexity.

After the model is estimated, the validity of the model should be verified by checking the cases such as AR roots less than 1 and the residuals of the model not containing autocorrelation and heteroscedasticity (Bo and Zing, 2011:125). The null hypothesis of this test indicates that there is no significant causal relationship. For a significant causality relationship, the null hypothesis must be rejected.

4. Results

Unit root tests are one of the most important preliminary analyzes in time series analysis. Stationary series have a fixed mean and variance, and the covariances of the observations are time independent. However, in series containing unit root, mean and variance change with time and there is time dependence. In addition, unit root tests help us understand how series behave in the face of unexpected events, in other words, shocks. The fact that the series is not stationary indicates that the effects of the shocks are permanent, while the reverse indicates that they are temporary.

When applying the Granger causality test, the series must be stationary. For this reason, we preferred to apply ADF (Dickey and Fuller, 1979), PP (Phillips and Perron, 1988) and KPSS (Kwiatkowski et al., 1992) tests to the series. According to all tests as shown in Table 3, the series were determined to be stationary at the level. This indicates that the effects of the shocks they are exposed to are temporary and that the series tend to return to the mean in the long run. However, when we consider the graphical movements and distribution characteristics of the series, we saw that they are volatile, have high kurtosis values and show non-normal distribution characteristics, so we decided to apply a non-parametric test in addition to the parametric tests to determine stationarity of the series. For this, we chose the variance ratio test.

Table 3. Unit Root Test Results

Test	Variable	Level		First Difference	
		Intercept	Intercept & Trend	Intercept	Intercept & Trend
ADF	**BDI**	-3.109**	-3.059	-10.936***	-10.920***
	RBT	-3.881***	-4.253***	-14.254***	-14.206***
PP	**BDI**	-3.143**	-3.107	-11.414***	-11.387***
	RBT	-3.782***	-4.206***	-14.874***	-14.817***
KPSS	**BDI**	0.193*	0.168***	0.039*	0.023*
	RBT	0.409**	0.078*	0.042*	0.036*

Notes: (1) CVs for ADF and PP are -3.473 for ***1%, -2.880 for **5%, -2.576 for *10% at Intercept, and -4.019 for ***1%, -3.439 for **5%, -3.144 for *10% at Intercept and Trend. (2) CVs for KPSS are 0.739 for ***1%, 0.463 for **5%, 0.347 for *10% at Intercept, and 0.216 for ***1%, 0.146 for **5%, 0.119 for *10% at Intercept and Trend. (3) Lag lengths were determined automatically by Schwarz information criterion in ADF. (4) Barlett kernel spectral estimation method and Newey-West Bandwidth were selected in PP and KPSS.

The variance ratio test is a non-parametric test used to test whether the series are martingale or not. The null hypothesis is that the series are martingale, that is, the observations are independent of each other and exhibit random walk (Bhar, 2010:16). In other words, accepting the null hypothesis indicates that the series contains unit root, while its rejection indicates that is stationary. The test results applied are presented in Table 4. The results show that the null hypothesis cannot be rejected at the level, and it is rejected when the first differences are taken. This indicates that the series are martingale and I(1), they carry shocks, and cannot be estimated using their historical values. This result was accepted as more robust considering the distribution characteristics of the series and the first differences of the series were used in the causality analysis.

Table 4. Variance Ratio Test Results

	Level	First Difference
BDI	1.271861	3.032466*
RBT	2.018741	4.225874*

Notes: (1) Test periods are 2, 4, 8, and 16. (2) Table includes joint test results. (3) Asymptotic normal probabilities were used. (4) Null of martingale was rejected at *1%.

In order to determine the most appropriate lag number of the VAR model to be estimated in the causality analysis, information criteria were applied, and the findings are presented in Table 5. The most appropriate lag was determined as 3 according to the LR, SC and HQ information criteria, and 4 according to the FPE and AIC information criteria.

Table 5. Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-197.7632	NA	0.054954	2.774488	2.815736	2.791249
1	-189.4741	16.23281	0.051776	2.714918	2.838660	2.765200
2	-177.8998	22.34472	0.046608	2.609720	2.815957	2.693523
3	-164.3327	25.81516*	0.040813	2.476844	2.765575*	2.594168*
4	-159.3924	9.263103	0.040290*	2.463784*	2.835010	2.614629
5	-157.4968	3.501606	0.041496	2.493011	2.946733	2.677378
6	-153.2298	7.763669	0.041359	2.489302	3.025518	2.707190
7	-150.4139	5.045009	0.042067	2.505749	3.124460	2.757158
8	-149.0592	2.389685	0.043672	2.542488	3.243694	2.827419

Notes: Suggested lags are shown by *. LR: Likehood Ratio, FPE: Final Prediction Error, AIC: Akaike Information Criterion, SC: Schwarz Information Criterion, HQ: Hannan-Quinn Information Criterion.

After determining the optimum lags considering the information criteria, we estimated the VAR model in Equation 3. We also estimated the same model for 4 lags.

$$recycling_t = \beta_{10} + \beta_{11} recycling_{t-1} + \beta_{12} recycling_{t-2} + \beta_{13} recycling_{t-3} + \propto_{11} bdi_{t-1} + \propto_{12} bdi_{t-2} + \propto_{13} bdi_{t-3} + u_{1t}$$

Then, it was examined whether the AR roots of these equations are inside the unit circle and the findings are presented in Figure 4. As can be seen, 6 parameters estimated for 3 lags and 8 parameters estimated for 4 lags are within the unit circles, that is, less than 1. The fact that the AR roots are larger than 1 may indicate that the model is not stationary, its stability is problematic, it has explosive properties, and its predictions are unreliable.

We also applied Portmanteau Tests for Autocorrelations, Serial Correlation LM Tests and Heteroskedasticity Tests to the residuals of both VAR models. According to the results, null hypotheses for all these tests were accepted at the 5% significance level, which supported the validity and reliability of the models.

After estimating the VAR models for 3 and 4 lags, we applied Granger causality analyzes and tested $H_0 = X\ does\ not\ Granger\ cause\ Y$. The results obtained are presented in Table 6. According to the results, there were significant causalities from BDI to Recycling variable in both 3 lags and 4 lags. In the opposite direction, no significant causality was detected. This situation reveals that the changes in freight significantly affect the amount of ships sent to ship recycling.

Since the Chi-square statistics were very close when we examined both VAR models, we checked the AIC value of the models to determine which model was better, and we found that the 4-lags model had a lower AIC value (2.40) than the 3-lags model (2.43). Therefore, we made our next applications based on 3-lags model.

Figure 4. Inverse Roots of AR Characteristic Polynomial

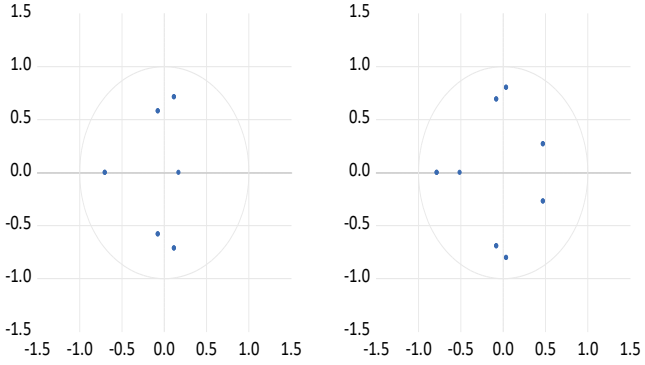


Table 6. Granger Causality Test Results

Null Hypothesis	Chi-Square Statistics	Degree of freedom	Probability
BDI does not Granger Cause RBT	33.591	3	0.0000*
RBT does not Granger Cause BDI	0.712	3	0.8704
BDI does not Granger Cause RBT	33.591	4	0.0000*
RBT does not Granger Cause BDI	5.144	4	0.2728

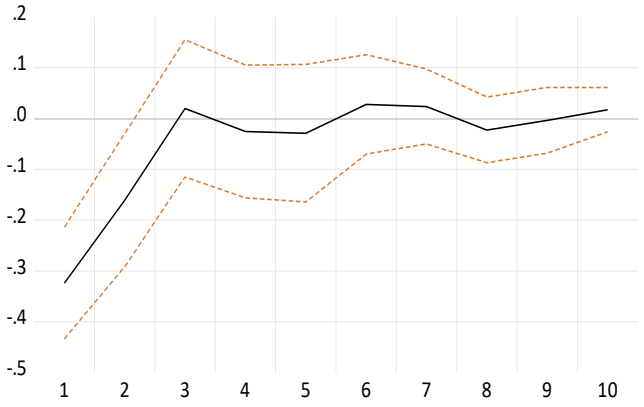
Notes: (1) Null of Non-causality was rejected at *1%.

In Figure 5, the reaction of the recycling to the 1 standard deviation shock in the BDI over time is shown by impulse & response analysis. The shock of increase in freights causes a decrease in the amount of ships going for scrapping. While there is a 30% decrease in the ships going for recycling in the first period when the shock first arrives, the effect of this shock is reset after about 3 periods, and it is removed from the system. Minor fluctuations remain in the system. This situation can be easily explained theoretically by the fact that

old and uneconomical ships also get contracts due to the increasing freights, and the ships are operated instead of being sent for recycling.

When there is a shortage of supply in the maritime market, new ships are constructed, balancing the market. But the delivery time of the ships is very long. For example, the delivery of the ships ordered as of 2023 is shown between 2025 and 2027, depending on the complexity of the construction Athenian S.A. (2023). Therefore, the stabilization in the graph cannot be explained by this. This can be explained by the high volatility of dry bulk freight. Freights have a standard deviation of 82%, so the market can take shape very quickly.

Figure 5. Response of RBT to BDI



Note: Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

After the impulse & response analysis, we applied the variance decomposition analysis and presented the results in Table 7. Variance decomposition analysis helps to understand how much of the variation in the variance of a given variable over time is contributed by other factors. The table contains the decomposed values of the RBT variable. Accordingly, while the BDI variable explains approximately 21% of the changes in the RBT variable in the early periods, this ratio decreases to 18% over time. So, the market is balanced. Also, a large part of the variation in ship recycling is due to its historical values.

Table 7. Variance Decomposition of RBT

Period	S.E.	LN BDI	LN RBT
1	0.293070	21.00733	78.99267
2	0.294056	20.93113	79.06887
3	0.304202	20.19691	79.80309
4	0.304475	20.01124	79.98876
5	0.308374	18.85423	81.14577
6	0.309911	18.82150	81.17850
7	0.310874	18.85238	81.14762
8	0.311106	18.85614	81.14386

Note: Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

5. Conclusion

The ship recycling industry is basically positioned under a two-way influence. The first is the maritime side, and the second is the iron and steel side. On the maritime side, it is mainly concerned with the removal of old ships that cannot carry out their economic activities from the market and their return to the economy. Thus, it contributes to the renewal of the global fleet, to the reduction of transportation and insurance costs, and to the reduction of environmental risks caused by old ship accidents. On the iron and steel side, although its environmental dimensions cause irreversible damage, the ship recycling industry provides important inputs to both the labor force and the sectors in countries where steel use is intense. Besides it is used extensively in the construction and infrastructure sectors, it is also partially used in the automotive, production, containerization and construction of renewable energy structures. Hence, the sector also has important contributions to regional economies.

Freight rates are the factor that affects it the most in the maritime market because freight is the most important factor that determines the profitability of shipping companies. In other words, it is the price of the transportation service that companies sell. In addition, in the maritime market, especially in the dry bulk market, each ship can be considered as a separate business in a perfectly competitive market. The costs of each differ due to the age and size of their ships. In addition, the demand for each ship size can change rapidly depending on the type of cargo, the problems in the global supply chain, and the political relations between countries. Considering the ships as separate businesses, the average transportation (service production) costs of each are also different. Older ships have higher average costs due to increased maintenance & repair and insurance costs. Therefore, when the price of transport services (freight rate) in the market falls, the older ones are affected first. Since they cannot carry out profitable operations, they are sent directly to recycling or if they expect freight to rise, they operate at a loss to a point. However, as expected, if freight rates continue to be low, they will inevitably be sent for ship recycling. On the other hand, if freight rates are on the rise and there are expectations that they will be higher in the future, old ships will continue to operate, and their economic life will be extended for a few more months or years. In this case, the ship tonnage going to ship recycling decreases. Thus, freight rates are the most important determinant of traffic in the ship recycling industry.

In our research, we examined the relationship between freight rate and ship tonnage sent for recycling with a causality approach for the dry bulk market. When we analyzed the data, we saw that the volatility rates are high, especially the DWT variable has very high volatility and risk. This is basically related to the fact that the dry bulk market is close to the perfectly competitive market and the shipping cycles can change very quickly. Even the seasonal cycles in the market have a very high impact. It is also clearly seen in the graphic in which seasonal factors are

presented. There is a significant increase in freights in Q4. In recycling, there is a significant decrease in Q3 and Q4. Shipowners who expect freight rates to increase in the last quarter may be delaying sending their ships to recycling. In the first quarter of recycling, seasonal increases occur in ship dismantling in parallel with the seasonal decreases in freight. We also verified that relationship by the correlation and found a negative relationship between the variables. Naturally, when the freight rates increase, the tonnage for dismantling decreases and vice versa. In the literature, there are studies that reveal this relationship with econometric methods. However, we aimed to differentiate from the others with a study that focused only on the dry bulk market and also modeled the possible lagged effects of the interaction.

In the standard unit root tests we applied, we determined that the series were stationary. However, due to the non-normal distribution of the series, we supported our results with the variance ratio test, which is a non-parametric test. This test showed that the series are martingale, that is, they move randomly. For this reason, we preferred to use the first differences of the series in the analyses. In addition, the fact that the series are not stationary also means that the shocks they are exposed to have permanent effects. In this permanence, the cycles in the maritime market and the herd behavior of the enterprises in the market are also effective.

As a result of the causality analysis, we found a unidirectional relationship from freight to recycling tonnage, as we expected. Theoretically, there may be an inverse relationship, because the decrease in ships in the market may decrease the supply and thus increase the freight rates. However, this relationship could not be statistically supported, probably because it was not very strong. In addition, in the impulse & response analysis, we found that a 1 standard deviation positive shock in freights had a negative effect on the recycling tonnage and this effect lost its effect after about 3 periods (quarter). We also saw that the impact of the shock was highest in the first period. In case of a negative shock in freight, the first reaction is the highest in the first period. This situation can be likened to a kind of shaking. In some cases, old ships are shaken off the market when the market is shaken, just as the ripe fruit falls off when the tree is shaken. This shaking keeps the fleet vigorous and dynamic.

In the variance decomposition analysis, we determined that most of the changes in the recycling tonnage were due to their own historical values. Freights account for an exchange rate of approximately 21%. This may be due to the close relationship of the recycling market with other markets. For example, when prices rise in the secondhand ship market, shipowners may continue to use their ships instead of sending them for dismantling. In addition, changes in steel prices also affect the demand for ships to be dismantled. At low steel prices, dismantling ships loses its financial advantage, as dismantling centers will also offer lower prices. International steel prices directly affect the profitability of dismantling centers. In addition, since the demand for scrap iron is narrower than crude steel in the sector, developments in the construction sector are of great importance for the shipbreaking demand.

In this study, we examined the relationship between freight and dismantling tonnage using a linear method. Since the distributions of the series are not normal, nonlinear methods may be preferred in future studies. In addition, panel models can be applied by considering variables related to other maritime markets such as containers and tankers. Thus, possible similarities and differences between shipping sectors can be revealed.

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RESP

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Araştırma Makalesi ● Research Article

Seçili OECD Ülkeleri Üzerinde Hasıla-Geri Dönüşüm İlişkisi Üzerine Panel Veri Analizi *

Panel Data Analysis On Product Recycling Relationship On Selected OECD Countries

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ANAHTAR KELİMELER

Doğrusal Ekonomi
Döngüsel Ekonomi
Geri Dönüşüm
Panel Veri

ÖZ

Doğrusal ekonominin büyüme odaklı yaklaşımı çevre sorunlarını beraber getirmiştir. Bu sorunlar iklim değişikliği, küresel ısınma ve çeşitli çevresel problem olarak ortaya çıkmaktadır. Bu durum karşısında döngüsel ekonomi mevcut tüketim sistemlerini çevrimsel bir sisteme dönüştürme maksadıyla ekonomik sürdürülebilirliği sağlamaya çalışan bunu gerçekleştirmek için teknolojiden yardım alan ekonomik yöntem olarak araştırmacıların ilgi odağı olmuştur. Çalışmada döngüsel ekonominin önemli bileşeni olan geri dönüşüm oranı seçili 13 OECD ülkesi üzerine gerçekleştirilen ekonometrik analiz de 2000-2020 yılları arası yıllık değerler dikkate alınmıştır. Çalışmanın amacı serileri oluşturan evsel, ambalaj, plastik, kâğıt, metal, cam, ahşap, elektronik atıkları geri dönüş oranı ile GSYH arasındaki nedenselliğin incelenmesidir. Çalışmanın bulgularına göre, seçili atık geri dönüşüm oranı değişkenlerinden GSYH'n doğru nedensellik bulunmamaktadır. GSYH'den ahşap atık geri dönüşümünü etkilemekte ve aralarında tek yönlü nedensellik bulunmaktadır.

KEYWORDS

Linear Economy
Circular Economy
Recycling
Panel Data

ABSTRACT

The growth-oriented approach of linear economy has brought environmental problems with it. These problems emerge as climate change, global warming and various environmental problems. In the face of this situation, circular economy has been the focus of attention of researchers as an economic method that tries to ensure economic sustainability with the aim of transforming existing consumption systems into a circular system and uses technology to achieve this. In this study, the econometric analysis of the recycling rate, which is an important component of the circular economy, on 13 selected OECD countries is based on annual values between 2000-2020. The aim of the study is to examine the causality between the recycling rate of household, packaging, plastic, paper, metal, glass, wood, electronic waste and GDP. According to the findings of the study, there is no causality from the selected waste recycling rate variables to GDP. GDP affects wood waste recycling and there is unidirectional causality between them.

1. Giriş

Dünya nüfusunun artması ihtiyaçların miktarını ve çeşitliliğini artırmıştır. Artan ihtiyaçların karşılanması konusunda araştırmalar artmış ve sanayi devriminde etkisiyle kitle üretim yöntemi ile bu ihtiyaçlar karşılanmaya çalışılmıştır. Ayrıca sanayi devrimi bir kavramın daha kazanılmasına katkı sağlamıştır. Bu kavram doğrusal ekonomi olarak bilinmekte ve hammaddenin tedariki, nihai malın üretilmesi, tüketilmesi ve tüketim aşamasından sonraki atık olma süreci şeklinde tanımlanmaktadır (Ateş, 2021: 125- 137). Doğrusal ekonomi, büyüme merkezli özellik sergilemesi sebebiyle uzun vadede birçok çevre sorununa neden olmuştur. Meydana gelen bu çevre sorunları sınırlı doğal kaynakları tüketmekle birlikte, başta küresel ısınma olmak üzere, iklim değişikliği, ozon tabakasının

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incelmesi, çölleşme, biyoçeşitliliğin kaybı vb. birçok sorununda ana nedeni olmuştur. Bu olumsuz durum döngüsel ekonomi adı verilen olgunun ortaya çıkmasına önayak olmuştur.

Döngüsel ekonomi kavramı hakkında literatür de farklı tanımlamalar mevcuttur. Ancak en temel ve yalın halini Avrupa Birliği yapmıştır. Avrupa Birliği'nin tanımında, ürün, malzeme ve kaynakların ekonomik değerinin uzun dönemlere yayıldığı ve atık oranının en düşük seviyelerde tutulduğu ekonomik bir yaklaşım olarak tanımlanmaktadır (Commission, 2015). Döngüsel ekonomi sürdürülebilir kalkınma ile yakın ilişkili iki kavramdır. Bu kavrama ilk olarak 1987 yılında Birleşmiş Milletler Çevre ve Kalkınma Komisyonu tarafından hazırlanan Brundtland Raporunda yer verilmiş ve gelecek nesillerin kendi ihtiyaçlarından taviz vermeden günümüzün ihtiyaçlarının karşılanmasından ödün verilmemesi olarak nitelendirilmiştir (United Nations, 1987). Tanımdan da anlaşılacağı gibi, döngüsel ekonomi ve sürdürülebilir kalkınma kavramı birbirinin tamamlayıcısı ve denklemin birer etmenidir (Can, 2017: 143).

Çalışmanın amacı, döngüsel ekonominin önemli parçalarından birisi olan geri dönüşüm oranları ile GSYH arasındaki ilişki incelenmektedir. Çalışmada ilk olarak, döngüsel ekonomi tanımları, döngüsel ekonomi ve geri dönüşüm kavramları ile döngüsel ekonomi amaç ve faydaları yer almaktadır. Daha sonra ise GSYH ile ahşap, cam, plastik, metal, kâğıt ve karton arasındaki ilişki seçili OECD ülkeleri kapsamında Engle&Granger nedensellik testi ile sınanmış ve seçilen değişkenler arasındaki ilişki uygulamalı olarak incelenmiştir.

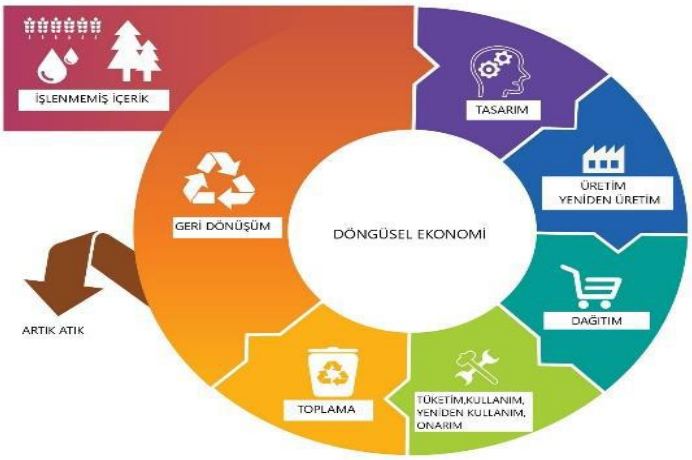
2. Döngüsel Ekonomi

Ekonomik büyüme için gerekli faktörlerden olan seri ve toplu üretim sınırlı düzeydeki kaynakların aşırı kullanımı ile çevreye verilen zarar uluslararası arenada gündeme gelmiştir. Konuyla ilgili çeşitli politikalar çerçevesinde özellikle Birleşmiş Milletler gibi uluslararası organizasyonlarda gündeme gelmiş ve soruna ilişkin çözüm arayışları başlamıştır. Ayrıca kaynakların etkin kullanımını esas alan ekonomik bir politikayı benimseyen neo-liberal politikalar ile serbest ekonomiye geçiş teşvik edilmiştir (Murray, Skene ve Haynes, 2017: 371).

Serbest ekonomi, tüketim ve rekabeti artırmış kaynak israfına neden olarak çevreye zarar vermeye başlamıştır. Kaynakların kısıtlılığı, çevre sorunlarının artması, ekonomik sorunların derinleşmesi, ekonomik büyümeyi sağlayacak güvenilir kaynak sağlayacak bir ekonomi modeline duyulan ihtiyacı gün yüzüne çıkarmıştır.

Bu anlayış ile döngüsel ekonomi ortaya çıkmıştır. Kavramla ilgili çeşitli tanımlamalar yapılmıştır. Döngüsel ekonomi, doğada var olan her maddenin başka bir nesnenin oluşumda ana kaynak sebebi olarak görülmekte ve bu düşünce temelinde geliştirilmiş bir sistemdir (Ateş, 2021: 128). Döngüsel ekonomi, Rachel Carson'ın "Silent Spring" adlı eserinden, Barbara Ward ve Kenneth Boulding'in kaleme aldığı eseri "Gelmekte Olan Uzaygemisi Ekonomisi" çalışmasından esinlenilerek oluşturulmuş bir kavramdır (Winans vd., 2017: 825-826). Ancak kavrama asıl şeklini veren Pearce ve Turner (1990) yılındaki çalışmasında ilk kez döngüsel ekonomi terimine yer vermiştir. İkili 1980 yılında kapalı ekonomi ve çevre etkileşimi sistemini tanımlamak için bu terimi kullandığı iddia edilmektedir (Yuan vd., 2006: 4). Ancak terim hakkında ortak bir mutabakata varılamamıştır.

Şekil 1. Döngüsel Ekonomi Modeli



Kaynak: (Economic Forum, 2018: 1162)

Şekil 1'deki (Economic Forum, 2018: 1162) kapalı döngü sistem şeması, döngüsel ekonomi modelinin ana aşamalarını göstermektedir. Ürünlerin kullanılabilirliği birbirinin devamı niteliğindedir. Örneğin; endüstri yan ürün atıkları ile ürünler yenilenebilir ürünler arasında değişim yapılabilir veya sıfırdan bir ürünün hammaddesi olarak kullanılabilir. Amaç kapalı döngü sistem şemasının dışındaki hammaddeleri atıllık kapasitesini azaltmak ve sistemin etkin işleyişine katkı sağlamaktır (European Commission, 2014: 5).

Döngüsel ekonomi, üretim için kullanılan hammadde girişinin azaltılması, ürün kullanım sonrası ayrıştırmanın kolayca yapılması ve geriye kalan atık malzemelerin yeniden kullanımının tasarlanması (eko-tasarım), bakım ve onarım ile ürünlerin kullanım ömrünün uzatılması, üretimde geri dönüştürebilir maddelerin kullanımı ve kapalı döngü sistem şeması dışında kalan maddelerin kazanımını içeren sistemsel yöntemdir (Kirchherr & Piscicelli, 2019: 1).

Bu kavram, üretim ve tüketim olgusunun yeniden tanımlanmasını içermektedir (MacArthur, 2013: 22). Döngüsel ekonominin sistem ve kaynak sorunlarına odaklanan önemli üç temel unsuru bulunmaktadır.

Bu üç temel unsuru şu şekilde sıralamak mümkün (Antikainen vd., 2018: 119);

- Doğal ve beşeri sermayeyi geliştirmek ve mevcut düzenin korunmasını sağlamak,
- Kaynak verimliliğinde etkinliğin sağlanması,

- Sistem etkinliğini korumak ve katkıda bulunmak.

İngilizce, Recyle (Geri Dönüşüm), Reduce (Azalt) ve Reuse (Tekrar Kullan) kelimelerinin baş harflerinden döngüsel ekonomi kavramını tanımlamak için 3R adı verilen kavram oluşturulmuştur (Liu vd., 2017: 1315). Bu kavramları sırasıyla açıklamak gerekirse (Koçan vd., 2019: 537);

1. Recycle (Geri Dönüşüm): Kullanım ömrünü tamamlamış maddelerin geri dönüştürerek başka bir ürünün üretiminde hammadde olarak kullanması veya atık maddelerin geri kazanımının daha işlevsel hale getirilmesi sürecidir.
2. Reduce (Azalt): Üretim ve tüketim süreci sonrasında oluşan atıkların en aza indirgenmesi durumudur. Döngüsel ekonominin de birincil görevi bu işlevi yerine getirmektir.
3. Reuse (Yeniden Kullan): Tekrar kullanımı mümkün olan atıkların yenileme, tamir veya üretilecek başka bir ürünün üretiminde kısmen ya da tamamen kullanılması olarak ifade edilmektedir.

Döngüsel ekonomide üretilen her ürün, en temel bileşenlerine ayrılarak, üretime yeniden dâhil edilecek biçimde tasarlanmalıdır. Süreç parçalara ayırma, uyarlama ve yeniden kullanma için imal edilmiş nesnelerin tasarımına odaklanmaktadır. Bu sisteme 'beşikten beşiğe' denilmektedir. Buradaki amaç hiçbir maddenin israf edilmemesi ve tekrar kullanılmasıdır. Bu sistemin doğru işleyebilmesi, ürünlerin üreticiye tekrar geri dönebilmesi için üretici, tüketici ve perakendeci arasında işbirliğinin sağlanması gerekmektedir (Can, 2019: 143).

Döngüsel Ekonominin Amaçları

Döngüsel ekonomi, birim başına çıktı da kullanılan enerji miktarının azaltılması ve ekonomide mevcut olan kıymetli kaynakların değerlendirilerek yeniden kazanım yoluyla yenilenebilir enerjiye geçiş sürecinin hızlandırılmasını hedeflemektedir (Arthur, 2013: 26).

Döngüsel ekonomi bir ürünün tüketim ömrünün sonundaki dönüşüm çözümlerine dayanmaz aynı zamanda atıkların tasarımı ve yeni ürün üretimi sürecini izleyen değerler zincirine dayanır. Döngüsel ekonomi amaçları aşağıdaki hususları da içerebilir (Gedik, 2020: 28):

- Bir ürünün üretimi için gerekli madde miktarının azaltılması (Hafifletmek),
- Ürünlerin kullanım ömrünün uzatılması (Dayanıklılık),
- Üretim ve kullanım aşamalarında kullanılan malzeme ve enerji miktarının en aza indirilmesi (Verimlilik),
- Ürünlerde geri dönüşümü güç veya kritik malzeme kullanımının azaltılması (İkame),
- Geri dönüşümü sağlanmış ürünler için yeni pazarlar yaratmak,
- Yan ürünlerin israfının önlenmesi için faaliyetlerin kümelenmesini kolaylaştırmak (Endüstriyel Simbiyoz),
- Atık oranlarının düşürülmesi ve tüketiciler için yüksek kalitede ayrıştırmayı özendirmek ve konu ile alakalı farkındalık oluşturmak (Commission, 2014: 4).

Döngüsel ekonomi yaklaşımının başarılı bir şekilde uygulanabilmesi için paydaşların sosyal eşitsizlik, atık azaltma, ekonomik fayda, çevresel yüklerin azaltılması, ürünlerin tekrar kullanımı hakkında bilgi sahibi olması gerekmektedir. Sosyal yenilikler, halkın bu konuyla ilgili eğitilmesi ve sosyal mecralardaki döngüsel ekonomi ile ilgili bilgilendirmeler bu girişiminin başarısı için şart bir durumdur (Winans vd., 2017: 830).

3. Döngüsel Ekonominin Önemli Bileşeni Geri Dönüşüm

Geri dönüşüm; üretim ve tüketim işlemleri sonucunda tekrar kullanılabilmesi mümkün atık maddelerin, türlü işlemler geçirerek üretim sürecine tekrar eklenmesi olarak tanımlanmaktadır (TÜDAM, 2016: 5). Geri dönüşüm kavramı ilk defa II. Dünya Savaşı esnasında hammadde açığının karşılanması amacıyla ortaya çıkmıştır. Savaşta yer alan çoğu ülke savaş sonrası da geri dönüşüme katkıda bulunmak için çeşitli kampanyalar düzenlemiştir. Ülkeler bu durumu vatanseverlik örneği olarak düşünmüştür. Bu kapsamda Japonya metal maddelerin %98'i ve plastik şişelerin %72'sinin geri dönüşümü sağlanmıştır. Buna ek olarak elektronik materyal atıklarının yüzde 90'ı yeni alet ve edevat üretimi için hammadde olarak değerlendirmesi geri dönüşüme verilen önemi göstermektedir. Ancak geri dönüşüm kavramı dünya genelinde henüz tam anlamıyla yaygınlaşmamıştır. Dünya atıklarının yalnızca %30'luk kısmı geri dönüştürülebilmektedir (Chamlin & Gaillochet, 2010: 32).

Geri dönüşüm kaynakların etkin kullanılmasını, üretim ve tüketim sonucunda ortaya çıkan atıkların değerlendirilerek yeniden ekonomiye kazandırılmasını böylece çevresel sorunların en aza indirilmesini amaç edinmektedir (Ateş, 2020: 129).

Tablo 1. Seçili OECD Ülkeleri İçin Geri Dönüşüm Oranları (2020, %)

	En yüksek		**En Düşük**	
Cam Atıkları	Belçika	96,9	Portekiz	52
Ahşap Atıkları	Danimarka	90,7	Hırvatistan	4,3
Metal Atıkları	Norveç	93,9	Avusturya	29,6
Kâğıt Atıkları	Hırvatistan	90,4	Fransa	21,4

Kaynak: Eurostat verileri yazar tarafından derlenmiştir.

Tablo 1'de analiz kapsamındaki seçili OECD ülkelerinde kullanılan dört temel atık türünün (cam atık, ahşap atık, metal atık ve kâğıt atık) en yüksek ve en düşük atık geri dönüşüm oranları yer almaktadır. Tablo 2020 yılı cam atık, ahşap atık, metal atık ve kâğıt atık dönüşüm oranları kullanılarak oluşturulmuştur. Buna göre, cam atık geri dönüşüm oranı en yüksek olan ülke Belçika'dır. Ahşap atıkta ise geri dönüşüm oranı en yüksek ülke Danimarka olurken en düşük 4,3 değerle Hırvatistan'dır. Kâğıt ve metal atık oranlarındaki geri dönüşüm oranları ise kâğıtta en yüksek ülke 90,4 ile Hırvatistan iken metal atık madde de en yüksek geri dönüşüm oranı 93,9 ile Norveç'tir. Metal atık geri dönüşüm oranının en düşük olduğu ülke ise 29,6 ile Avusturya'dır. Tablodan da görüleceği üzere, seçili OECD ülkeleri arasındaki geri dönüşüm oranlarında bir homojenlik söz konusu değildir.

4. Literatür

Üretim ve tüketimin hız kazanması döngüsel ekonomiye olan ilgiyi artırmıştır. Tek dünyamız olduğu ve kaynakların sınırlılığı göz önüne alındığında döngüsel ekonomi kavramının insan yaşamı için ne kadar önemli hale geldiği açıktır. Bu anlayış çerçevesinde döngüsel ekonomi ile ilgili çeşitli akademik çalışmaların hız kazanmasına ortam hazırlamıştır.

Cioaca (2018), çalışmasında AB'ye üye 28 ülkenin 2005-2016 yılları arası verileri temel alınarak ambalaj ve bio atık geri dönüşüm oranı, evsel atık geri dönüşüm oranı ve bu atıkların tekrar kullanımı için yapılan harcamaların GSYH'ye etkisi panel ekonometri analizi ile incelenmiştir. Sonuç olarak, atıkların geri dönüşümünün kaynak verimliliğini artırdığı ve atık geri dönüşümü için yapılan harcamalar ile ekonomik büyüme arasında doğrudan bir ilişki olduğu sonucuna ulaşılmıştır.

Vuta vd. (2018); çalışmasına göre, belediye temel atıkları, ambalaj atıkları ve biyolojik atıkların ekonomik büyüme üzerindeki etkileri analiz edilmiştir. Çalışma 2005-2016 yıllarını kapsamakta olup 28 Avrupa Birliği ülkesi üzerine gerçekleşmiştir. Sonuç olarak belediye atıklarındaki %1'lik artış kaynak verimliliğini 0.01307 artmıştır. Ayrıca teknolojideki %1'lik artış GSYH'yi 0,159988 artırdığı sonucuna ulaşılmıştır.

Busu ve Trica (2019); çalışmada döngüsel ekonomi göstergeleri üzerinden döngüsel malzeme kullanımı, işgücü verimliliği, kaynak verimliliği ve belediye atıklarının geri dönüşüm oranı temel alınarak ekonomik büyümeye etkisi analiz edilmiştir. Sonuç olarak döngüsel ekonominin kaynakların arzı etkinliğinin ekonomik büyüme ve sosyal yaşama katkı sağlayacağı yönündedir.

Busu (2019); çalışmasında 2008-2017 yılları arasında Avrupa Birliği ülkelerinin belediye atıklarının geri dönüşüm oranı ile yeşil enerji kullanımı arasındaki ilişkinin ekonomik büyümeye etkisi analiz edilmiştir. Sonuç olarak yenilenebilir enerji, çevresel istihdam, teknolojik yenilikler, geri dönüşüm oranı, kaynak verimliliği faktörleri ekonomik büyümenin önemli bileşenleri olduğu sonucuna varılmıştır.

Apaydın (2020); çalışmasında OECD ülkeleri 2000-2017 yılları arasındaki veriler kullanılarak atıkların geri dönüştürülmesi ile ekonomik büyüme arasındaki ilişki analiz edilmiştir. Sonuç olarak ekonomik büyüme ve atık değerlendirme ve şekillendirme yöntemleri arasında pozitif yönlü ilişki bulunmuştur.

Hysa vd. (2020); çalışmada AB ülkelerinin ekonomik büyümesinde döngüsel ekonomi ve sürdürülebilirliği destekleyen temel bileşenleri belirleyerek döngüsel ekonomi ile ekonomik büyüme arasındaki ilişki incelenmiştir. Çalışmanın analiz kısmında panel veri analizi ve genelleştirilmiş momentleri ekonomik yöntemleri kullanılmıştır. Sonuç olarak ekonomik büyüme ile döngüsel ekonomi arasında pozitif yönlü bir ilişki olduğu sonucuna ulaşılmıştır.

Utkulu ve Bilik (2020); çalışmalarında 27 AB ülkesinin atık yönetimi ve ekonomik büyüme ilişkisini Genelleştirilmiş Momentler Metodu (GMM) yöntemi ile analiz edilmiştir. Sonuç olarak belediye atık maddelerinin geri dönüşüm oranı ile GSYH arasında doğru orantı mevcut olup birbirini etkilemektedir. Ayrıca yurtiçi malzeme kullanım oranı ile elektronik atık geri dönüşüm oranı da GSYH pozitif etki gösterdiği sonucuna ulaşılmıştır.

Androcineau, Kinnunen ve Georgescu (2021); çalışmada döngüsel ekonomi, ekonomik büyüme ve çevre konularını zaman serileri analizi yöntemi kullanarak incelemiştir. Analiz sonucunda, insani gelişim endeksi ile belediye atıkları geri dönüşüm oranı arasında güçlü korelasyon olduğu sonucuna ulaşılmıştır. Ayrıca, döngüsel ekonomi yönteminin Avusturya, Hollanda ve Almanya gibi Batı Avrupa ülkelerinde İskandinav ülkelerine göre daha etkin kullanıldığı sonucuna ulaşılmıştır.

Ateş (2021); çalışmasında AB üyesi 27 ülke grubuna 2008-2017 dönemi için kâğıt, plastik, metal, cam, elektronik, evsel, ambalaj, ahşap atıkların geri dönüşüm oranları değişkenleri ile GSYH arasındaki ilişki incelenmiştir. Sonuç olarak geri dönüşüm oranları ile GSYH arasında güçlü korelasyon bulunmuştur. Ancak analiz sonucuna göre, otomobil atık ve parçaları, plastik atık, ambalaj atıkları geri dönüşüm oranı ile GSYH arasında negatif korelasyon olduğu sonucuna varılmıştır. Genel sonuç ise, geri dönüşümün GSYH'yi artırdığı yönündedir.

5. Yöntem, Veri Seti ve Modeller

Çalışmada seçili 13 OECD ülkesi Belçika, Almanya, Danimarka, İspanya, Fransa, Hırvatistan, İtalya, Lüksemburg, Avusturya, İsveç, Norveç, Hollanda, Portekiz ülkeleri ile analiz gerçekleştirilmiştir. Veriler EUROSTAT ve Word Bank internet sitesinden alınmıştır. Çalışmada veri aralığı 2000-2020 arası yıllık değerler esas alınarak incelenmiştir. Çalışmada GSYH (GDP) ile ahşap atık (LNAHS), cam atık (LNCAM), plastik atık (LNPLSTK), metal atık (LNMETAL), kâğıt atık ve karton atık (LNKK), ambalaj atık (LNAMB) geri dönüşüm oranları seçilmiş ve

GSYH ile atık değişim oranları değişkenleri arasındaki ilişki incelenmiştir.

Tablo 2. Değişkenlerin Tanımı

Değişken	Tanım	Kaynak
GDP	GSYH	Dünya Bankası
LNCAM	Cam Atık Geri Dönüşüm Oranı	Eurostat
LNMETAL	Metal Atık Geri Dönüşüm Oranı	Eurostat
LNAHS	Ahşap Atık Geri Dönüşüm Oranı	Eurostat
LNPLSTK	Plastik Atık Geri Dönüşüm Oranı	Eurostat
LNKK	Kağıt Atık Geri Dönüşüm Oranı	Eurostat
LNAMB	Ambalaj Atık Geri Dönüşüm Oranı	Eurostat

Çalışmanın amacı seçili OECD ülkelerde belirli atık hammaddelerin geri dönüşüm oranları ile GSYH arasındaki ilişkiyi incelemektir. Analiz için çalışmada Augmented Dickey-Fuller birim kök testi ile Granger nedensellik testi kullanılmıştır. Çalışma da yer verdiğimiz ekonometrik testlerin teorik içeriği yer almaktadır.

Çalışmanın analiz kısmında panel veri ekonometri yöntemi uygulandığı için panel birim kök testlerine başvurulmaktadır. Ekonomik yazında, panel veri analiz yöntemi çeşitli birim kök testleri içermektedir. Bunlardan ilki, birinci nesil birim kök testidir. Buna göre, birinci nesil birim kök testleri, verideki değişkenler (ülke, firma vb.) arasında yatay kesit bağımlılığı olmadığı varsayımına dayanmaktadır. İkinci nesil birim kök testleri ise kesitler arasında yatay kesit bağımlılığı olduğunu varsaymaktadır. Ekonometrik analizde birim kök testlerinden hangisinin uygulanılacağını belirlemek için değişkenler arasında yatay kesit bağımlılığının incelenmesi gerekmektedir. Yatay kesit bağımlılığının incelenmesi için dört farklı test kullanılmaktadır. Bunlar, Breusch-Pagan (1980) Lagrange Multiplier (LM), Pesaran (2004) Scaled LM, Baltagi, Feng ve Kao (2012) tarafından geliştirilen Bias-corrected scaled LM ve Pesaran (2004) CD (Cross-section Dependence) yatay kesit bağımlılığı testleridir.

Yatay Kesit Bağımlılığı Testi

Panel veri analizinde yatay kesit bağımlılığını analiz etmek için çeşitli testler uygulanmaktadır. Seriler arasındaki yatay kesit bağımlılığının var olması veya olmaması durumu regresyondaki bulguları önemli ölçüde etkilemektedir (Pesaran, 2004: 435). Bu bağlamda yatay kesit bağımlılığının varlığının çeşitli yöntemlerle test edilmesi önem arz etmektedir. Yatay kesit bağımlılığının göz ardı edildiği uygulamalarda hatalı sonuçlar gözlenmektedir (Göçer vd., 2012: 456).

Yatay kesit bağımlılığı, panelin zaman boyutunun yatay kesit boyutundan büyük (T>N)ise, Breusch-Pagan (1980) Lagrange Multiplier (LM) testiyle; her ikisi de büyük olduğunda Pesaran (2004) Cross-Section Dependence (CD) testiyle incelenebilmektedir (Çırak, 2021: 824). Bu çalışmada 13 ülke ve 2000-2020 yıl arası 20 yıl olduğu için yani T>N, LM (Lagrange Multiplier) testi kullanılmıştır.

Bu testler, grup ortalaması sıfır ancak bireysel ortalama sıfırdan farklı bir değer olduğunda, sapmalı olmaktadır. LM (Lagrange Multiplier) test istatistiği aşağıdaki gibi formüle edilmektedir (Mercan, 2014: 235):

$$LM = T\sum_{i=1}^{N=1}\sum_{j=i+1}^{N}(\widehat{P_{ij}}) \sim X^2 N(N-1)/2 \qquad \textbf{(1)}$$

Bu istatistik daha sonra yapılan düzenlemeyle şu hale gelmiştir (Pesaran vd.2008).

$$LMLM_{adj} = \left(\frac{2}{N(N-1)}\right)^{\frac{1}{2}} \sum_{i=1}^{N=1}\sum_{j=i+1}^{N}\left[\hat{P}_{ij}\left(\frac{(T-K-1)\hat{P}_{ij}-\widehat{\mu_{Tij}}}{\vartheta_{rij}}\right]\right. \sim N(0,1) \qquad \textbf{(2)}$$

Burada μ_{Tij} ortalamayı, ϑ_{rij} varyansı temsil etmektedir. buradan elde edilecek olan test istatistiği asimptotik olarak standart normal dağılım sergilemektedir.

Testin hipotezleri ise;

H_0: Yatay kesit bağımlılığı yoktur.

H_1: Yatay kesit bağımlılığı vardır.

Bu çalışmada, değişkenlerde ve eş bütünleşme denkleminde yatay kesit bağımlılığının varlığı LM testi ile kontrol edilmiş ve Tablo 3'deki sonuçlar elde edilmiştir.

Tablo 3. Modelin Yatay Kesit Bağımlılığı Test Sonuçları

GDP			
Breusch-Pagan LM	627.5612	45	0.0000
LNAHS			
Breusch-Pagan LM	198.7178	45	0.0000
LNAMB			
Breusch-Pagan LM	369.7062	45	0.0000
LNCAM			
Breusch-Pagan LM	201.9931	45	0.0000
LNKK			
Breusch-Pagan LM	279.9516	45	0.0000
LNMETAL			
Breusch-Pagan LM	394.9079	45	0.0000
LNPLSTK			
Breusch-Pagan LM	426.3767	45	0.0000

Not: *, %1 anlamlılık düzeyini ifade etmektedir.

Tablo 3'deki sonuçlara göre, analizde kullanılan değişkenlere ve eş bütünleşme denklemine ait olasılık değerleri 0.05'ten küçük olduğu için Breusch-Pagan LM testine göre H_0 hipotezi reddedilirken H_1 hipotezi kabul edilmiştir. Serilerde ve eş bütünleşme denkleminde yatay kesit bağımlılığının olduğuna karar verilmiştir. Yatay kesit bağımlılığı seriyi oluşturan birimler arasında korelasyonun varlığını ifade etmektedir. Yatay kesit bağımlılığının bulunması sebebiyle panel veri analizi uygulamadan önce yatay kesit bağımlılığını dikkate alan testlerin kullanılması önem arz etmektedir. Çalışmada birim kök testi uygulanırken yatay kesit bağımlılığını dikkate alan eş

bütünleşme analizi yöntemleri uygulanmıştır. İkinci nesil birim kök testlerinden biri olan Peseran (2007) panel birim kök testi (CIPS) testi ile verilerin durağanlıkları incelenmiştir. CIPS testi sonuçları aşağıdaki Tablo 4'te verilmiştir.

Table 4. Pesaran (2007) Panel Birim Kök Testi (CIPS)

Değişken	Trendsiz		Trendli	
	Zt-bar	Olasılık	Zt-bar	Olasılık
GDP	-2.699*	0.003	-1.772**	0.038
lNCAM	-4.318*	0.000	-3.813*	0.000
LNMETAL	-5.214*	0.000	-3.327*	0.000
LNAHS	-3.760*	0.000	-2.581*	0.005
LNPLSTK	-3.819*	0.000	-2.891*	0.002
LNKK	-4.521 *	0.000	-2.960*	0.002
LNAMB	-4.185*	0.000	-3.614 *	0.000

Not: *, ** ve ***, sırasıyla %1, %5 ve %10 anlamlılık düzeyini ifade etmektedir.

Tablo 4'te yer alan CIPS panel birim kök testi bulgularına göre, serilerin hepsinin düzeyde durağan olduğu ve birim kök içermediği sonucuna ulaşılmıştır. Bu nedenle nedensellik analizi olan Engle&Granger nedensellik testi uygulanabilmektedir. Engle&Granger nedensellik testi değişkenler arasındaki uzun dönemli ilişkiyi incelerken modelde yer alan tüm değişkenler aynı derecede durağan olduğunu varsaymaktadır. Veri setinde yer alan değişkenlerin farklı dereceden durağan olmaları durumunda Engle&Granger nedensellik testi uygulanmamaktadır (Taban ve Kar, 2006: 167) Engle&Granger nedensellik testine ait sonuçlar Tablo 5'te verilmiştir.

Tablo 5. Engle&Granger Nedensellik Testi Sonuçları

Gecikme Sayısı=1	F istatistik	Olasılık
GDP => LNAHS	0.765603	0.3816
GDP => LNAMB	0.000868	0.9765
GDP => LNCAM	1.363366	0.2430
GDP => LNKK	0.277350	0.5984
GDP => LNMETAL	0.065313	0.7983
GDP =>LNPLSTK	0.204461	0.6511

Test sonuçlarında GSYH (GDP)'a ahşap atık, ambalaj atık, cam atık, karton ve kâğıt atık, metal atık ve plastik atık geri dönüşüm oranından etkilenmemekte ve değişkenler arasında nedensellik ilişkisinin olmadığını ifade eden sıfır hipotezi reddedilmektedir.

H_0: Nedensellik yoktur.

H_1: Nedensellik vardır.

Seçili atık geri dönüşüm oranı değişkenlerinden GSYH'n doğru nedensellik bulunmamaktadır. Ancak GSYH'den ahşap atık geri dönüşümünü etkilemekte ve aralarında tek yönlü nedensellik bulunmaktadır. Seçili OECD ülkeleri üzerine gerçekleştirdiğimiz sonuca göre, ülkelerin gelirinin artması ile atık geri dönüşüm arasında herhangi bir ilişkinin olmadığı görülmüştür. Geri dönüşüm politikaları bu ülkeler de gelirden bağımsız sürdürülmektedir.

6. Sonuç

Çalışmanın ana amacı döngüsel ekonominin önemli parçası olan geri dönüşümün seçili OECD ülkelerinde plastik, kâğıt ve karton, metal, cam ve ambalaj atık geri dönüşüm oranı ile ekonomik büyüme arasındaki ilişkinin incelenmesidir.

Çalışmanın literatür bölümünde benzer çalışmalara yer verilmiş ve detaylı bir şekilde incelenmiştir. Çıkan sonuçlara göre, atık geri dönüşüm oranları ile ekonomik büyüme arasında pozitif yönlü bir ilişki bulunduğu ortaya konmuştur. Ekonomik büyümenin gerçekleşmesinde atık yönetiminin etkisinin oldukça fazla olduğu çoğu ülkenin atık politikasına yönelik adımlarının ekonomik büyüme ve kalkınmaya katkı sağladığı yönünde olumlu sonuçlara ulaşılmıştır. Bu bulgular literatür kısmında incelenen çalışmalarla paralellik arz etmektedir. Çalışmanın ekonometrik analiz sonucuna göre ambalaj, plastik, kâğıt ve karton, metal ve cam gibi atıkların geri dönüşümünün GSYH üzerinde herhangi bir nedensellik ilişkisinin bulunmadığı bulgusuna ulaşılmıştır. Çalışmanın teorik bölümünde döngüsel ekonomi ve geri dönüşüm kavramlarına yer verilmiştir. Seçili OECD ülkelerinde ülkelerin gelirlerinin artması geri dönüşüm arasında herhangi bir ilişkinin olmadığı görülmüştür. Geri dönüşüm politikaları bu ülkeler de gelirden bağımsız bir şekilde sürdürülmektedir. Döngüsel ekonomi konsepti uzun vadeli bir stratejidir. Bu stratejiyi hükümetler, bilim dünyası, firmaların kullanabileceği ortak bir mevzuatla gerçekleştirilmesi mümkündür.

Döngüsel ekonominin en önemli ayağı geri dönüşümdür. Üretim ve tüketim sonrasında atık halini alan maddeler geri dönüşüm yoluyla hem ekonomiye geri kazandırılmakta hem de çevre kirliliğini önleyerek daha yaşanılabilir dünya mirası sağlanmaktadır. Ayrıca bu maddelerin daha sonra başka bir malın üretiminde kullanılması ekonomik olarak israfın önüne geçilmesi yönünden önem arz etmektedir. Ülkeler doğal ve beşeri sermayenin korunması, sürdürülebilirliği ve geleceği için döngüsel ekonomi ve geri dönüşüm kavramlarına gereken önemin verilmesi adına vatandaşlarına çeşitli eğitimler vermelidir. Döngüsel ekonominin önemi hakkında gerek kamu spotu gerekse çeşitli teşviklerle üretici ve tüketiciler bilinçlendirilmelidir. Geri dönüşümle ilgili yatırımlar yapılmalı ve uluslararası organizasyonlarla konuya dikkat çekilmelidir. Ayrıca geri dönüşüm ve çevre duyarlılığını dikkate alan firmalar, üreticiler ödüllendirilerek kamuoyuna duyurulmalıdır. Tüm bu çalışmalar sonucunda üretim ve tüketim döngüsü yeniden şekillenecek ve maliyetler azalacak, çevre kirliliği oranlarında düşüşler yaşanacak ve bir yandan yeni istihdam imkânlarına ortam hazırlarken diğer yandan gelecek nesillere yaşanabilecek çevre mirası bırakılmış olacaktır.

Kaynakça

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Assessing the current and future efficiency of OECD countries in municipal solid waste management

OECD ülkelerinin belediye katı atık yönetiminde mevcut ve gelecekteki verimliliğinin değerlendirilmesi

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ANAHTAR KELİMELER

Belediye Katı Atıkları
OECD
Öngörü
Dalgacık analizi
Burg modeli

ÖZ

Bu makalenin amacı, OECD ülkelerinin belediye katı atık yönetiminde mevcut ve gelecekteki verimliliğini değerlendirmektir. Metodoloji iki yönlüdür. Mevcut verimliliği değerlendirmek için yazarlar, GSYİH ile ölçülen daha fazla mal ve hizmet üretmenin, daha fazla belediye katı atık üretmek anlamına geldiğini varsayarak, belediye katı atıklarının GSYH'ye oranını hesaplamışlardır. Bu orana göre sonuçlar, 2020 yılında belediye katı atık yönetiminde Türkiye'nin en az verimli ülkelerden biri olduğunu, onu Kolombiya, Meksika, Şili ve Yunanistan'ın takip ettiğini göstermektedir. Norveç, 2020 yılında belediye katı atıklarında en düşük oranla en verimli yönetici olurken, onu Lüksemburg, İrlanda, İsviçre ve İsveç takip etmektedir. OECD ülkelerinin belediye katı atık yönetiminde gelecekteki verimliliğini değerlendirmek amacıyla, veri eksikliği nedeniyle Avustralya, Kanada ve Kosta Rika hariç 35 OECD ülkesi için toplanan zaman serileri dalgacık analizi ile tahmin edilerek 2100 belediye katı atık projeksiyonu sunulmaya çalışılmaktadır.

KEYWORDS

Municipal Solid Waste
OECD
Forecasts
Wavelet analysis
Burg model

ABSTRACT

The purpose of this paper is to assess the current and future efficiency of OECD countries in managing municipal solid waste. The methodology is twofold. To assess the current efficiency, the authors develop a ratio of municipal solid waste to GDP, assuming that producing more of goods and services, measured with GDP, means producing more municipal solid waste. Based on this ratio, results show that Turkey was the least efficient manager in municipal solid waste in 2020, followed by Colombia, Mexico, Chile and Greece. Norway was the most efficient manager in municipal solid waste in 2020 with the lowest ratio, followed by Luxembourg, Ireland, Switzerland, and Sweden. To assess future efficiency of OECD countries in managing municipal solid waste, 2100 projections of municipal solid waste are obtained by forecasting with wavelet analysis historical time series gathered by OECD from 35 countries excluding Australia, Canada, and Costa Rica for lack of data.

1. Introduction

This paper aims to assess the current and future efficiency of OECD countries in municipal solid waste management. Current efficiency will be measured from historical data and future efficiency from 2021-2100 municipal solid waste projections. 35 OECD countries are selected, excluding Australia, Canada, and Costa Rica for lack of data. Municipal solid waste includes items disposed by the public, such as product packaging, grass clippings, furniture, clothing, bottles, food scraps, newspapers, appliances, paint, and batteries. It comes mainly from household consumption but includes also some commercial and industrial wastes (US EPA, 2023). 2100 projections are obtained by forecasting with wavelet analysis municipal solid waste historical time series gathered by OECD from 35 countries. The Organization for Economic Co-operation and Development is an international organization of 38 countries that works to 'build better policies for better lives'. The OECD promotes 'prosperity, equality, opportunity and well-

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being for all' (OECD, 2023a). Together with governments, policy makers and citizens, the OECD works to set evidence-based international standards and find solutions to a range of social, economic and environmental challenges such as solid waste management. Looking at 2020 data of municipal solid waste produced by OECD countries gathered in Table 1 (source of the data: OECD, 2023b) and their relationship with GDP (current US$), GDP per capita, population, land and land + water superficies per country, allow researchers to identify strong relationships between municipal solid waste and GDP (correlation coefficient of +98.90%), municipal solid waste and population (+95.34%) and municipal solid waste and land area and land+water area (+93%). The higher the population, GDP and land area (or land + water area), the more municipal solid waste will be produced, which intuitively makes sense.

Table 1. 2020 municipal solid waste, Land + water area in km^2, Land area in km^2, Population, 2022 GDP (current US$) in millions USD and 2022 GDP per capita (current US$) by country

Country	(1) 2020 municipal solid waste in Tonnes, Thousands	(2) Land + water area in km^2	(3) Land area in km^2	(4) Population 2022 or 2023 estimates	(5) 2022 GDP (current US$) in millions USD	(6) 2022 GDP per capita (current US$)	(7) = (1) / (5) in %	(8) = (7) *normalized*	Ranking of (8) from highest to lowest
Correlation Coefficient ρ:		ρ(1,2) = 93.75%	ρ(1,3) = 93.44%	ρ(1,4) = 95.34%	ρ(1,5) = 98.90%	ρ(1,6) = 10.62%			
Austria	7,438.0	83,871	82,445	9,120,091	471,400.07	52,131.40	1.58%	-0.06	15.00
Belgium	8,408.0	30,528	30,278	11,755,313	578,604.10	49,582.80	1.45%	-0.22	18.00
Chile	8,177.4	756,102	743,812	19,960,889	301,025.25	15,355.50	2.72%	1.39	4.00
Colombia	12,082.5	1,141,748	1,038,700	52,215,503	343,939.45	6,630.30	3.51%	2.41	2.00
Costa Rica	1,459.3	51,100	51,060	5,213,362	68,380.84	13,198.80	2.13%	0.65	9.00
Czech Republic	5,814.0	78,871	77,171	10,827,529	290,923.53	27,638.40	2.00%	0.48	11.00
Denmark	4,744.0	2,220,093	2,220,072	5,941,388	395,403.91	66,983.10	1.20%	-0.54	25.00
Estonia	509.0	45,227	42,388	1,365,884	38,100.81	28,332.60	1.34%	-0.37	21.00
Finland	3,370.0	338,425	303,816	5,541,016	280,825.96	50,536.60	1.20%	-0.54	24.00
France	36,370.0	640,679	640,427	68,042,591	2,782,905.33	40,963.80	1.31%	-0.40	23.00
Germany	53,322.0	357,114	348,672	84,358,845	4,072,191.74	48,432.50	1.31%	-0.40	22.00
Greece	5,613.0	131,957	130,647	10,482,487	219,065.87	20,732.10	2.56%	1.20	5.00
Hungary	3,931.0	93,028	89,608	9,678,000	178,788.57	18,463.20	2.20%	0.73	8.00
Iceland	225.0	103,000	100,250	390,830	27,841.65	72,903.00	0.81%	-1.04	31.00
Ireland	3,210.0	70,273	68,883	5,149,139	529,244.87	104,038.90	0.61%	-1.30	34.00
Israel	5,976.0	20,770	20,330	9,741,000	522,033.45	54,659.80	1.14%	-0.61	26.00
Italy	28,945.0	301,339	294,140	58,803,163	2,010,431.60	34,158.00	1.44%	-0.23	19.00
Japan	41,669.0	377,976	364,546	124,500,000	4,231,141.20	33,815.30	0.98%	-0.81	29.00
Korea	22,544.6	100,210	99,909	51,439,038	1,665,245.54	32,254.60	1.35%	-0.34	20.00
Latvia	909.0	64,559	62,249	1,885,400	41,153.91	21,851.10	2.21%	0.75	7.00
Lithuania	1,350.0	65,300	62,680	2,862,274	70,334.30	24,826.80	1.92%	0.38	12.00
Luxembourg	498.0	2,586	2,586	660,809	82,274.81	126,426.10	0.61%	-1.30	35.00
Mexico	42,102.8	1,964,375	1,943,945	129,035,733	1,414,187.19	11,091.30	2.98%	1.73	3.00
Netherlands	9,304.0	41,850	33,893	17,887,100	991,114.64	55,985.40	0.94%	-0.87	30.00
New Zealand	3,705.0	270,467	262,443	5,199,100	247,234.05	48,249.30	1.50%	-0.16	17.00
Norway	3,247.0	385,207	365,957	5,504,329	579,267.37	106,148.80	0.56%	-1.35	36.00
Poland	13,117.0	312,696	311,888	37,726,000	688,176.61	18,321.30	1.91%	0.36	13.00
Portugal	5,279.0	92,226	91,119	10,467,366	251,945.38	24,274.50	2.10%	0.60	10.00
Slovak Republic	2,612.0	49,037	48,105	5,426,857	115,468.80	21,258.10	2.26%	0.82	6.00
Slovenia	1,024.0	20,273	20,151	2,116,972	62,117.77	29,457.40	1.65%	0.03	14.00
Spain	21,989.0	505,992	498,980	48,196,693	1,397,509.27	29,350.20	1.57%	-0.06	16.00
Sweden	4,460.0	447,425	407,284	10,538,026	585,939.17	55,873.20	0.76%	-1.10	32.00
Switzerland	6,096.0	41,277	39,997	8,865,270	807,706.04	92,101.50	0.75%	-1.11	33.00
Turkey	34,581.0	783,562	769,632	85,279,553	905,987.82	10,616.10	3.82%	2.80	1.00
United Kingdom	31,002.0	242,495	241,930	67,026,292	3,070,667.73	45,850.40	1.01%	-0.78	28.00
United States	265,224.5	9,833,517	9,147,593	335,038,000	25,462,700.00	76,398.60	1.04%	-0.74	27.00
						Average =	1.62%		
						Stand. Dev. Pop. =	0.78%		

Sources: OECD website at https://stats.oecd.org/index.aspx?DataSetCode=MUNW, [Time series of Municipal waste generated in Tonnes, Thousands], on the World Bank website at https://data.worldbank.org/indicator/NY.GDP.MKTP.CD [GDP (current US$), 2022 estimates], on Wikipedia website at https://en.wikipedia.org/wiki/List_of_countries_and_dependencies_by_population [Sovereign states and dependencies by population, 2022 or 2023 estimates] and on Wikipedia website at https://en.wikipedia.org/wiki/List_of_countries_and_dependencies_by_area [Countries and dependencies by area]

Table 2 confirms the positive and strong relationship between variables, except the 'GDP per capita' variable, which has a weak relationship with all other variables.

Table 2. Correlation coefficient table between 2020 municipal solid waste, Land + water area, Land area, Population, 2022 GDP (current US$) in millions USD and 2022 GDP per capita (current US$) variables

	(1) 2020 municipal solid waste in Tonnes, Thousands	(2) Land + water area	(3) Land area	(4) Population	(5) 2022 GDP (current US$) in millions USD	(6) 2022 GDP per capita (current US$)
(1) 2020 municipal solid waste in Tonnes, Thousands	100.00%					
(2) Land + water area	93.75%	100.00%				
(3) Land area	93.44%	99.98%	100.00%			
(4) Population	95.34%	86.53%	86.47%	100.00%		
(5) 2022 GDP (current US$) in millions USD	98.90%	93.16%	92.71%	91.45%	100.00%	
(6) 2022 GDP per capita (current US$)	10.62%	13.52%	13.27%	-2.26%	17.87%	100.00%

To track how effectively OECD countries are managing their municipal solid waste, the authors develop a ratio of 2020 municipal solid waste in tonnes, thousands to 2022 GDP (current USD) in USD million, assuming that producing more of goods and services, measured with GDP, means producing more municipal solid waste. The ratio is normalized for the 36 OECD countries, the more positive the ratio, the higher the ratio is than the average for OECD countries, the worse the management of municipal solid waste is. Conversely, the more negative the ratio, the lower the ratio is than the average for OECD countries, the better the management of municipal waste. Based on Table 1, with the highest normalized ratio of +2.80 (refer to the column labelled "8" in the first row and the row corresponding to Turkey), Turkey was the least efficient manager in municipal solid waste in 2020, followed by Colombia, Mexico, Chile and Greece. Norway was the most efficient manager in municipal solid waste in 2020 with the lowest normalized ratio of -1.35, followed by Luxembourg, Ireland, Switzerland and Sweden.

Section 2 reviews the literature on wavelet analysis modelling and starts with the literature on solid waste projections. Section 3 explains the forecasting method used in this paper. Section 4 presents and discusses the results. Section 5 concludes.

2. Literature Review

This research intends to assess the current and future efficiency of OECD countries in municipal solid waste management. Current efficiency will be measured from historical data and future efficiency from 2021-2100 municipal solid waste projections obtained with a forecasting model based on wavelet analysis. The first part of the literature review discusses solid waste projections in the literature, the second part presents wavelet analysis forecasting models in the literature.

2.1. Solid waste projections in the literature

Among seminal papers in the literature of solid waste projections, Kolekar et al. (2016) proposed a review of municipal solid waste generation prediction models. According to them, prediction models related to municipal solid waste generation used economic, socio-demographic or management-orientated data and identify possible factors that will help in selecting the crucial design options within the framework of mathematical modelling; most common attributes affecting waste generation being overall size of the household, income level of households, and the level of education. The World Bank was also a pioneer in the literature review of solid waste projections in its global snapshot of solid waste management to 2050 (Kaza et al., 2018). According to this study, waste generation will radically overtake population growth by more than double by 2050. By 2050, the world is expected to generate 3.40 billion tons of waste per year, a significant increase from 2.01 billion tons (2018 estimate). Although countries take action to improve and innovate in solid waste management, urgent action is still needed. Solid waste management affects all humans but first the most vulnerable ones who may lose their lives and homes from landslides of waste dumps, may work in unsafe waste-picking conditions, and suffer diseases. Plastic waste, one of the components of solid waste, is seeing its consumption increase. An example of article that describes the impact of plastic waste on the environment and humans' health in Pakistan is Sanjrani et al. (2023). In 2016, globally, 242 million tonnes of plastic waste were generated, which represents 12 percent of all municipal solid waste. In 2016, globally, about 1.6 billion tonnes of CO2-equivalent greenhouse gas emissions were generated from solid waste management, about 5 percent of total emissions. According to the World Bank study (Kaza et al., 2018), 'without action, solid waste–related emissions are anticipated to increase to 2.6 billion tonnes of CO2-equivalent by 2050.' Chen et al. (2020) studied trends and impacts of the world's growing municipal solid waste. They applied compositional Bayesian regression to produce the first estimates of past and future (1965–2100) waste generation disaggregated by composition and treatment, along with resultant environmental impacts, for every country. They found that total wastes grow at declining

speed with economic development, and that global waste generation increased from 635 Mt in 1965 to 1999 Mt in 2015 and will reach 3539 Mt by 2050. Chen et al. showed that a continuation of current trends and improvements is insufficient to reduce pressures on natural systems and achieve a circular economy. More recently, Teshome et al. (2023) proposed a multiple linear regression models to estimate the rate of household solid waste generation. They found that household solid waste generation rate is about 0.39 kilograms per capita per day and that organic waste accounted for the majority of the waste generated in the study area (71.28 percent), followed by other waste (9.77 percent), paper (6.71 percent), and plastic waste (6.41 percent). The solid waste generation rate demonstrated a positive relationship ($p<0.05$) with monthly household income and educational level. However, there was a negative association between family size and age ($p > 0.05$). The following section discusses how wavelet analysis, the model used in this paper, is applied in the literature of forecasting.

2.2. Wavelet analysis forecasting model in the literature

Wavelet analysis was first applied to physical phenomena including electrical, audio or seismic signals which propagate through space in waveforms. Wavelet analysis has also been applied in finance and economics since interest rates, exchange rates, volatility of asset returns, gross domestic product, levels of employment or consumer spending propagate through time in waveforms. Rostan and Rostan (2018a) illustrated the versatility of wavelet analysis when forecasting financial time series. To exemplify the versatility of wavelet analysis, Rostan and Rostan (2019) identified when European Muslim population will be majority in Europe with wavelet analysis. Rostan et al. (2015) assessed the financial sustainability of the Spanish pension system, and Rostan and Rostan (2018b) applied an identical methodology to Saudi pension system. Wavelet analysis was applied to the forecast of economic time series of countries such as Spain (Rostan and Rostan, 2018c) and Greece (Rostan and Rostan, 2018d), Saudi Arabia (Rostan and Rostan, 2021a and Rostan et al., 2023a), Austria (2020), countries of the Persian Gulf (2022a), Turkey (2022b), UK (2022c), Australia (2023a), South Korea (2023b), Brazil, Mexico and Argentina (2023d), Cyprus (2023e) and Eurozone (Rostan et al., 2023b). Interest rates were forecasted with wavelet analysis due to their valuable property of propagating through time in waveforms (Rostan et al., 2017). In addition, fossil fuels price estimates (Rostan and Rostan, 2021b), population estimates (Rostan et al., 2015; Rostan and Rostan, 2017) and global temperature projections (Rostan and Rostan, 2023c) were forecasted with wavelet analysis.

In this article, the authors assume that time series of the annual amount of municipal solid waste of the OECD countries propagate overtime in waveform patterns, like signals through space. Wavelet analysis focuses on the analysis, synthesis, and modification of signals. Wavelets mimic signals with specific properties that make them useful for signal processing. From a finite record of a stationary data sequence, Wavelet analysis estimates how the total power is distributed over frequency (Stoica & Moses, 2005). Wavelet analysis uses Discrete Wavelet Transform (DWT) due to several not tractable properties of Continuous Wavelet Transform (CWT) such as highly redundant wavelet coefficients (Valens, 1999), infinite number of wavelets in the wavelet transform and no analytical solutions found for most functions of the wavelet transforms. To refine wavelet-based forecasting method, Renaud et al. (2002) proposed redundant 'à trous' wavelet transform and multiple resolution signal decomposition.

Section 3 presents the methodology. Section 4 gathers the results and section 5 concludes.

3. Methodology

Table 3 gathers the information related to time series of Municipal solid waste in Tons, Thousands generated by OECD countries and collected by the OECD (2023b). The authors interpolated some data using the arithmetic average of previous and subsequent data when it was applicable. The numbers of interpolated data per country appear in Table 3

Table 3. Number of available data of historical time series of OECD countries (source of data: OECD, 2023b), number of data interpolated by the authors, level of decomposition applied in wavelet analysis (refer to step 2 of the methodology section), number of forecasted data for each OECD country

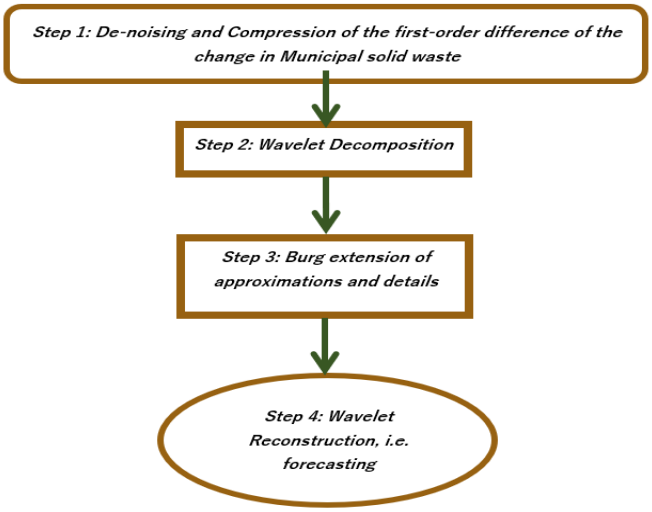
	Country	Available Data of time series of Municipal solid waste in Tons, Thousands	Number of interpolated data	Level of decomposition used in forecasting	Number of forecasted data
1	Australia	13 data from 2007 to 2019	0	No possible forecast	No possible forecasts due to a reduced number of available data
2	Austria	31 data from 1990 to 2020	0	4	80
3	Belgium	32 data from 1990 to 2021		4	79
4	Canada	No data available	0	No possible forecast	No possible forecasts with no available data
5	Chile	19 data from 2000 to 2019	2	6	81
6	Colombia	16 data from 2003 to 2018	0	7	82

7	Costa Rica	12 data from 2010 to 2021	0	No possible forecast	No possible forecasts due to a reduced number of available data
8	Czech Republic	27 data from 1995 to 2021	0	4	79
9	Denmark	28 data from 1994 to 2021	0	4	79
10	Estonia	27 data from 1995 to 2021	0	4	79
11	Finland	28 data from 1994 to 2021	0	4	79
12	France	30 data from 1992 to 2021	1	4	79
13	Germany	27 data from 1995 to 2021	0	4	79
14	Greece	30 data from 1990 to 2019	3	4	81
15	Hungary	32 data from 1990 to 2021	4	4	79
16	Iceland	26 data from 1995 to 2020	1	4	80
17	Ireland	26 data from 1995 to 2020	0	4	80
18	Israel	22 data from 2000 to 2021	0	5	79
19	Italy	31 data from 1990 to 2020	2	4	80
20	Japan	31 data from 1990 to 2020	0	4	80
21	Korea	31 data from 1990 to 2020	0	4	80
22	Latvia	27 data from 1995 to 2021	0	4	79
23	Lithuania	27 data from 1995 to 2021	0	4	79
24	Luxembourg	32 data from 1990 to 2021	0	4	79
25	Mexico	23 data from 1990 to 2012	1	5	88
26	Netherlands	32 data from 1990 to 2021	1	4	79
27	New Zealand	29 data from 1990 to 2018	14	4	82
28	Norway	32 data from 1990 to 2021	2	4	79
29	Poland	32 data from 1990 to 2021	0	4	79
30	Portugal	32 data from 1990 to 2021	1	4	79
31	Slovak Republic	32 data from 1990 to 2021	2	4	79
32	Slovenia	27 data from 1995 to 2021	0	4	79
33	Spain	27 data from 1995 to 2021	0	4	79
34	Sweden	32 data from 1990 to 2021	3	4	79
35	Switzerland	32 data from 1990 to 2021	0	4	79
36	Turkey	31 data from 1990 to 2020	3	4	80
37	United Kingdom	32 data from 1990 to 2021	4	4	79
38	United States	29 data from 1990 to 2018	0	4	82

Sources: OECD website at https://stats.oecd.org/index.aspx?DataSetCode=MUNW, [Time series of Municipal waste generated in Tonnes, Thousands]

Besides measuring the current efficiency of OECD countries in municipal solid waste management, this paper intends to measure future efficiency from 2021-2100 municipal solid waste projections obtained with a forecasting model based on wavelet analysis. The forecasting model, improved with a de-noising and compression step of the methodology presented in a seminal paper of Rostan & Rostan (2018a), requires four steps illustrated in Figure 1. The detailed methodology is available in Rostan & Rostan (2022b, *Journal of Emerging Economies & Policy*). The choice of the level of decomposition in step 2 is conditional to the number of available data, the greater the number of historical data of the time series, the lower the level of decomposition. The ideal number, as explained in Rostan & Rostan (2018a), is level-2 decomposition to generate more accurate projections. However, the constraint of a low number of historical data provided by the OECD (2023b), as detailed in Table 3, implies a minimum level of decomposition of 4 and a maximum level of 7 depending on the number of available data per country.

Figure 1. Flowchart of the methodology from steps 1 to 4.



4. Results

This paper aims to assess the current and future efficiency of OECD countries in municipal solid waste management. Current efficiency will be measured from historical data and future efficiency from 2021-2100 annual amount of municipal solid waste projections generated with wavelet analysis. In section 3, a four-step methodology is applied to the historical times series of annual amount of municipal solid waste, data recorded and disseminated by the OECD (2023b). Figures 2, 3, 4 and 5 illustrate the forecasts per OECD country obtained with the wavelet analysis forecasting model. The number of forecasted data, varying per country, is mentioned in the last column of Table 3. Table 4: 1) ranks OECD countries by 2020 ratios of efficiency in management of municipal solid waste from (1) least efficient country to (36) most efficient country and 2) ranks OECD countries by annual growth rates of 2021-2100 projections of the amount of municipal solid waste from (1) highest growth of the amount of municipal solid waste to (36) lowest growth of the amount of municipal solid waste. As mentioned earlier, with the highest normalized ratio of +2.8 (refer to the column labelled "4" in the first row of Table 4 and the row corresponding to Turkey), Turkey was the least efficient manager in municipal solid waste in 2020, followed by Colombia, Mexico, Chile and Greece. Norway was the most efficient manager in municipal solid waste in 2020 with the lowest normalized ratio of -1.35, followed by Luxembourg, Ireland, Switzerland and Sweden. With the highest annual growth rate of 2.63% (refer to the column labelled "5" in the first row of Table 4 and the row corresponding to Belgium) of its 2021-2100 projections of the amount of municipal solid waste, Belgium will have the most difficulty controlling the generation of municipal solid waste, followed by Austria, the Slovak Republic, the Czech Republic and Colombia. With the lowest annual growth rate of -1.31%, Japan will be best able to control municipal solid waste generation, followed by Sweden, Denmark, Switzerland and the UK. Switzerland and Sweden, appearing twice in the list of best-performing OECD countries in terms of current and future efficiency in the way they manage municipal solid waste, should serve as models for other countries to improve their management of municipal solid waste.

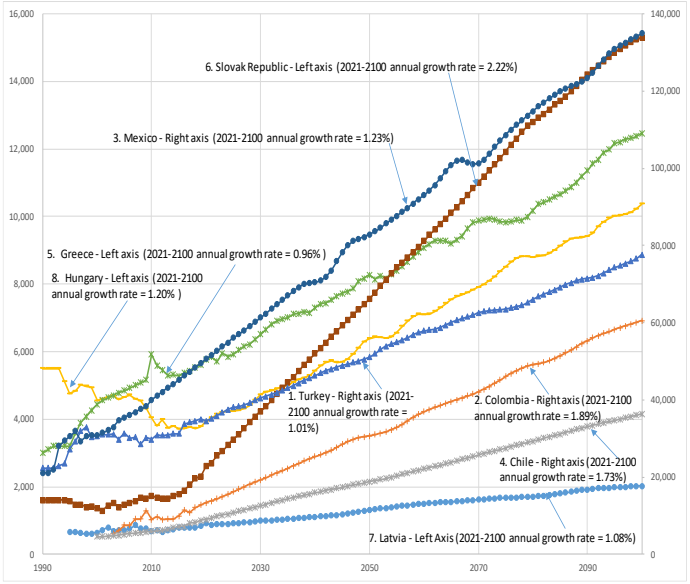
Table 4. 2020 Ranking of OECD countries by ratio of efficiency in management of municipal solid waste from (1) least efficient country to (36) most efficient country and Ranking of OECD countries in Annual Growth Rate of 2021-2100 projections of the amount of municipal solid waste from (1) highest growth of the amount of municipal solid waste to (36) lowest growth of the amount of municipal solid waste.

Country	(1) 2020 municipal solid waste in Tonnes, Thousands	(2) 2022 GDP (current US$) in millions USD	(3) = (1) / (2) in %	(4) = (3) *normalized*	Ranking of (4) from highest to lowest	(5) 2021-2100 Annual Growth Rate of municipal solid waste	Ranking of (5) from highest to lowest
Turkey	34,581.00	905,987.82	3.82%	2.8	1	1.01%	21
Colombia	12,082.50	343,939.45	3.51%	2.41	2	1.89%	5
Mexico	42,102.80	1,414,187.19	2.98%	1.73	3	1.23%	15
Chile	8,177.40	301,025.25	2.72%	1.39	4	1.73%	8
Greece	5,613.00	219,065.87	2.56%	1.2	5	0.96%	22
Slovak Republic	2,612.00	115,468.80	2.26%	0.82	6	2.22%	3
Latvia	909	41,153.91	2.21%	0.75	7	1.08%	20
Hungary	3,931.00	178,788.57	2.20%	0.73	8	1.20%	16
Costa Rica	1,459.30	68,380.84	2.13%	0.65	9	N/A	N/A
Portugal	5,279.00	251,945.38	2.10%	0.6	10	1.17%	17
Czech Republic	5,814.00	290,923.53	2.00%	0.48	11	2.18%	4
Lithuania	1,350.00	70,334.30	1.92%	0.38	12	0.73%	24
Poland	13,117.00	688,176.61	1.91%	0.36	13	1.76%	7
Slovenia	1,024.00	62,117.77	1.65%	0.03	14	1.10%	19
Austria	7,438.00	471,400.07	1.58%	-0.06	15	2.28%	2
Spain	21,989.00	1,397,509.27	1.57%	-0.06	16	0.50%	27
New Zealand	3,705.00	247,234.05	1.50%	-0.16	17	1.55%	12
Belgium	8,408.00	578,604.10	1.45%	-0.22	18	2.63%	1
Italy	28,945.00	2,010,431.60	1.44%	-0.23	19	0.43%	29
Korea	22,544.60	1,665,245.54	1.35%	-0.34	20	0.90%	23
Estonia	509	38,100.81	1.34%	-0.37	21	0.15%	30
Germany	53,322.00	4,072,191.74	1.31%	-0.4	22	0.49%	28
France	36,370.00	2,782,905.33	1.31%	-0.4	23	0.59%	26

Finland	3,370.00	280,825.96	1.20%	-0.54	24	1.62%	10
Denmark	4,744.00	395,403.91	1.20%	-0.54	25	-0.24%	33
Israel	5,976.00	522,033.45	1.14%	-0.61	26	1.54%	13
United States	265,224.50	25,462,700.00	1.04%	-0.74	27	1.40%	14
United Kingdom	31,002.00	3,070,667.73	1.01%	-0.78	28	0.09%	31
Japan	41,669.00	4,231,141.20	0.98%	-0.81	29	-1.31%	35
Netherlands	9,304.00	991,114.64	0.94%	-0.87	30	0.70%	25
Iceland	225	27,841.65	0.81%	-1.04	31	1.13%	18
Sweden	4,460.00	585,939.17	0.76%	-1.1	32	-1.20%	34
Switzerland	6,096.00	807,706.04	0.75%	-1.11	33	-0.02%	32
Ireland	3,210.00	529,244.87	0.61%	-1.3	34	1.67%	9
Luxembourg	498	82,274.81	0.61%	-1.3	35	1.59%	11
Norway	3,247.00	579,267.37	0.56%	-1.35	36	1.80%	6
		Average =	1.62%				
		Stand. Dev. Pop. =	0.78%				

Figure 2 gathers the 9 least efficient countries among 36 OECD countries based on the 2020 ratio of efficiency in municipal solid waste management ranked from (1) the least efficient country to (36) the most efficient country.

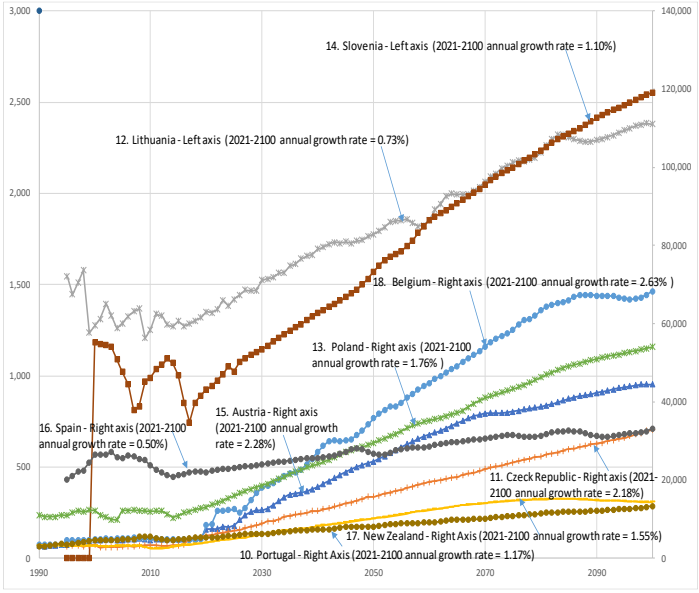
Figure 2. 2100 projections of annual amount of municipal solid waste of OECD countries ranked from 1 to 9 in Table 1 (last column)



Among 8 countries of Figure 2 (8 countries instead of 9, Costa Rica projections were not obtained due to limited historical data), the Slovak Republic will have the most difficulty controlling the generation of municipal solid waste (2021-2100 annual growth rate of +2.22%) and Greece will be best able to control municipal solid waste generation (2021-2100 annual growth rate of +0.96%).

Figure 3 gathers the 9 countries among 36 OECD countries ranked from 10 to 18 based on the 2020 ratio of efficiency in municipal solid waste management ranked from (1) the least efficient country to (36) the most efficient country.

Figure 3. 2100 projections of annual amount of municipal solid waste of OECD countries ranked from 10 to 18 in Table 1 (last column)



Among 35 countries under study (35 countries instead of 36, Costa Rica projections were not obtained due to limited historical data), Belgium will have the most difficulty controlling the generation of municipal solid waste, with a 2021-2100 annual growth rate of +2.63% of its amount of municipal solid waste. Among the 9 countries of Figure 3, Spain will be best able to control municipal solid waste generation (2021-2100 annual growth rate of +0.50%).

Figure 4 gathers the 9 countries among 36 OECD countries ranked from 19 to 27 based on the 2020 ratio of efficiency in municipal solid waste management ranked from (1) the least efficient country to (36) the most efficient country.

Figure 4. 2100 projections of annual amount of municipal solid waste of OECD countries ranked from 19 to 27 in Table 1 (last column)

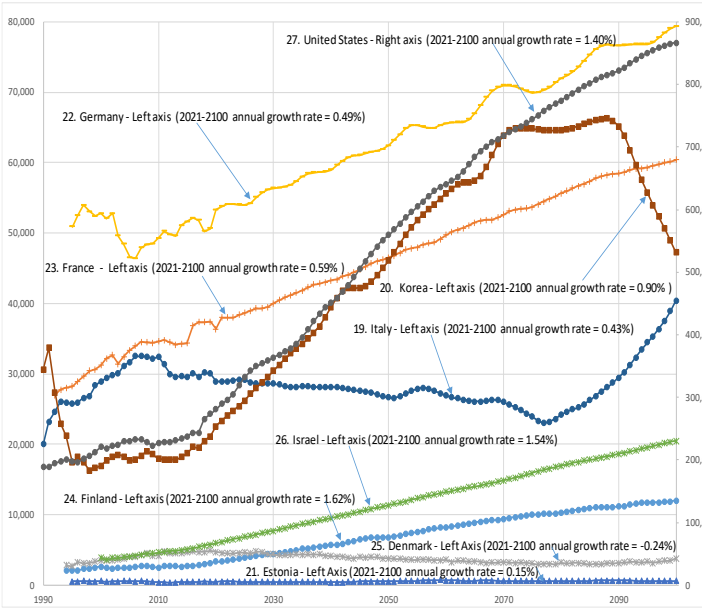
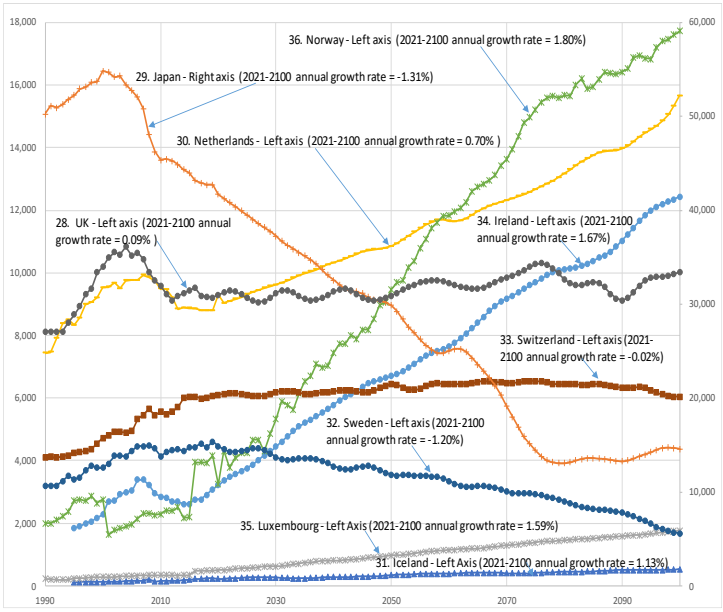


Figure 5. 2100 projections of annual amount of municipal solid waste of OECD countries ranked from 28 to 36 in Table 1 (last column)



Among the 9 countries of Figure 4, Finland will have the most difficulty controlling the generation of municipal solid waste (2021-2100 annual growth rate of +1.62%) and Denmark will be best able to control municipal solid waste generation (2021-2100 annual growth rate of -0.24%).

Figure 5 gathers the 8 countries among 36 OECD countries ranked from 28 to 36, identified as the best countries in terms of management of municipal solid waste based on the 2020 ratio of efficiency in municipal solid waste management ranked from (1) the least efficient country to (36) the most efficient country.

Among 35 countries under study (35 countries instead of 36, Costa Rica projections were not obtained due to limited historical data), Japan will be best able to control municipal solid waste generation with a 2021-2100 annual growth rate of -1.31% of its amount of municipal solid waste. Among the 9 countries of Figure 5, Norway will have the most difficulty controlling the generation of municipal solid waste (2021-2100 annual growth rate of +1.80%).

5. Conclusion

This paper measures the current and future efficiency of OECD countries in municipal solid waste management. Current efficiency was measured from 2020 historical data for 36 OECD Countries excluding Australia, and Canada for lack of data. Future efficiency was measured from 2021-2100 municipal solid waste projections for 35 OECD Countries excluding Australia, Canada and Costa Rica for lack of data. 2021-2100 municipal solid waste projections are obtained by forecasting historical data of annual amounts of municipal solid waste with wavelet analysis. Time series of annual amounts of municipal solid waste are collected by the OECD (2023b). Wavelet analysis uncovers municipal solid waste time series by transforming them into simplified time series after decomposition, extrapolating the information embedded in these simplified series and reconstructing the predicted time series.

To measure the current efficiency of OECD countries in municipal solid waste management, a 2020 ratio of efficiency is obtained by dividing 2020 municipal solid waste (in Tons, Thousands) by 2022 GDP (current US$) in millions USD, then normalized it for the 36 countries (including Costa Rica). The correlation coefficient between municipal solid waste and GDP over 36 countries is 98.90%, which suggests that the greater the production of goods and services, the greater the municipal solid waste generation. This high correlation coefficient intuitively explains the rationale for using the ratio as an indicator of current efficiency. OECD countries are ranked with their 2020 ratio of efficiency in municipal solid waste management from (1) least efficient country to (36) most efficient country. With

the highest normalized ratio of +2.80, Turkey was the least efficient manager in municipal solid waste in 2020, followed by Colombia, Mexico, Chile and Greece. Norway was the most efficient manager in municipal solid waste with the lowest normalized ratio of -1.35, followed by Luxembourg, Ireland, Switzerland and Sweden.

To measure the future efficiency of OECD countries, 35 OECD countries are ranked with their Annual Growth Rate of 2021-2100 projections of the amount of municipal solid waste from (1) highest growth of the amount of municipal solid waste (least efficient) to (35) lowest growth of the amount of municipal solid waste (most efficient). Out of 36 countries, Costa Rica was dropped from the list since Costa Rica projections were not obtained due to limited historical data. With the highest annual growth rate of 2.63% of its 2021-2100 projections of the amount of municipal solid waste out of 35 OECD countries, Belgium will have the most difficulty controlling the generation of municipal solid waste, followed by Austria, the Slovak Republic, the Czech Republic and Colombia. With the lowest annual growth rate of -1.31%, Japan will be best able to control municipal solid waste generation, followed by Sweden, Denmark, Switzerland and the UK. Switzerland and Sweden, appearing twice in the list of best-performing OECD countries in terms of current and future efficiency in the way they manage municipal solid waste, should serve as models for other countries to improve their management of municipal solid waste.

Further research could focus on identifying the secret recipes of countries like Switzerland, Sweden or Japan in their efficient management of municipal solid waste and how to implement these recipes in countries that lack efficiency.

Data availability statement: The data that support the findings of this study are openly available on OECD website at https://stats.oecd.org/index.aspx?DataSetCode=MUNW, [Time series of Municipal waste generated in Tonnes, Thousands], on the World Bank website at https://data.worldbank.org/indicator/NY.GDP.MKTP.CD [GDP (current US$), 2022 estimates], on Wikipedia website at https://en.wikipedia.org/wiki/List_of_countries_and_dependencies_by_population [Sovereign states and dependencies by population, 2022 or 2023 estimates] and on Wikipedia website at https://en.wikipedia.org/wiki/List_of_countries_and_dependencies_by_area [Countries and dependencies by area]

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RESP

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Araştırma Makalesi ● Research Article

Yeşil ve Döngüsel Ekonomide Düzgün Olmayan İşler: Türkiye'de Atık Toplama ve Geri Kazanım Faaliyetlerinden Bulgular

Non-Decent Jobs in the Green and Circular Economy: Findings from Waste Collection and Recovery Activities in Turkiye

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ANAHTAR KELİMELER

Geri dönüşüm
Sürdürülebilir ekonomik kalkınma
Yeşil iş
Düzgün iş

ÖZ

Bu çalışma, yeşil ve döngüsel ekonomi modeline önemli rolleri olan atık toplama ve geri kazanım faaliyetlerindeki çalışma koşullarına odaklanmaktadır. Bu açıdan mevcut çalışma Türkiye Hanehalkı İşgücü Anketi'nden elde edilen mikro verilere lojistik regresyon modellemesini uygulayarak, demografik ve işle ilgili bağlamlar açısından atık toplama ve geri kazanım faaliyetlerindeki işlerin yeşil iş konseptiyle uyumlu düzgün işler olup olmadığını araştırmayı amaçlamaktadır. Ampirik analiz atık toplama ve geri kazanım faaliyetlerinin istihdamda cinsiyet eşitsizliği, güvenli çalışma ortamı ve sosyal güvenceden yoksunluk, sendikal örgütlenmedeki zorluklar, çalışan yoksulluğu, kaçak göçmen, mülteci ve çocuk işçi çalıştırma ile karakterize edildiği sonucuna ulaşmıştır.

KEYWORDS

Recycling
Sustainable economic development
Green job
Decent job

ABSTRACT

This study focuses on working conditions in waste collection and recovery activities which have important roles in the green and circular economy model. In this respect, the present study aims to investigate whether jobs in waste collection and recovery activities are decent jobs in line with the green jobs concept in terms of demographic and work-related contexts, by applying the logistic regression modelling to microdata obtained from the Turkish Household Labour Force Survey. The empirical analysis concludes that employment in waste collection and recovery activities is characterised by gender inequality, lack of safe working environment and social security, difficulties in unionisation, employee poverty, illegal migrant, refugee and child labour.

1. Giriş

Yeryüzünde insanlar bazı tahminlere göre, yaklaşık 300 bin yıldır büyük ölçüde doğal kaynaklara ve ekosistemlere bağımlı olarak yaşamaktadır. İnsanlığın dünyada bu denli uzun süre varlığını devam ettirmiş olması, önemli ölçüde doğa ile uyumlu sürdürülebilir bir yaşam sürmesi ile yakından ilişkilidir. Ancak sanayileşme ile birlikte, insanların değişen yaşam tarzlarını devam ettirebilmek için doğayı kontrol etme hızı da artırmıştır. Sanayileşme aynı zamanda Şekil 1'de gösterildiği gibi "Al-Yap-Kullan-At" (take-make-use-dispose) kültürünün vurgulandığı bir "doğrusal ekonomi" yaratmıştır. Ancak son yüz yılda hızla artan ve kentlileşen insan nüfusunun gezegenin sınırlı kaynaklarını aşırı derecede tüketmesi ve ekosistemleri kirletmesi, olağan dışı hava koşullarına ve deniz seviyelerinin yükselmesine yol açmıştır (Patil vd., 2020).

Özellikle, 2. Dünya Savaşı'ndan sonra küresel ekonomi benzeri görülmemiş bir büyüme göstermesine rağmen, kirlilik kontrolü ve atık yönetimi ile ilgili ciddi endişeler ortaya çıkmış ve son 30-40 yılda küresel tüketim oranı 8 kat artmıştır. Bu süreçte dünyanın kaynak kullanımının 2050 yılına kadar üç kat daha artması ve bu artışın büyük kısmının da gelişmekte olan ekonomilerde gerçekleşmesi beklenmektedir (Lamba vd., 2023). Ancak, al-yap-kullan-at

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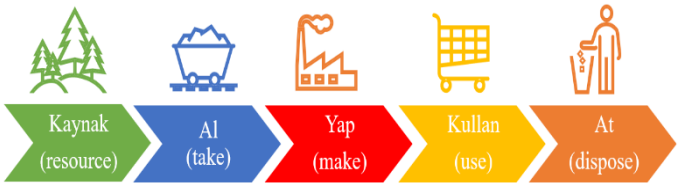
modeli olarak bilinen mevcut ekonomik ve endüstriyel model, doğal kaynağın kullanımından sonra sonsuza kadar kaybolduğu, paranın ve kaynağın mutlak israfına yol açan doğrusal bir modeldir. Bununla birlikte, bu ekonomik etkiye ilave olarak, atık ürünlerin bertarafı sırasında çevre üzerinde büyük bir baskı da oluşmaktadır (Upadhyay vd.,2022). Ayrıca doğrusal ekonomi ile sağlanan bu büyüme, ekonomik kalkınma için çevre ve kaynaklar pahasına olup, kaçınılmaz olarak ekolojik kirlilik başta olmak üzere, biyo-çeşitliliğin kaybı ve doğal kaynakların hızla tüketilmesine yol açacak ve eninde sonunda ekonomik büyümeyi de ciddi bir biçimde tehdit edecektir (Liu, 2009).



Şekil 1: Doğrusal ekonomi modeli

Diğer taraftan çevresel sorunlardaki artış bir taraftan dünyanın yaşam destek sistemlerini tehlikeye atarken, diğer taraftan işsizlik, kötü çalışma koşulları, sosyal kırılganlık, yoksulluk, toplumsal eşitsizliklerdeki atışlar nedeniyle toplumsal beklentiler karşılanamaz hale gelmiştir. Bununla birlikte arz riski, sorunlu sahiplik yapıları, iyi işlemeyen serbest piyasalar ve kusurlu teşvik yapıları gibi ekonomik zorluklar, şirketler ve tüm ekonomiler için finansal ve ekonomik istikrarsızlıkları artırmaktadır (Geissdoerfer vd. 2017). Sonuç olarak seller, sıcak hava dalgaları ve yağış seviyelerindeki düşüşler gibi iklim değişikliğinden kaynaklanan olumsuz doğa olaylarındaki artışın genel ekonomiyi de negatif etkilemesi beklenmektedir. Bu bağlamda, iklim değişikliği, iklim koşullarına doğrudan bağlı olan altyapı ve enerji, turizm, sigortacılık, tarım, ormancılık ve balıkçılık sektörlerine karşı oldukça hassas sektörleri doğrudan etkileyecektir (Martinez-Fernandez vd., 2010). Bu açıdan gelecek yıllarda insanların yaşam standartlarının korunabilmesi, sürdürülebilir ekonomik kalkınma, doğal kaynakların ve ekonomik faaliyetlerin nasıl yönetileceğine ve restore edileceğine bağlı olacaktır. Ancak iklim değişikliği ve doğrusal ekonominin yol açtığı aşırı tüketim ve çevresel kirlilik ile başa çıkmak için gerekli önlemler zamanında alınmazsa, gelecek nesillerin yaşam standardı ve insani gelişme beklentileri eninde sonunda düşecektir (ILO ve OECD, 2012). Bütün bunlar aşırı tüketim ve ekolojik kirliliğe yol açan mevcut sürdürülemez doğrusal ekonomiden daha sürdürülebilir bir "döngüsel ekonomiye" geçişi gerekli kılmaktadır.

Döngüsel malzeme akışları kavramının köklerini 1960'lara kadar götürmek mümkündür. Bu kavram ilk kez, Boulding'in (1966) "The Economics of the Coming Spaceship Earth" adlı kitabında önerilmiştir. Boulding, dünyadaki insan yaşamını uzun vadede garanti altına almak için küresel ekonomideki döngüsel sistemlerin kaçınılmaz olduğunu ileri sürmüştür (Geisendorf ve Pietrulla, 2018). 1970'lerde ABD ve Avrupa'da çevre hareketleri ilgi görmeye başlamış ve döngüsel ekonomiye yönelik Avrupa'da ilk adım 1972 yılında atık bertaraf yasasının kabul edildiği Almanya'da atılmıştır. Daha sonra 1996'da "Kapalı Madde Döngüsü ve Atık Yönetimi Yasası"nı kabul eden Almanya, döngüsel ekonominin ulusal yasalara entegre edilmesinde yine öncü olmuştur (Geissdoerfer vd. 2017; Geisendorf ve Pietrulla, 2018).

Genel olarak, Boulding'in fikirlerine dayanan "döngüsel ekonomi" kavramı ilk kez 2 ünlü İngiliz çevre ekonomisti R. Kerry Turner ve David W. Pearce (1989) tarafından ortaya atılmış ve toksik maddelerin kullanımının ortadan kaldırılması, yenilenebilir enerji kullanımı ve yenileme yoluyla "ömrünü tamamlamış ürün" kavramı yerini "döngüsel ekonomiye" bırakmıştır (Upadhyay vd., 2022). 1990'lara gelindiğinde, küreselleşen sürdürülebilir kalkınmayla birlikte, gelişmiş ülkeler döngüsel ekonomiyi geliştirmiş ve sürdürülebilir kalkınma için önemli bir yol olarak döngüsel ekonomi odaklı bir toplumsal yapı inşa etmeye çalışmıştır. Neticede, 1960'lardan bu yana insanlar doğal ekolojik sistemi taklit etme arzusu ile doğal ekosistemin malzeme geri dönüşümü ve enerji akışı yasasına uygun olarak, ekonomik sistemi yeniden yapılandırmakta, malzeme döngüsü sürecini doğal ekosistemlere uyumlu bir şekilde entegre etmekte ve döngüsel ekonomiye geçmektedir (Liu, 2009).

Döngüsel ekonomideki gelişmeler akademik olarak da yakından takip edilmiş ve döngüsel ekonomiyle ilgili önemli ölçüde bir literatür birikmiştir. Bu literatür, yoğunluklu olarak döngüsel ekonominin sürdürülebilirlik ile ilişkisi, ekonomi, çevre ve toplum üzerindeki etkisinin analiz edilmesinin yanı sıra, tüketicilerinin farkındalığının artırılması ve döngüsel yenilikçi iş modellerinin ve bunları destekleyecek hükümet politikalarının geliştirilmesi ve teşvik edilmesini içermektedir. Ayrıca döngüsel ekonomiyi bir kavram olarak inceleyen çok sayıda çalışma bulunmaktadır. Örneğin, Ellen MacArthur Vakfı (2013), mavi ekonomi, performans ekonomisi, rejeneratif tasarım, beşikten beşiğe ve biyomimikri gibi daha çağdaş teorilerin döngüsel ekonomi fikrinin sonraki evriminde önemli ilerlemeler sağladığını belirtmektedir. Bu anlamda döngüsel ekonomi aynı zamanda diğer araştırma akımları için de doğal bir çıkış noktası sağlamaktadır. Bunlar arasında endüstriyel ekosistemler ve endüstriyel simbiyozlar, ürün-hizmet sistemleri, beşikten beşiğe tasarım, temiz üretim, performans ekonomisi, eko-verimlilik, doğal kapitalizm, sıfır emisyon, sosyal-ekolojik sistemlerin biyomimikri dayanıklılığı kavramları ve diğerleri yer almaktadır (Korhonen vd. 2018). Öte yandan döngüsel ekonomi ile ilgili çalışmaların çoğu Çin'deki döngüsel ekonomi uygulamalarını ele almaktadır. Bu açıdan hızlı ekonomik büyümesini doğa ve çevresel sermayesi pahasına gerçekleştiren Çin, sürdürülebilir kalkınma için döngüsel ekonomiyi ulusal bir politika olarak seçmiştir (Geng vd. 2012; Ghisellini vd. (2016). Bu bağlamda son yıllarda Çin, çeşitli düzenlemeler ile yeşil muhasebeyi, yeşil teknolojiyi

ve yeşil tüketimi geliştirerek ekonomik, sosyal ve ekolojik sürdürülebilirliği teşvik etmek için döngüsel ekonomiyi aktif olarak geliştirmektedir (Liu, 2009). Diğer taraftan Kirchherr ve arkadaşları (2017) ise, 114 döngüsel ekonomi çalışmasını analiz etmiş ve döngüsel ekonominin ağırlıklı olarak azaltma, yeniden kullanma, geri dönüştürme ve geri kazanım faaliyetlerinin bir kombinasyonu olduğunu ileri sürmüşlerdir. Ruiz-Real vd. (2018), "eko-tasarım, atık yönetimi ve eko-inovasyon"u döngüsel ekonomi ve çevrenin korunması konusunda ortaya çıkan üç araştırma odağı olarak belirlemişlerdir.

Döngüsel ekonomi yaklaşımında dünya, ekonomi ve çevrenin yan yana var olduğu, sınırlı kaynaklara sahip döngüsel ve kapalı bir sistem olarak tasvir edilmektedir. Bu açıdan döngüsel ekonomi, bir ekonomik sistem içerisinde döngüyü kapatan üretim modellerinin benimsenmesini teşvik ederek, ekonomi, çevre ve toplum arasında daha iyi bir denge ve uyum sağlamak için kentsel ve endüstriyel atıklara özel olarak odaklanarak, kaynak kullanımının verimliliğini artırmayı amaçlamaktadır (Ghisellini vd. 2016; Hysa vd. 2020). Modern atık yönetimi uygulamaları sadece atıkların işlenmesine değil, aynı zamanda yararlı maddelere dönüştürülmesine de önem vermektedir. Böylece çevreye duyarlı tüketiciler perakendecilerden daha temiz ürünler talep edebilir ve bu da hizmet sağlayıcılar ile çevre koruma arasındaki ilişkiyi simbiyotik hale getirebilir (Tulebayeva vd., 2020). Ayrıca bu simbiyotik ilişki ile bir işletmenin atığı başka bir işletmenin hammaddesi olarak geri dönüştürülebilir ya da yeniden kazandırılabilir.

Döngüsel ekonominin çevre ve ekonomik kalkınma boyutuyla ilgili önemli sayıda çalışma yapılmasına rağmen, döngüsel ekonominin sosyal açıdan işgücü ve istihdam koşullarının ampirik olarak yeterince incelenmediği fark edilmiştir. Aslında sosyal boyutu eksik olan bir ekonomik dönüşüm sürecinin başarılı olması pek mümkün değildir. Diğer taraftan Avrupa Çevre Ajansı'na (2015) göre, yeşil ekonomi yaklaşımı döngüsel ekonomiyi de kapsayan genel bir şemsiye oluşturmaktadır. Bu bağlamda Uluslararası Çalışma Örgütü (ILO) gelişen yeşil ekonomik sektörlerde yaratılan yeşil işlerin güvenli çalışma ortamı, sosyal güvence ve yeterli ücret sunan uluslararası çalışan haklarına saygılı düzgün işler sunması gerektiğinin altını kalın çizgilerle çizmektedir. Bu açıdan Türkiye'de yeşil ve döngüsel ekonomiye geçiş çalışmalarının hız kazandığı son yıllarda, atık toplama ve geri kazanım (ATGK) faaliyetlerindeki istihdam koşullarının incelenmesi ve işgücü sorunlarının tespit edilerek döngüsel ekonomiye geçiş sürecine sosyal bir boyut kazandırılması ile geleceğe yönelik istihdam politikalarının ve planların yapılması ve işgücü piyasası hedeflerinin belirlenmesi son derece önemlidir. Bu amaca yönelik bu çalışma, sürdürülebilir ekonomik kalkınma ve çevresel kirliliğin azaltılması ile karakterize edilen döngüsel ekonomi modelinde önemli rolleri olan ATGK faaliyetlerinde ILO'nun düzgün iş koşullarının sağlanıp sağlanmadığına odaklanmaktadır. Bu anlamda çalışmanın metodolojisi temelde, Türkiye özelinde ATGK faaliyetlerinin demografik ve işle ilgili bağlamlar arasındaki ilişkisini analiz etmek için Türkiye İstatistik Kurumu'ndan (TÜİK) alınan 2021 yıllarına ait Türkiye Hanehalkı İşgücü Anket verilerine (THİA) lojistik regresyon modelleme tekniğinin uygulanmasına dayanmaktadır.

Çalışmanın geri kalan kısmı altı ana bölümden oluşmaktadır. İlk olarak, döngüsel ekonomin temel dinamikleriyle ilgili bir inceleme yapıldıktan sonra, döngüsel ekonominin sürdürebilirlik ve yeşil ekonomi ile ilişkisi ve temel bağlantı noktaları değerlendirilecektir. Ardından Türkiye'de yeşil ve döngüsel ekonomiye geçişle ilgili yürütülen çalışmalar ele alınacaktır. Çalışmanın yöntem bölümü veri ve değişkenlerin tanımlanması ile araştırma sonuçlarının analiz edilmesine dayanmaktadır. Son olarak, tartışma ve sonuç bölümünde, elde edilen bulgular ILO'nun düzgün iş konsepti çerçevesinde tartışılacaktır.

2. Döngüsel Ekonomi Modeli

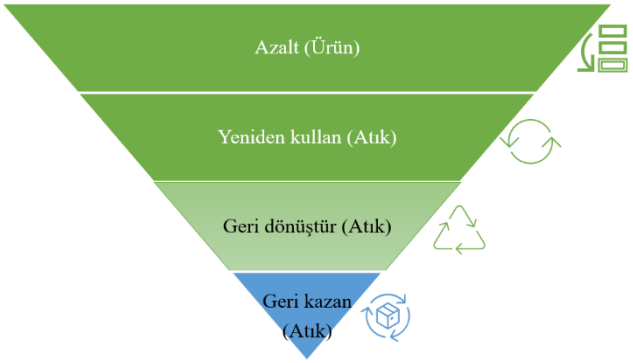
Döngüsel ekonomi, malzeme ve enerjinin geri dönüşümünü sağlamak için temiz üretim ve enerji kaynaklarının kapsamlı kullanımı, ekolojik tasarım ve sürdürülebilir tüketim ve benzerlerini entegre ederek, sosyo-ekonomik faaliyetleri yönlendirmek için esas olarak biyomimikriyi kullanmaktadır (Liu, 2009). Döngüsel ekonominin odak noktası, Şekil 2'de gösterildiği gibi, atık ürünlerin kullanılabilir ürünlere dönüştürülebilmesi için bir "Geri dönüştür-Yeniden yap-Yeniden kullan" endüstrisi kurmaktır (Upadhyay vd.,2022). Yani döngüsel ekonomi, malzeme ömrünün sonuna gelindiğinde yeniden dönüştürülerek değer yaratmayı temel alan bir ekonomik kalkınma modelidir. Özü itibariyle, çevre ve ekonomik kalkınma arasındaki çelişkileri ve çatışmaları temelden ortadan kaldırarak, ekonomi ve çevre arasındaki sürdürülebilir kalkınmanın mükemmel bir uygulaması olan atık kullanımı ve çevrenin korunması işlevlerini gerçekleştirmesi beklenmektedir (Liu, 2009). Bu açıdan döngüsel ekonomi, yenilenebilir ve kademeli enerji akışları ve malzeme döngüleri ile doğrusal ekonomik sistemlerin üretim-tüketim yapılarını değiştirmeyi amaçlayan sürdürülebilir bir kalkınma modelidir (Korhonen vd., 2018). Bu anlamda, döngüsel ekonomi çevrenin temel rolünün yanı sıra, işlevlerini ve çevre ile ekonomik sistem arasındaki karşılıklı etkileşimi kabul ettiği için kendisini hem teorik hem de pratik açıdan neoklasik ekonomiye alternatif bir model olarak sunmaktadır (Hysa vd. 2020). Bu açıdan, döngüsel ekonomi özünde tasarımı itibariyle onarıcı olan bir endüstriyel sistem kurmayı önermektedir. Bu modelin nihai hedefi, çevreyi etkilemeden ekonomik büyümeyi sağlamaktır. Yani, üretimde çevreye verilen zararı azaltırken, işletmenin performansını ve verimliliğini artırmayı amaçlamaktadır (Lamba vd., 2023).

Döngüsel ekonomi aynı zamanda kaynakların yeniden kullanımını sağlayarak ve atık ürünlerin çevrede ayrışmasını azaltarak, sosyo-ekonomik ve çevresel mükemmelliği de sağlamaktadır (Upadhyay vd.,2022). Bununla birlikte

toplumun al-yap-kullan-at ekonomik davranışından "dönüştür, yeniden yap, yeniden kullan" davranışına geçmesi, sadece ekonomik sürdürülebilirliği değil, aynı zamanda çevresel ve sosyal yaşamın sürdürülebilirliğini de hedeflemektedir. Yani döngüsel ekonomi, kökten yeni modelleri anlama ve uygulamanın yanı sıra, toplumun malzeme, enerji ve çevresel maliyetlerini düşük veya hiç maliyete katlanmaksızın daha fazla sürdürülebilirlik ve refaha ulaşılmasına yardımcı olma potansiyeline sahiptir (Ghisellini vd. 2016). Bu açıdan sürdürülebilir kaynak yönetimi, toplumsal davranış değişikliği ve yeni iş operasyon modelleri yoluyla başarılabilir. Bu nedenle döngüsel ekonomiye geçiş, toplumun tüm aktörlerinin katılımı ve bu aktörlerin sürdürülebilir işbirliği ve değişim modelleri oluşturma ve birbiri ile bağlantı kurma kapasitelerinin geliştirilmesini gerektirmektedir (Ghisellini vd. 2016; Hysa vd. 2020). Bu yüzden döngüsel ekonomi, geleneksel geri dönüşümü ve yüksek katma değerli malzeme döngülerini teşvik etmenin yanı sıra, sürdürülebilir kalkınma çalışmalarında üreticilerin, tüketicilerin ve diğer toplumsal aktörlerin işbirliğine yönelik sistem yaklaşımları geliştirmelidir (Korhonen vd. 2018).

Şekil 2: Döngüsel ekonomi modeli

Döngüsel ekonomi kavramı esas olarak "3R davranış kodu çerçevesi" olarak bilinen Reduce (azalt), Reuse (yeniden kullan), Recyle (geri dönüştür) ile popülerlik kazanmıştır (Lamba vd., 2023). Dünyanın en önemli sorunları olarak kabul edilen "3P"ye, yani Pollution (Kirlilik), Population (Nüfus) ve Poverty'ye (Yoksulluk) karşı, önlem olarak döngüsel ekonominin 3R'si önerilmiştir (Yılmaz, 2019). 3R davranış kodu çerçevesine Avrupa Birliği (AB) Atık Çerçeve Direktifi'nde (2008) dördüncü R olarak 'Geri kazandır'ın da ilave edilmesi ile Şekil 3'te gösterildiği gibi, 4R'ye dönüşmüştür. Daha sonra bu 4R bazı araştırmacılar tarafından 6R'ye, hatta 9R'ye kadar çıkarılmıştır. Bu açıdan Kirchherr ve arkadaşları (2017) döngüsel ekonomiyi, üretim/dağıtım ve tüketim süreçlerinde malzemelerin kullanımının azaltılması, alternatif olarak yeniden kullanılması, geri dönüştürülmesi ve geri kazanılmasından oluşan 4R ile "ömrünü tamamlamış ürün" kavramının yerini alan iş modellerine dayanan bir ekonomik sistem olarak tanımlamaktadır. Böylece döngüsel ekonomi mikro düzeyde (ürünler, şirketler, tüketiciler), mezo düzeyde (eko-endüstriyel parklar) ve makro düzeyde (şehir, bölge, ulus ve ötesi), mevcut ve gelecek nesillerin yararına çevresel kalite, ekonomik refah ve sosyal eşitlik yaratmayı hedefleyen sürdürülebilir kalkınmayı gerçekleştirmek amacıyla faaliyet göstermektedir (Kirchherr vd. 2017).



Şekil 3: Döngüsel ekonomi modelinin 4R davranış kodu çerçevesi

Döngüsel ekonomi modeli, Şekil 3'te gösterilen 4R çerçevesini sosyo-ekonomik faaliyetlerin davranış kodu haline getirmeyi hedeflemektedir (Liu, 2009). R davranış kodu çerçevesi bir hiyerarşi içinde hareket etmektedir. Örneğin, ilk R (azalt) ikinci R'ye (yeniden kullan) göre, daha öncelikli olarak görülmektedir ve diğerleri içinde de bu böyle devam etmektedir.

Döngüsel ekonomi modelinde 4R davranış kodu çerçevesinde, ilk R yani "azalt", üretimde ve tüketimde daha az hammadde ve enerji girdisi kullanmayı yani eko-verimlilik çabalarını göstermektedir. Eko-verimlilik aynı zamanda çevresel kirlenmeyi azaltırken, yeni bir değer yaratmayı amaçlayan bir iş çerçevesi olarak anlaşılmaktadır. Ayrıca ekonomik faaliyetlerin daha başında tasarruf etmek kaynak kullanımı ve çevresel kirliliği de azaltmaktadır (Liu, 2009; Ghisellini vd., 2016).

İkinci R, "yeniden kullan", döngüsel bir "sökme ve yeniden kullanma" dizisi için ürünlerin ve iş modellerinin daha iyi tasarlanması anlamına da gelmektedir (Ghisellini vd., 2016). Ayrıca yeniden kullanım, ürünlerin ve ambalajların tekrar tekrar kullanılmasını gerektirir (Liu, 2009). Böylece yeniden kullanım, kaynakların dikkatli bir şekilde değerlendirilmesiyle israfın azaltılmasını da sağlamaktadır (Patil vd., 2020).

Üçüncü R, "geri dönüştür", organik maddelerin yeniden işlenmesi de dahil, atık malzemelerin orijinal veya başka amaçlar için ürün, malzeme veya hammadde olarak yeniden işlendiği herhangi bir geri dönüşüm işlemini ifade etmektedir (Ghisellini vd., 2016).

4R çerçevesinin son R'si 'geri kazandır'; malzeme, su ve enerji atıklarını doğaya salınması veya israf edilmesi yerine, yeniden kullanılması, geri dönüştürülmesi veya yeniden kullanılacak değerli kaynaklar olarak değerlendirilmesidir. Bir ürün yaşam döngüsünün sonuna ulaştığında, gömülü

malzemelerin veya enerjinin üretim döngüsüne geri döndürülmesi kritik bir öneme sahiptir. Bir şeyi kaynaklarına geri dönüştürmek çok zor olduğunda veya bu kaynaklara artık ihtiyaç duyulmadığında (örneğin zehirli oldukları düşünüldüğünde ve daha güvenli alternatifler tercih edildiğinde), çoğu atık yakma veya diğer (biyo-)kimyasal işlemlerle enerjiye dönüştürülebilir. Bu beşikten beşiğe yaklaşımı, kaynaktan kullanıma ve tekrar kaynağa kadar olan döngüyü kapatmayı amaçlamaktadır. Genel olarak bu yaklaşımlar, döngüsel ekonomideki en verimli seçenek olmasa da kesinlikle bir çöp sahasını doldurmaktan daha iyi bir alternatiftir. Dolayısıyla geri kazanım, sürdürülebilir ve döngüsel bir ekonomiye ulaşmanın önemli parçalarından birini oluşturmaktadır (Shiraz, 2023).

2.1. Döngüsel ekonomi ve sürdürülebilirlik ilişkisi

Döngüsel ekonomi genellikle sürdürülebilir bir kalkınma ve sağlıklı bir toplum için yeni bir iş modeli olarak yorumlandığı için bu ekonomik yaklaşım, sürdürülebilir kalkınmanın sosyal veya ekonomik sürdürülebilirlik gibi yönlerini de içermektedir (Ghisellini vd., 2016). Uluslararası Standartlar Örgütü "sürdürülebilir kalkınmayı", çevresel, sosyal ve ekonomik alt sistemleri içeren, gelecek nesillerin kendi ihtiyaçlarını karşılama kabiliyetine zarar vermeden bugünün ihtiyaçlarının karşılandığı küresel bir sistem olarak tanımlamaktadır (Patil vd., 2020). Bu çerçevede 2015 yılında Birleşmiş Milletler'e (BM) üye 193 ülke, 2030 yılına kadar herkesin uyum ve refah içinde yaşamasını sağlarken, gezegeni korumak için Birleşmiş Milletler Çevre Programı (UNEP) tarafından önerilen 17 Sürdürülebilir Kalkınma Hedefini kabul etmiştir (Lamba vd., 2023). BM Sürdürülebilir Kalkınma hedeflerinin döngüsel ekonomi ve sürdürülebilirliğin birbiriyle bağlantılı olduğu ve birbirini beslediği açıkça görülmektedir. Bu açıdan döngüsel ekonomi sadece maddi kaynakların yeniden kullanımı ve geri dönüşümü ile sınırlı değildir (Patil vd., 2020), aynı zamanda döngüsel ekonominin bir diğer odak noktasını sistemi uygulayan ekonomik aktörler oluşturmaktadır. Sürdürülebilirlik çevreye, ekonomiye ve genel olarak topluma fayda sağlamayı hedeflerken, döngüsel ekonomi modelinde çevrenin daha az kaynak tüketimi ve kirlilikten kurtulması, toplumun ise çevresel iyileştirmelerden ve daha fazla iş veya daha adil vergilendirme gibi belirli eklentilerden yararlanması öngörülmektedir (Geissdoerfer vd. 2017; Hysa vd. 2020).

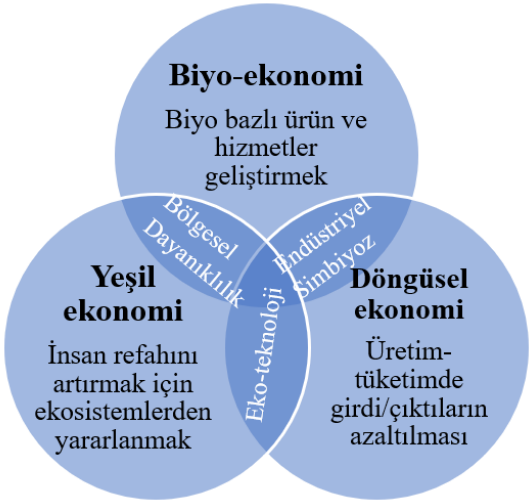
2.2. Döngüsel ekonomi ve yeşil ekonomi yaklaşımları

Onlarca yıldır literatürde var olmasına rağmen, 2008 küresel finansal krizin ardından, doğrusal ekonomiden "yeşil ekonomiye" geçiş fikri yeniden gündeme gelmiştir. Yeşil ekonomiye geçiş düşüncesi, 2012 yılındaki RIO + 20 konferansının ardından Birleşmiş Milletler ve Ekonomik İşbirliği ve Kalkınma Örgütü, Uluslararası Para Fonu, Dünya Bankası, Dünya Ticaret Örgütü ve Dünya Sürdürülebilir Kalkınma İş Konseyi gibi uluslararası kurumların da güçlü siyasi desteği ile yeniden bir ivme kazanmıştır (D'Amato ve Korhonen, 2021). Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi kapsamında 1990'lı yıllarda başlatılan iklim değişikliği ile küresel çapta mücadele yaklaşımı, 2015 yılında daha geniş katılımlı ve kapsamlı Paris Anlaşması ile yeni bir evreye geçmiştir. Öte yandan, AB 2015 yılında Avrupa ekonomisini doğrusal ekonomi modelinden döngüsel ekonomi modeline geçirmeyi amaçlayan "Döngüsel Ekonomi Eylem Planı"nı kabul etmiştir (EC, 2015). Ardından Mart 2020'de küresel rekabet gücünün arttırılması, sürdürülebilir ekonomik büyümenin teşvik edilmesi ve yeni iş imkanlarının yaratılması amacıyla yeni bir döngüsel ekonomi eylem planını daha kabul edilmiştir. İki Eylem Planından (2015 ve 2020) oluşan bu paket, Avrupa'nın sürdürülebilir büyümeye yönelik yeni gündeminin temel yapı taşlarından biridir (The EU Swicth to Green Flagship Initiative, 2023). Daha sonra 2019 yılında kabul edilen Avrupa Yeşil Mutabakatı ile AB'nin iklim, enerji, ulaştırma ve vergilendirme politikalarını, net sera gazı emisyonlarını 2030 yılına kadar 1990 seviyelerine kıyasla en az %55 oranında azaltılması hedeflenmektedir (EC, 2019). Böylece ekonomik kalkınmanın yeşil ekonomi ile nasıl birlikte gidebileceğini anlamaya yönelik yeni bir uluslararası siyasi ilgi dalgası oluşmuştur.

Bütün bunlar yeşil büyümenin, çevreye yapılan yatırımların ekonomik büyümenin motoru haline getirilmesi anlamına gelmektedir. Aslında yeşil ekonomiye geçiş, gelir ve istihdam artışının yanı sıra, karbon emisyonlarının ve çevresel kirliliğinin azaltılması, enerji ve kaynak verimliliğinin artırılması ve biyoçeşitlilik ile ekosistemin korunması yaklaşımları döngüsel ekonomiyi desteklerken (Tulebayeva vd., 2020), döngüsel ekonomi modelinin vurguladığı biyogaz, rüzgar ve güneş enerjisi gibi yenilenebilir enerji kaynaklarının kullanımı da yeşil ekonomik dönüşümü desteklemektedir (Patil vd., 2020). Ayrıca, Avrupa Çevre Ajansı'na (2015) göre, yeşil ekonomi yaklaşımı, ekosistem direncini ve insan refahını güvence altına almak için su, enerji, arazi ve biyo-çeşitliliğin nasıl yönetilmesi gerektiğine odaklanırken, döngüsel ekonomi ise, atıkları en aza indirerek maddi kaynak akışlarını optimize etmeye çalışmaktadır. Bu açıdan yeşil ekonomi yaklaşımı, Şekil 4'te tasvir edildiği gibi, çevrenin kilit ekonomik sektörlerin politikalarına entegre edilmesi için döngüsel ekonomiyi de içine alan daha geniş bir çerçeve sunmaktadır.

Şekil 4: Bütünleştirici yeşil ekonomi çerçevesi (Kaynak: European Environment Agency, 2015)

Diğer taraftan, D'Amato ve Korhonen, (2021) Şekil 5'te gösterildiği gibi, yeşil ekonomi, döngüsel ekonomi ve biyo-ekonomi yaklaşımlarının tek başına kapsamlı bir çözüm paketi sunmadığını ileri sürmektedir. Bu açıdan yeşil ekonomi eko-sistemlerden yararlanarak, toplumsal ihtiyaçları ele alırken, toplumsal çıktılar konusunda sınırlı kalmaktadır. Döngüsel ekonomi, maddi döngülerde gömülü olan değeri mümkün olduğunca uzun süre muhafaza ederek toplumsal girdi ve çıktıları azaltmayı önermesine rağmen, doğal sermaye ve eko-sistem hizmetlerinin rolüne hala yeterince değinememektedir. Biyo-ekonomi ise, biyolojik bazlı ürün ve hizmetleri teşvik ederken, toplumsal çıktılarla ilgili konuları göz ardı etmektedir. Sosyal boyuttan hem döngüsel ekonomi hem de biyo-ekonominin bölgesel üretim-kentsel sistem akışları konusunda daha fazla farkındalığı varken, kaynak akışlarının küresel dinamiklerine ve nesil içi ve nesiller arası adalete çok az vurgu yapmaktadır. Bu yüzden yeşil ekonomi, döngüsel ekonomi ve biyo-ekonomi yaklaşımları birlikte ele alındığında, günümüzde ve gelecekte tüm insanların ekonomik ve sosyal gereksinimlerini karşılayan yeni bir küresel toplum ve ekonomi anlayışını ortaya koyabilir (D'Amato ve Korhonen, 2021).



Şekil 5: Üç sürdürülebilirlik makro kavramı arasındaki bağlantı (Kaynak: D'Amato ve Korhonen, 2021)

Her türlü eleştiriye rağmen, yeşil ekonomiye geçiş ve döngüsel ekonominin çevre ile uyumlu sürdürülebilir bir toplum ve ekonomik kalkınma modeli oluşturulması yönündeki beklentiler bir hayli yüksek gözükmektedir. Bu açıdan, bu yeni ekonomik yaklaşımların yeni ve düzgün iş fırsatları yaratması, karbon emisyonu salınımı ve çevresel kirliliğini azaltması, kaynak israfını önlemesinin yanı sıra, malzeme ve enerji verimliliğini artırması gibi beklentiler bulunmaktadır.

2.3. Yeşil iş-düzgün iş bağlamı

Son yıllarda yeşil ekonomi sektörlerinin dünyanın doğal sermayesini geliştiren ve buna katkıda bulunan veya çevresel kıtlığı ve çevresel riskleri azaltan düşük karbonlu ulaşım, temiz teknolojiler, yenilenebilir enerji, enerji verimliği yüksek binalar, iyileştirilmiş atık yönetimi ve tatlı su temini, sürdürülebilir tarım sektörlerine yapılan yatırımlarla önemli ölçüde büyüdüğü görülmektedir (Tulebayeva vd., 2020). Yeşil ekonominin gelişimiyle birlikte yeşil ekonomik sektörlerde çalışan sayısında da hızlı bir artış görülmüş ve hatta bu sektörlerin yarattığı işler "yeşil işler" olarak anılmaya başlanmıştır. Bu anlamda, ILO'ya (2016, 2023) göre yeşil işler, "ister imalat ve inşaat gibi geleneksel sektörlerde, ister yenilenebilir enerji ve enerji verimliliği gibi yeni ortaya çıkan yeşil ekonomi sektörlerinde olsun, çevrenin korunmasına veya restore edilmesine katkıda bulunan düzgün işlerdir". Öte yandan UNEP de ILO'nun bu yeşil iş yaklaşımı çerçevesinde ülkelerin düzgün işler yaratmaya yönelik sürdürülebilir tüketimi ve üretimi geliştiren yeşil ve döngüsel yaklaşımlarını desteklemektedir (UNEP, 2020). ILO'nun düzgün iş konseptine göre, yeşil işlerin güvenli çalışma ortamı, sosyal güvence ve yeterli ücret sunması ve uluslararası çalışan haklarına saygılı olması gerekmektedir (ILO, 2012). Bu açıdan, yeşil işler ile düzgün işler çalışma hakları, istihdamda cinsiyet eşitliği, sosyal güvence, iş güvenliği, sağlık, göç, ücretler, çalışma sürelerinin yanı sıra, örgütlenme ve toplu pazarlık özgürlüğünün de dahil olduğu sosyal diyalog gibi birbirine bağlı unsurlar ile karşılıklı olarak birbirini desteklemektedir (Evans-Klock vd., 2009). UNEP, ILO, IOE ve ITUC'un oluşturduğu "düzgün iş inisiyatifi" Şekil 6'da gösterilen yeşil/düzgün iş matrisinde önemli bir rol oynadığı görülen "becerilerin" artırılmasının yeşil ve düzgün işler yaratmak için yeterli olmadığını özellikle vurgulamaktadır. Aynı zamanda yerel kalkınmayı, kayıt dışı ekonomiyi, mikro ve küçük işletmeleri ve gençler, işsizler, düşük vasıflılar ve yoksullar gibi dezavantajlı grupları dikkate alan politikalar ve eğitim programlarının adil bir şekilde yapılması ve uygulanması gerekmektedir (UNEP, ILO, IOE & ITUC, 2008).

2015'te BM Genel Kurulu'nda üye 193 ülke, 2030 yılına kadar herkesin uyum ve refah içinde yaşamasını sağlarken, dünyayı korumak için UNEP tarafından önerilen 17 Sürdürülebilir Kalkınma Hedefini kabul etmiştir. Bu hedeflerden 8'incisi direkt olarak "istikrarlı, kapsayıcı ve sürdürülebilir ekonomik büyümeyi, tam ve üretken istihdamı ve herkes için insana yakışır düzgün işleri desteklemek" olarak belirlenmiştir. Aynı yıl ILO da insana yakışır düzgün iş ve kapsayıcı büyüme için işin istikrarı ve güvenliği, güvenli çalışma ortamları ve sosyal güvenliği içeren on kriter tanımlamıştır (ILO, 2023). Ayrıca düzgün iş perspektifi, AB'nin "Sürdürülebilir Kalkınma için 2030 Gündemi" başlıklı belgesinde formüle edilen sürdürülebilir kalkınma hedeflerine ulaşmanın bir parçası olarak kabul edilmiştir (Sulich ve Sołoducho-Pelc, 2022; ILO, 2023). Diğer taraftan birçok Güneydoğu Asya Uluslar Birliği (ASEAN) ülkeleri bile, temiz ve yenilenebilir enerjiye erişim sağlayan, enerji verimliliğini artıran, rekabet gücü ve yeşil teknoloji pazarlarının geliştiren ve düzgün iş yaratılmasını destekleyen düşük karbonlu yeşil büyüme paradigmasını benimsemiştir (Toan vd. 2016).

Şekil 6: Yeşil iş - düzgün iş matrisi (Kaynak: UNEP, ILO, IOE & ITUC, 2008; Görmüş, 2016)

2.4. Türkiye'de yeşil ve döngüsel ekonomiye geçiş çalışmaları

Son yıllarda ABD, İngiltere, Japonya, Çin ve özellikle AB ülkelerinde yeşil ve döngüsel ekonomiye geçilmesi düşüncesi büyük bir ivme kazanmıştır. Çin'de döngüsel ekonomi yukarıdan aşağıya ulusal bir politik hedef olarak teşvik edilirken AB, Japonya ve ABD gibi diğer bölge ve ülkelerde aşağıdan yukarıya çevre ve atık yönetimi politikaları tasarlamaya yönelik bir araç olarak kullanılmaktadır (Ghisellini vd. 2016). Diğer taraftan 2019'da açıklanan Avrupa Yeşil Mutabakatı ile getirilen "Sınırda Karbon Düzenlemesi Mekanizması", AB ile ticari ilişkileri olan bütün ülkeler ve ekonomik aktörleri etkilemektedir. Bu kapsamda Türkiye de dünyadaki yeşil ve döngüsel ekonomi ile ilgili gelişmeleri yakından takip etmektedir. Çünkü AB ülkeleri Türkiye'nin 1. en büyük ticaret ortağıdır ve 2022 yılında Türkiye'nin ithalatının %26'sı ve ihracatının %41'i AB ülkeleri ile gerçekleşmiştir (EC, 2023). Bu çerçevede Türkiye'nin uluslararası ticareti göz önünde bulundurulduğunda gerek AB gerekse diğer uluslararası aktörlerdeki gelişmelerin takip edilmesi oldukça önemlidir (Sapmaz Veral, 2021). Bu çerçevede 2019'da Sanayi ve Teknoloji Bakanlığı tarafından yayınlanan 2023 Sanayi ve Teknoloji Stratejisinde, yeşil ekonomik dönüşüme yönelik organize sanayi bölgesi alt yapı ve şirketlerin temiz üretime yönelik teknoloji yatırımlarının teşvik edileceğini ve döngüsel ekonomiye yönelik "ekonomik değerli atık izleme sistemi" kurulacağı açıklanmıştır (Güney, 2022).

Aslında Türkiye'de yeşil ve döngüsel ekonomi modeline ilişkin çalışmalar 2017 yılında Çevre ve Şehircilik Bakanlığı tarafından yürütülen "Sıfır Atık Projesi" ile başlamıştır. 2019 yılında yayınlanan Sıfır Atık Yönetmeliği ile belediyelerin yanı sıra, hastaneler, okullar, üniversiteler, organize sanayi bölgeleri, özel sektör kuruluşları ile bazı üretim yapan firmalar da proje kapsamına alınmıştır. Aynı yıl plastik poşet tüketimini azaltmaya yönelik alışveriş poşetlerinin ücretlendirilmesinin yanı sıra, deniz ve kıyıların korunmasına yönelik "Sıfır Atık Mavi Projesi" de etkinleştirilmiştir (Mısır ve Arıkan, 2022). Sıfır Atık Projesi kapsamında 2017-2022 yılları arasında 17,5 milyon kişiye eğitim verilmiş ve %27,2 geri kazanım oranı ile 530 milyon kWh enerji, 347 milyon ağaç, 572 milyon m3 su, 87 milyon varil petrol, 650 milyon ton hammadde ve 69 milyon m3 depolama alanı tasarrufu ile 3,9 milyon ton sera gazı salınımı engellenmiştir. Yapılan bu tasarruflarla 550 bin ton plastik poşet, 20,4 milyon ton kağıt/karton, 0,5 milyon ton metal, 5,2 milyon ton organik atık, 5,4 milyon ton plastik, 2,3 milyon ton cam geri kazanılmış, 150 bin bina/yerleşke sıfır atık sistemine geçmiş ve atık suların %4,2'si arıtılmıştır (Çamaş vd. 2022).

2020 yılında Türkiye Çevre Ajansı kurulmasının ardından, İskoçya'nın Glasgow kentinde gerçekleştirilen 76. BM Genel Kurulu'nda Türkiye'nin de Paris İklim Anlaşması'na taraf olacağı açıklanarak 2053 yılı net sıfır emisyon ve yeşil kalkınma hedefleri sunulmuştur. Türkiye'nin yeşil kalkınma hedefleri kapsamında 29 Ekim 2021'de Çevre ve Şehircilik Bakanlığı'nın adı "Çevre, Şehircilik ve İklim Değişikliği Bakanlığı" olarak değiştirilmiş ve bakanlık bünyesinde İklim Değişikliği Başkanlığı kurulmuştur. Bu çerçevede İklim Değişikliği ve Uyum Koordinasyon Kurulu da yeniden yapılandırılmıştır. Bunun dışında 2021'de Ticaret Bakanlığı öncülüğünde ilgili tüm kamu ve özel sektör kuruluşlarıyla işbirliği ile sürdürülebilir, kaynak etkin ve yeşil bir ekonomiye geçişin desteklenmesini amaçlayan "Yeşil Mutabakat Eylem Planı"nı hazırlanmıştır. Diğer taraftan Türkiye, 2015'te BM İklim Değişikliği Çerçeve Sözleşmesinde yer alan temel hedefine yönelik olarak 2030 yılında sera gazı salınımlarını %21 oranına kadar azaltma hedefini "Niyet Edilen Ulusal Katkısı"nda sunmuştur. Daha sonra Kasım 2022 tarihinde düzenlenen

"Taraflar Arası Üst Düzey Bakanlar Zirvesi"nde (COP 27) Türkiye, 2030 yılındaki sera gazı emisyon azaltım hedefini %41 oranında azaltıma yükseltmiştir.

Çalışmanın geri kalan bölümünde Türkiye'de ATGK faaliyetlerindeki işlerin ILO'nun yeşil ve düzgün iş konseptine uygun olarak güvenli çalışma ortamı, sosyal güvence ve yeterli ücret sunan uluslararası çalışan haklarına saygılı işler olup olmadıkları araştırılacaktır.

3. Yöntem

3.1. Veri

Bu çalışmada TÜİK'in düzenli yayınladığı işgücü piyasasının özellikleri ile ilgili en temel veri kaynağı olan THİA'nın en güncel 2021 yılı mikro verisi talep edilerek kullanılmıştır. THİA'da "hane" istatistiksel birim olarak kullanılmakta olup, 2021 yılı için her yaştan 635.159 hane halkının işgücü durumlarıyla ilgili yüz yüze ve telefon yardımı ile anketler yapılmıştır (TÜİK, 2022). Çalışma kapsamında, ATGK faaliyetlerinde istihdam edilen 1.063 çalışan demografik ve işle ilgili bağlamlar açısından analiz edilecektir.

3.2. Bağımlı değişken

2021 THİA'da NACE2_ESAS_K kodlu soruda katılımcıların çalıştığı esas işinin "kuruluş veya işyerinin ana faaliyeti" Avrupa Topluluğunda Ekonomik Faaliyetlerin İstatistiki Sınıflamasına (NACE2) göre sınıflandırılmaktadır. NACE2'de kuruluş veya işyerinin ana faaliyeti 2 dijit olarak kodlanmıştır. Buna göre, 38 kodlu "Atığın toplanması, ıslahı ve bertarafı faaliyetleri; maddelerin geri kazanımı" ve 39 kodlu "İyileştirme faaliyetleri ve diğer atık yönetimi hizmetleri" birleştirilerek "ATGK faaliyetleri" (Y=1) olarak yeniden kodlanmıştır. Geri kalan ekonomik faaliyetler ise, "diğer ekonomik faaliyetler" (Y=0) olarak yeniden kodlanmıştır.

3.3. Bağımsız değişkenler

Bu çalışmada kullanılan bağımsız değişkenler demografik ve işle ilgili bağlamlar olmak üzere iki ana gruba ayrılmaktadır.

Demografik bağlamlar arasından katılımcıların cinsiyeti kendi öz beyanlarından "kadın" ve "erkek" olarak alınmıştır. Yaş değişkeni "15-24'den" "65 yaş üstüne" kadar yukarıdan aşağı 6 ayrı kategoriye ayrılmıştır. Medeni durum değişkeni "hiç evlenmedi", "evli" ve "boşandı veya eşi öldü" olmak üzere üç ayrı kategoride ele alınmıştır. Katılımcıların eğitim durumu ortaokul, lise ve üniversite düzeyi eğitim kategorileri kendi içinde birleştirilerek, "okul bitirmedi"den "üniversite ve dengine" yukarıdan aşağı 5 ayrı kategoride incelenmiştir. Ancak "5 veya 6 yıllık fakülte ya da lisansüstü eğitim" düşük örneklem büyüklüğü nedeniyle analize alınmamıştır.

Çalışmada kullanılan "işle ilgili bağlamlar" yedi kategorik değişkenden oluşmaktadır. Çalışanların kamu ya da özel sektörde istihdam edildiğini gösteren "Kamu/özel sektör" değişkeni katılımcıların kendi öz ifadelerinden alınmıştır. Katılımcıların çalıştığı işyeri büyüklüğü ise TÜİK ve Eurostat'ın tanımlarına uygun olarak katılımcıların kendi ifadelerinden "9'dan az çalışanlı mikro ölçekli'den 250'den fazla çalışanlı büyük ölçekli"ye yukarıdan aşağı 5 gruba ayrılmıştır. Katılımcıların aynı işyerinde geçirdikleri istihdam süresi "0-2 ay, 3-5 ay, 6-8 ay, 9-11 ay ve 1 yıl ve üstü" olmak üzere 5 ayrı kategoride ölçülmüştür. Katılımcıların çalıştığı işyerinde "Kayıtlı ya da kayıt dışı çalışması", "Çalışma şekli", ve "Ek iş arama durumu" değişkenleri, katılımcıların kendi öz ifadelerinden alınmıştır. Son olarak aylık gelir durumunu incelemek için yukarıdan aşağı "1-TL'den 5001-TL'den fazlasına" kadar beş ayrı ücret bandı oluşturulmuştur. "2800-3000" ücret bandı 2021 yılına ait asgari ücret miktarını göstermektedir.

3.4. Betimsel bulgular

Tablo 1'de ATGK faaliyetlerinin demografik ve işle ilgili bağlamlar açısından gözlemlenen frekans ve oranlarına ait çapraz tablolar gösterilmektedir. Tabloya genel olarak bakıldığında, ATGK faaliyetlerinin ILO'nun düzgün iş konseptinden negatif ayrıştığı söylenebilir. Ancak yine de tablonun ayrıntılı bir şekilde analiz edilmesi gerekir.

Tablo 1'e göre, ATGK faaliyetlerinin kadın istihdamı açısından daha az istihdam olanaklarına sahip olduğu gözlenmektedir. Buna göre, ATGK faaliyetlerindeki istihdamın sadece %12,4'ü kadınlardan oluşmaktadır. Yaş kategorileri incelendiğinde, ATGK faaliyetleri ve yaş bantları arasında bir "ters U" ilişkisi gözlenmektedir. Diğer taraftan ATGK faaliyetlerinde 15-24 yaş arası genç istihdamı %14,6 iken, 55-64 yaş bandında %11,7'dir. Medeni durum açısından, ATGK faaliyetlerinde çalışanların %70,8'inin evli olduğu gözlenmektedir.

Eğitim durumuna bakıldığında ise, ATGK faaliyetlerinin bir eğitimi olmayan ya da ilkokul mezunları açısından yüksek istihdam olanakları sunarken, lise ve dengi ile üniversite mezunları için daha düşük imkanlara sahiptir. Bu açıdan, ATGK faaliyetlerinde çalışanların %22'sinin hiçbir eğitimi yokken, ilkokul mezunu oranı %38,3'tür. Diğer taraftan üniversite mezunları ise ATGK faaliyetlerindeki istihdamın sadece %4,4'ünü oluşturmaktadır.

Tablo 1. ATGK faaliyetleri için çapraz tablo sonuçları

		ATGK faaliyetleri	
		N	%
Cinsiyet	Erkek	931	87,6
	Kadın	132	12,4
Yaş	15-24	155	14,6
	25-34	254	23,9
	35-44	289	27,2
	45-54	209	19,7
	55-64	124	11,7
	65+	32	3,0

Medeni durumu	Hiç evlenmedi	212	19,9
	Evli	753	70,8
	Boşandı veya eşi öldü	98	9,2
Eğitim durumu	Bir okul bitirmedi	233	22,0
	İlkokul	406	38,3
	Ortaokul ve dengi	245	23,1
	Genel lise ve dengi	128	12,1
	Üniversite ve dengi	47	4,4
Kamu/özel sektör	Özel sektör	1.031	97
İşyeri ölçeği	1-9 mikro ölçekli	757	71,2
	10-19 küçük ölçekli	77	7,2
	20-49 küçük ölçekli	76	7,1
	50-249 orta ölçekli	124	11,7
	250+ büyük ölçekli	29	2,7
İstihdam süresi	0-2 ay	139	13,1
	3-5 ay	89	8,4
	6-8 ay	43	4
	9-11 ay	49	4,6
	1 yıl +	743	69,9
Çalışma şekli	Kısmi süreli	136	12,8
Ek iş arama durumu	Evet	119	11,2
Sosyal güvenlik kaydı	Kayıt dışı	640	60,2
Aylık gelir	1-2799	54	14,1
	2800-3000 asgari ücret	157	40,9
	3001-4000	102	26,6
	4001-5000	39	10,2
	5001+	32	8,3

Kaynak: 2021 Hanehalkı İşgücü Anketi mikro verisinden yazarın kendi analizi.

Tabloya göre, ATGK faaliyetlerinde istihdamın %97'sinin özel sektörde olduğu göze çarpmaktadır. Diğer taraftan işyeri ölçeği incelendiğinde, ATGK faaliyetlerinde istihdamın %71,2 gibi büyük bir kısmı 1-9 çalışanı bulunan mikro ölçekli işyerlerinde yoğunlaşırken, orta (%11,7) ve büyük (%2,7) ölçekli işyerlerinde istihdam oranlarının görece daha sınırlı olduğu gözlenmektedir. Bu oranlar Türkiye'de ATGK faaliyetlerinin büyük oranda mikro ölçekli işyerlerinde yoğunlaştığını göstermektedir.

Tablo istihdam süresi açısından incelendiğinde, ATGK faaliyetlerinde istihdam edilenlerin %69,9'unun 1 yıl ve üstü aynı işyerinde çalıştığı görülmektedir. Bu arada aynı işyerinde 0-2 ay gibi kısa süreli çalışanların oranı %13,1 olarak gerçekleşmiştir. Diğer taraftan ATGK faaliyetlerinde çalışanların %60,2'si gibi yüksek bir kısmı bir sosyal güvenceden yoksun kayıt dışı istihdam edilmektedir. Ayrıca bu yüksek kayıt dışılığın paralelinde, ATGK faaliyetlerinde çalışma şeklinin %12,8'i kısmi süreli iken, ATGK faaliyetlerinde çalışanların %11,2'si geçinemediği için ek iş arayışı içindedir.

Tablo aylık gelir bandı incelendiğinde, ATGK faaliyetlerinde istihdam edilenlerin %14,1'i 2021 yılı asgari ücret bandından daha düşük bir ücret almaktayken, %40,9'unun asgari ücret bandında çalıştığı gözlenmektedir. Bu sonuç, ATGK faaliyetlerinde asgari ücret bandının neredeyse ortalama ücret haline geldiğini göstermektedir.

Tablo 1 genel olarak yorumlandığında, demografik ve işle ilgili bağlamlar ile ATGK faaliyetlerindeki istihdam koşullarının değişen oranlarda Türkiye'deki genel işgücü piyasası ortalamalarının oldukça altında olduğu gözlenmektedir.

3.5. Lojistik regresyon modeli

3.5.1. Analitik teknik

Bu çalışmada bir bağımlı değişken ile bir dizi bağımsız (yordayıcı veya açıklayıcı) değişken arasındaki ilişkiyi tahmin etmek için kullanılan lojistik regresyon modeli kullanılmıştır. Lojistik regresyonda sonuç değişkeni ikili (dikotom) olarak oluşturulmaktadır (Hosmer ve Lemeshow, 2000). Bu doğrultuda, çalışmanın bağımlı değişkeni, katılımcının ATGK faaliyetlerinde çalışıp çalışmadığıdır. Bu çerçevede ikili yanıt evet ve hayır şeklinde oluşturulmuş ve model tahminlemesinde Maksimum Olabilirlik tekniği kullanılmıştır.

ATGK faaliyetlerinde çalışma olasılığı (p) X1, X2, X3, ...,Xp sonuç değişkenleri ile tahmin edilmektedir. ATGK faaliyetlerinde çalışma olasılığı p/(1-p) oranı ile elde edilir ve "β" X değiştiğinde "olasılık değişim oranı" olarak yorumlanan regresyon katsayılarını gösterir. Model eşitlilik 1'de şu şekilde formüle edilmiştir:

$$L = \ln\left(\frac{p}{1-p}\right) = \beta 0 + \beta 1X1 + \beta 2X2 + \ldots + \beta pX \qquad (1)$$

Bu çalışmada lojistik regresyon modelleri, ATGK faaliyetleri ile bir dizi demografik (yaş, medeni durum ve eğitim durumu) ve işle ilgili bağlamlar (kamu/özel sektörde çalışma, işyeri ölçeği, istihdam süresi, SGK kaydı, çalışma şekli ve ek iş arama durumu) arasındaki ilişkiyi tahmin etmektedir. Cinsiyet ve aylık gelir değişkenleri modelin uyum iyiliğini bozduğu için analizden çıkarılmıştır. Tablo 4'te, demografik ve işle ilgili değişkenler, bağımlı değişken ile bağımsız değişkenler arasındaki ilişkilerdeki değişiklikleri gözlemleyen ve her bir bağımsız değişken kategorisinin model üzerindeki göreceli önemini değerlendiren tek bir blokta tasarlanmıştır. Ayrıca, blok içindeki bağımsız değişkenlerin sırası, sonuçları önemli ölçüde etkilememektedir.

Lojistik regresyon modelinin uyum iyiliğini (goodness of fit) doğrulamak için gözlemlenen gx2 tablosundan Pearson Ki-kare istatistiğinin hesaplanmasıyla elde edilen ve beklenen frekansları tahmin eden Hosmer-Lemeshow

istatistiği kullanılmıştır (Hosmer ve Lemeshow 2000).

3.5.2. Diagnostik testler

Lojistik regresyon analizine geçmeden önce tüm modeller için diagnostik testlerin ayrı ayrı incelenmesi gerekmektedir. Tablo 2'de bu çalışmada kullanılan değişkenlerle ilgili korelasyon matrisi gösterilmektedir. Buna göre, bağımsız değişkenler arasında zayıf bir korelasyon olduğu gözlenmektedir. Bu da kullanılan değişkenler arasında potansiyel bir çoklu bağlantı sorunu olmadığına işaret etmektedir.

Tablo 2. Korelasyon matrisi

		1	2	3	4	5	6	7	8	9	10
1	**ATGK Faal.**	1									
2	**Yaş**	-0,007*	1								
3	**Eğitim**	0,010*	0,540*	1							
4	**Medeni durum**	-0,050*	-0,387*	-0,236*	1						
5	**Kamu/özel**	-0,027*	-0,035*	0,042*	0,387*	1					
6	**İşyeri ölçeği**	-0,023*	-0,180*	-0,034*	0,356*	0,422*	1				
7	**İstihdam süresi**	-0,009*	0,250*	0,197*	0,038*	0,160*	0,065*	1			
8	**SGK kaydı**	-0,038*	-0,249*	-0,053*	0,433*	0,325*	0,528*	0,087*	1		
9	**Çalışma şekli**	-0,003	-0,062*	-0,007*	0,145*	0,097*	0,217*	0,085*	0,322*	1	
10	**Ek iş arama durumu**	-0,016*	0,106*	0,054*	-0,021*	0,079*	0,044*	0,152*	0,067*	0,079*	1

Kaynak: *2021 Hanehalkı İşgücü Anketinden yazarın kendi analizi*. **Not:** ** p< 0,.001.*

Table 3. Çoklu doğrusallık istatistiği

	Tolerance	VIF
Yaş	0,583	1,715
Medeni durum	0,690	1,450
Eğitim	0,641	1,560
Kamu/özel	0,722	1,385
İşyeri ölçeği	0,641	1,559
İstihdam süresi	0,877	1,141
SGK kaydı	0,599	1,670
Çalışma şekli	0,886	1,129
Ek iş arama durumu	0,959	1,042

Kaynak: *2021 Hanehalkı İşgücü Anketinden yazarın kendi analizi*.

Lojistik regresyon modelinin çoklu doğrusallık ve uyum iyiliği açısından da test edilmesi gerekmektedir. Garson (2009) bağımsız değişkenler arasındaki güçlü korelasyonun lojistik regresyonda çoklu doğrusallık sorununa işaret ettiğini belirtmektedir. Ayrıca, modelde çoklu doğrusal bağlantı sorunu olup olmadığını test etmek için Varyans Enflasyon Faktörü (VIF) kullanılmıştır.

Tablo 3'te, modelin çoklu doğrusal bağlantı sorunu olup olmadığını test eden VIF sonuçlarını gösterilmektedir. VIF (<2) ve tolerans (<1) değerleri tahmin edilen modellerde bağımsız değişkenler arasında çoklu bağlantı sorunu olmadığını göstermektedir. Bu sonuçlar korelasyon matrisinden elde edilen sonuçları da teyit etmektedir.

3.5.3. Lojistik regresyon tahmini

Tablo 4, çalışmada kullanılan 2021 yılına ait demografik ve işle ilgili bağlamlara ait kategorilerinin ATGK faaliyetlerinde istihdam olasılığını inceleyen lojistik regresyon modelini göstermektedir. Tabloda her bir kategorinin ATGK faaliyetlerinde istihdam olasılıkları (OR) ve anlamlılık düzeyleri, katsayılar, standart hata ve Wald istatistikleri yer almaktadır.

Tablo 4. Lojistik regresyon modeli

		Katsayı	St. Hata	Wald Testi	Odds Oranı
Yaş				152,808	***
	15-24	1,893	0,226	69,917	6,638***
	25-34	1,933	0,199	94,683	6,912***
	35-44	1,441	0,192	56,535	4,226***
	45-54	1,087	0,194	31,466	2,964***
	55-64	0,763	0,200	14,564	2,144***
	65+	I	I	I	I
Medeni durum				43,425	***
	Hiç evlenmedi	-0,878	0,151	33,745	0,415***
	Evli	-0,683	0,110	38,307	0,505***
	Boşandı veya eşi öldü	I	I	I	I
Eğitim durumu				377,845	***
	Bir okul bitirmedi	2,727	0,175	244,151	15,288***
	İlkokul	1,887	0,170	123,717	6,597***
	Ortaokul ve dengi	1,468	0,166	77,712	4,339***
	Genel lise ve dengi	0,793	0,175	20,563	2,211***
	Üniversite ve dengi	I	I	I	I
Özel sektör		0,875	0,195	20,141	2,399***
İşyeri ölçeği				24,739	***
	1-9 mikro ölçekli	0,489	0,200	5,965	1,631*
	10-19 küçük ölçekli	0,526	0,221	5,643	1,691*
	20-49 küçük ölçekli	0,590	0,220	7,190	1,804**
	50-249 orta ölçekli	0,911	0,207	19,341	2,487***
	250+ büyük ölçekli	I	I	I	I
İstihdam süresi				29,432	***
	0-2 ay	-0,276	0,098	7,922	0,759**
	3-5 ay	0,176	0,116	2,303	1,192
	6-8 ay	0,215	0,160	1,804	1,240
	9-11 ay	0,563	0,151	13,927	1,755***
	1 yıl +	I	I	I	I
Kayıt dışı istihdam		0,715	0,086	69,622	2,044***
Kısmi süreli çalışma		-0,432	0,096	20,252	0,649***
Ek iş arıyor		0,566	0,102	30,889	1,761***
Sabit (Constant)		-9,160	0,339	731,394	0,000***
∆ df					8,000
-2 LLR					12.282,721
Pearson Ki-kare					12,846
Hosmer & Lemeshow Test					0,117

Kaynak: *2021 Hanehalkı İşgücü Anketinden yazarın kendi analizi*. Referans kategorisine göre anlamlılık düzeyi**:** **p< ,05, **p< ,01, ***p< ,001*

Modelde değişkenlere ait son kategoriler "referans kategori" olarak tanımlanmıştır. Diğer taraftan Wald istatistiği ile bağımsız değişkenlerin modele alınmasının önemli olup olmadığını test edilmiş, değişkenlerin modele katkılarının anlamlı olduğu görülmüştür. Ayrıca modelin uyum iyiliğini test eden Hosmer-Lemeshow istatistik sonucu (0,117 (p) > 0.05) modelin uyum iyiliği varsayımını karşıladığını kanıtlamaktadır. Böylece, sınıflandırma tablosuna geçilmiştir.

Model yaş kategorileri açısından ATGK faaliyetlerinde istihdam edilme olasılığının 15-24 yaş bandında (OR= 6,638, p < 0,001) ve 25-34 yaş bandında (OR= 6,912, p < 0,001) referans kategoriye göre anlamlı şekilde yaklaşık 7 kat daha yüksek olduğu gözlenmektedir. Ayrıca, bu sonuçlar ATGK faaliyetlerinde istihdam edilme olasılığının yaş ilerledikçe düştüğünü ve daha çok çalışma çağının en aktif dönemi olan 15-34 yaş grubundakiler tarafından tercih edildiğini göstermektedir. Medeni duruma bakıldığında, bekar (OR= 0,415, p < 0,001) ve evlilerin (OR= 0,505, p < 0,001) ATGK faaliyetlerinde istihdam edilme olasılıklarının referans kategoriye nazaran anlamlı şekilde daha düşük olduğu izlenmektedir.

Eğitim durumuna gelince, modelde katılımcıların kazanılmış eğitim düzeyi arttıkça, ATGK faaliyetlerinde istihdam edilme olasılıklarının giderek düştüğü gözlenmektedir. Eğitim durumundaki en çarpıcı sonuç, bir okul bitirmeyenler kategorisindedir. Bu açıdan, bir okul bitirmeyenlerin (OR= 15,288, p < 0,001) ATGK faaliyetlerinde istihdam edilme olasılıkları üniversite ve dengi mezunlara kıyasla anlamlı şekilde daha yüksek gözükmektedir. Bu sonuçlar, ATGK faaliyetlerinin daha çok düşük vasıf gerektiren işler sunduğunu açıkça göstermektedir.

İşle ilgili bağlamlar açısından, model özel sektör çalışanlarının (OR= 2,399, p < 0,001) ATGK faaliyetlerinde istihdam edilme olasılığı, kamu sektörüne nazaran 2 kattan daha yüksek gözükmektedir. İşyeri ölçeğine bakımından, 1-9 çalışanlı mikro ölçekli (OR= 1,631, p < 0,05), 10-19 çalışanlı küçük ölçekli (OR= 1,691, p < 0,05), 20-49 çalışanlı küçük ölçekli (OR= 1,804, p < 0,01) ve 50-249 çalışanlı orta ölçekli (OR= 2,487, p < 0,001) işyerlerinde çalışanların ATGK faaliyetlerinde istihdam edilme olasılığı, referans kategoriye göre anlamlı şekilde daha yüksektir.

Aynı işyerinde geçirilen istihdam sürelerine bakıldığında, 9-11 ay istihdam edilenlerin (OR= 1,755, p < 0,001) ATGK faaliyetlerinde bulunma olasılığı, aynı işyerinde 1 yıl ve daha fazla çalışanlara göre, anlamlı şekilde daha yüksekken, 0-2 ay süre ile istihdam edilenlerin (OR= 0,759, p< 0,01) ATGK faaliyetlerinde çalışma olasılığı anlamlı şekilde daha düşüktür. Bu sonuç ATGK faaliyetlerinde aynı işyerinde 1 yıldan daha fazla istihdam süresinin oldukça düşük bir olasılık olduğunu göstermektedir. Diğer taraftan, ATGK faaliyetlerinde kayıt dışı istihdam olasılığı (OR= 2,044, p < 0,001) kayıtlı çalışmaya göre, anlamlı bir şekilde 2 kat daha yüksektir. Son olarak, ATGK faaliyetlerinde kısmi süreli işlerde çalışma olasılığı (OR= 0,649, p < 0,001) anlamlı bir şekilde düşük olmasına rağmen, geçinemedikleri için ek iş arama olasılıkları (OR= 1,761, p< 0,001) anlamlı bir şekilde daha yüksektir.

4. Tartışma

Bu çalışmada, Türkiye'deki yeşil ve döngüsel ekonomiye geçiş çalışmaları bağlamında, ATGK faaliyetlerinde istihdam koşullarıyla ilgili ampirik araştırma eksikliğini gidermek için ATGK faaliyetleri ile demografik ve işle ilgili bağlamlar arasındaki ilişki lojistik regresyon modelleme tekniği ile incelenmiştir. Ampirik analiz sonuçları, genel olarak ATGK faaliyetleri ile bu çalışmada kullanılan bağımsız değişkenler arasındaki ilişkilerin anlamlı olduğunu ortaya koymuştur. Ancak çalışmadan elde edilen bulgular, ATGK faaliyetlerindeki işlerin ILO'nun yeşil iş kapsamında öne çıkardığı güvenli çalışma ortamı, sosyal güvence ve yeterli ücret sunan ve işçi haklarına saygılı düzgün iş konsepti açısından negatif ayrıştığını açıkça göstermektedir.

Çapraz tablolar ATGK faaliyetlerindeki istihdam yapısının erkek çalışan yoğunluklu olduğunu göstermektedir. Bu açıdan atığın toplanması, ıslahı, bertaraf edilmesi ve geri kazanım işleri kadın istihdamına uygun olmayan kirli ve sağlıksız iş ortamlarında gerçekleştirildiği için bu sonuç hiç şaşırtıcı değildir. Yaş kategorileri açısından regresyon sonuçları, ATGK faaliyetlerinde istihdamın 15-24 yaş arası genç ve 25-34 orta yaş grubunda en yüksek seviyede olduğunu göstermektedir. Diğer taraftan ATGK faaliyetleri bekar ve evliler yönünden düşük istihdam olanaklarına sahiptir. Bununla birlikte, ATGK faaliyetlerinde eğitim kazanımları arttıkça, istihdam olanaklarının giderek azaldığı görülmektedir. Bu açıdan ATGK faaliyetlerinin daha çok vasıfsız ve düşük vasıflı çalışanlara uygun iş fırsatları sunduğunu söyleyebiliriz.

Analiz sonuçlarına göre, ATGK faaliyetlerinde çalışanların, yoğunluklu olarak özel sektörde ve mikro, küçük ve orta ölçekli işletmelerde (KOBİ) yoğunlaştığı görülmektedir. Ancak özellikle özel sektördeki mikro ölçekli işletmeler ve KOBİ'ler çalışma ortamı güvenliği açısından Türkiye'de iş kazası riskinin çok yüksek olduğu işyerleri olarak bilmektedir. Bu açıdan, Sosyal Güvenlik Kurumu (2023) istatistiklerine göre, 2022 yılında gerçekleşen iş kazalarının yaklaşık %55'i KOBİ'lerde gerçekleşirken, ölümle sonuçlanan iş kazası oranlarının yaklaşık %57'si 1-49 çalışanı olan mikro ve küçük ölçekli işyerlerinde, %24'ü ise, orta ölçekli işyerlerinde meydana gelmiştir. Bu bağlamda mali güçsüzlük, kayıt dışılık, taşeronlaşma ve denetim yetersizliği vb. nedenler mikro ölçekli işletmeler ve KOBİ'lerde çalışma ortamı güvenliğinin yeterli ölçüde sağlanmasını engellemektedir (Baybora, 2014; Öçal ve Çiçek, 2017).

Diğer taraftan 4857 sayılı İş Kanunu'na göre, iş güvencesinin 30 işçiden daha az çalışanı olan işyerlerinde uygulanmamasından dolayı, ATGK faaliyetlerinde çalışanların büyük çoğunluğu iş güvencesi kapsamının da dışında kalmaktadır. Ayrıca KOBİ'lerde işçi-işveren ilişkilerinin geleneksel olarak yüz yüze, çalışan sayısının az

ve çalışanların iş güvencesinden yoksun olması sendikal örgütlenmeyi negatif etkilerken, KOBİ işverenlerinin de yoğun rekabet ortamında sendikal örgütlenmeye hoşgörülü bakmaması sendikalaşmayı zorlaştırmaktadır (Güloğlu, 2021). Bu yüzden ATGK faaliyetleri sendikalaşma açısından da ILO'nun düzgün iş konseptinin dışında kalmaktadır.

Lojistik regresyon sonuçları ATGK faaliyetlerinde aynı işyerinde istihdam süresinin genel olarak 3 ila 11 ay arasında yoğunlaştığını göstermektedir. Bu da ATGK faaliyetlerinde çalışanların günübirlik veya mevsimlik işler gibi istikrarsız işlerde istihdam edildiği anlamına gelmektedir. Bu açıdan çapraz tablolar ATGK faaliyetlerinde yaratılan istihdamın %12'sinin tam süreli işlere göre, daha düşük vasıf gerektiren, daha düşük ücretli ve sosyal koruma, mesleki gelişme, eğitime katılma ve kariyer fırsatlarından yoksun kısmi süreli işlerden (Görmüş, 2021) oluştuğuna işaret etmektedir. Bu açıdan Türkiye'de kısmi süreli istihdam biçimi (Kısmi süreli çalışmanın toplam istihdam içindeki payı 2019'da %6,39'dur (Görmüş, 2021)) çok yaygın görülmemesine rağmen, ATGK faaliyetlerindeki kısmi süreli istihdam oranı genel ortalamanın oldukça üzerindedir. Diğer taraftan ampirik sonuçlar, ATGK faaliyetlerinde çalışanların ön bulgulara göre %60 gibi büyük bir kısmının işsizlik, yaşlık, malullük, iş kazası, meslek hastalığı ve hastalık gibi sosyal risklere karşı savunmasız (ILO, 2015) olarak kayıt dışı istihdam edildiğini ima etmektedir. ILO'nun sosyal güvenceye sahip düzgün iş konsepti açısından, %60'lık bir kayıt dışı istihdam oranı, hiç de azımsanmayacak kadar yüksektir. Bununla birlikte, regresyon sonuçları ATGK faaliyetlerinde sosyal korumadan yoksun düşük ücretli işlerde çalışanların önemli ölçüde mevcut durumlarını telafi edebilmek için ek iş arama zorunda kaldıklarını ortaya koymaktadır.

Çapraz tablo analizi, ATGK faaliyetlerinde çalışanların yarıdan fazlasının (yaklaşık %55) referans yılın (2021) asgari ücret seviyesi ya da daha atında bir üret karşılığı çalıştığını açıkça göstermektedir. Bu sonuç ATGK faaliyetlerinde ücret yeterliliği açısından da ILO'nun düzgün iş konseptinin karşılanamadığı anlamına gelmektedir. Türkiye'de ATGK faaliyetlerinde kayıt dışı istihdam ve yabancı kaçak işçi çalıştırma düşük ücret sorununa negatif bir etki yaratmaktadır. Bu bağlamda, İnsan Hakları İzleme Örgütü'nün (Human Rights Watch) 2022 raporuna göre, Türkiye'de geri dönüşüm tesislerinde çalışanların büyük çoğunluğu, çalışma izni olmayan göçmen ve mültecilerden oluşmaktadır. Diğer taraftan Türkiye'de ortalama ücret konumuna gelen ve ailesini hesaba katmadan 1 işçinin yaşama koşullarına göre belirlenen asgari ücretin ILO'nun düzgün iş konseptine uygun olduğunu söylemek oldukça güçtür. Bu sonuçlar Türkiye'de ATGK faaliyetlerinde çalışan yoksulluğunun ciddi bir sorun olduğunu göstermektedir. Diğer taraftan ATGK faaliyetlerinin ILO'nun düzgün iş konseptine uygun uluslararası işçi haklarına saygılı işler yaratıldığını söylemek de oldukça zordur. Özellikle mülteci ya da göçmen çocuklar, atık konteynırlarından döngüsel ekonominin ihtiyaç duyduğu atıkları toplayarak hayatlarını sürdürmektedirler. Bu bağlamda İnsan Hakları İzleme Örgütü'nün (2022) raporunda, Türkiye'de tehlikeli işlerde çocuk işçi çalıştırılması yasak olmasına rağmen, plastik geri dönüşüm tesislerinde eğitimden yoksun bırakılmış göçmen ya da mülteci çocuklar çalıştırıldığı bildirilmektedir.

5. Sonuç

Ekonominin yeşil ve döngüsel hale gelmesi, özellikle de hızla gelişen ATGK faaliyetlerinde, düzgün iş açısından kendiliğinden radikal bir değişim sağlamamaktadır. Bu çalışmadan elde edilen sonuçlar Türkiye'de ATGK faaliyetlerinde istihdamda cinsiyet eşitsizliği, çalışma ortamı ve iş güvencesinden yoksunluk, sendikal örgütlenmedeki zorluklar, çalışan yoksulluğu, kaçak göçmen ve mülteci işgücü, kayıt dışı istihdam ve çocuk işçiliği gibi sorunların yaşandığını açıkça göstermektedir. Bütün bunlar yeşil ve döngüsel ekonominin önemli bir kısmında ILO'nun altını çizdiği düzgün iş koşullarının sağlanamadığını göstermektedir. Ayrıca bu çalışmadan elde edilen bulgular, ATGK faaliyetlerinde çalışanların istihdam sorunuyla ilgili buz dağının sadece görünen yüzünü yansıtmaktadır. Bu bağlamda Türkiye'de yeşil ve döngüsel ekonomiye yönelik politikaların ve kararların oluşturulması süreçlerinde çalışanlar, sendikalar, işverenler ve kamu otoritelerinin sosyal diyalog mekanizmalarında birlikte hareket etmelerine ve proaktif işgücü piyasası politikalarıyla adil bir geçişin sağlanmasına bağlı olacaktır. Bu açıdan, bu çalışmanın Türkiye'de yeşil ve döngüsel ekonomiye adil geçişin sağlanmasıyla ilgili literatüre zenginlik katacağını, işgücü piyasası politikalarına ve gelecek araştırmalara ilham vereceğini umuyoruz.

Son Not: Bu çalışma, Uluslararası Geri Dönüşüm Ekonomisi ve Sürdürülebilirlik Politikası Kongresi'nde sunulan "Döngüsel Ekonomi Bağlamında Türkiye'de Atık Toplama ve Geri Kazanım Faaliyetleri ile İmalat Sanayinde İstihdam Yapısının Karşılaştırmalı Analizi" başlıklı bildirinin genişletilmiş ve yeniden düzenlenmiş halidir.

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RESP

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Derleme Makalesi ● Review Article

Indigenous Land Rights and Environmental Challenges: A Comparative Analysis of Canada and Brazil

Yerli Toprak Hakları ve Çevresel Sorunlar: Kanada ve Brezilya'nın Karşılaştırmalı Bir Analizi

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ANAHTAR KELİMELER

Uluslararası Yerli Hukuku
Yerli Hakları
Yerli Toprak Hakları
Kolonizasyon
Sosyal Adalet ve İnsan Hakları

ÖZ

The Amazon Forest fires of 2019 raised climate change awareness within the context of indigenous efforts to claim their indigenous land rights and environmental rights to a different level. Brazil is facing unprecedented polarization in its politics due to the contrasting public opinions on the environmental rights of its indigenous people and the future of the Amazon. Canadian national railway networks have been shut downdue to Canada-wide protests against a multi-billion-dollar pipeline that is planned to pass through the unceded lands of the indigenous Wet'suwet'en people of British Columbia. Environmental justice concerning development that threatens the land rights of indigenous people also threatens their natural environment. Such rights are protected under various national and international legal instruments. Perhaps it is the competing socio-political and socio-economic interests that juxtapose the question of indigenous land rights and environmental justice. Such conflicting interests also paint the indigenous people's land rights as an extension of threats to national sovereignty. This paper examines the land rights of the indigenous people, primarily using the cases of the Canadian indigenous nations and the Brazilian indigenous people as the contextual lens.

KEYWORDS

International Indigenous Law
Indigenous Rights
Indigenous Land Rights
Colonisation
Social Justice and Human Rights

ABSTRACT

2019'daki Amazon Ormanı yangınları, yerlilerin toprak haklarını ve çevre haklarını farklı bir düzeye taşıma çabaları bağlamında iklim değişikliği farkındalığını artırdı. Brezilya, yerli halkının çevresel hakları ve Amazon'un geleceği konusundaki zıt kamuoyu görüşleri nedeniyle siyasetinde benzeri görülmemiş bir kutuplaşmayla karşı karşıya. Kanada ulusal demiryolu ağları, Britanya Kolumbiyası'nın yerli Wet'suwet'en halkının sahipsiz topraklarından geçmesi planlanan milyarlarca dolarlık boru hattına karşı Kanada çapındaki protestolar nedeniyle kapatıldı. Yerli halkın toprak haklarını tehdit eden kalkınmaya ilişkin çevresel adalet, aynı zamanda onların doğal çevresini de tehdit etmektedir. Bu haklar çeşitli ulusal ve uluslararası hukuki araçlarla korunmaktadır. Belki de yerlilerin toprak hakları ve çevre adaleti sorununu yan yana getiren, rekabet eden sosyo-politik ve sosyo-ekonomik çıkarlardır. Bu tür çatışan çıkarlar aynı zamanda yerli halkın toprak haklarını da ulusal egemenliğe yönelik tehditlerin bir uzantısı olarak gösteriyor. Bu makale, öncelikle Kanada yerli ulusları ve Brezilya yerli halkı örneklerini bağlamsal mercek olarak kullanarak, yerli halkın toprak haklarını incelemektedir.

1. Introduction

International Environmental Law ("**IEL**"), as a body of International Law ("**IL**"), is not a new corpus of law (Plater, 1993). The intense debate on the scope of IEL with regard to indigenous communities and their rights is also not new (Anaya. 1991). However, the efficacy of the IL in protecting

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the natural environment of indigenous communities is a different story altogether. The European colonization of North and South America, post-16th century led to the mass exploration of earth's natural resources. It became the *ab initio* of the first industrial revolution (Lüthy, 1961).

Before the advent of the so-called social media, news of happenings such as environmental degradation or mistreatment of indigenous communities was reported subservient to the editorial priorities of the major news outlets. Social media has given birth to a new wave of 'citizen reporting' that at times allows for airing facts that may or may not be prioritized by mainstream news outlets. Scholars now term social media as the 'ambient' (Hermida, 2010) journalism.

The oil sands of Alberta, Canada and the various oil pipelines that carry crude oil to oil terminals on the pristine west coast of Canada became a hot topic of debate in the global social media (Bakardjieva, et.al., 2018). The framing of the argument between the mainstream media and the social media exposed the fissures between the corporate media outlets and ordinary citizens reporting on social media. The matter pertains to an oil pipeline passing through the unceded territory of the *Wet'suwet'en* Nation in British Columbia ("**BC**"), Canada.

The *Wet'suwet'en* nation set up blockades around the entry points to its lands, preventing the pipeline company from proceeding with the construction. On December 31st, 2019, the B.C. Supreme Court granted an injunction on behalf of Coastal GasLink (Coastal GasLink Pipeline Ltd, 2019), which is the subsidiary of TransCanada Energy ("**TC Energy**") to remove the blockades.

The Amazon Forest spans nine South American countries. 60 percent of Amazon is in Brazil. *Guajajara* people are one of the indigenous communities guarding around 1,500 square miles of Amazon's rainforest. Violence against indigenous communities protecting the Amazon against illegal land grabs and setting off forest fires to cut old growth has resulted in indigenous deaths. The year 2019 saw over a hundred indigenous people murdered, protecting the Amazon Forest (Sauer, 2018).

Brazil's Federal Constitution 1988 formally recognized that the indigenous people were the first inhabitants of the lands before the colonisers arrived. The 1988 Constitution determined the year 1993 as the deadline for the Federal government to demarcate the indigenous lands. The so-called "time-frame limitation" (Carneiro da Cunha et.al., 2017) gave rise to a series of legal challenges threatening the recognition of indigenous land rights under the "Marco temporal" (Ioris et.al., 2019) cause. This paper examines the rights of indigenous people in Canada and Brazil using the cases of Wet'suwet'en nation and Guajajara people as its contextual lens.

2. Canada: Crown's Recognition of Indigenous Rights

The Royal Proclamation 1763 (Slattery, 1763) issued by King George III, recognized the Aboriginal title for the indigenous communities in North America. The proclamation also recognized that all lands are to be considered Aboriginal lands until ceded by treaty. The British dominion over North America came at the end of the seven-year war between France and its allies and Britain and its allies (Baugh, 2014). It ended in the French dominion of North America and ushered in the British dominion that exists in Canada today in the form of the nebulous doctrine of the 'Crown'.

The Royal Proclamation 1763 is enshrined in Section 35 of the Canadian Constitution Act 1982 (Freedoms, Fundamental, and Democratic Rights, 1982). Section 35 does not create Indigenous rights, nor does it define them. It simply 'recognizes' indigenous rights and leaves them open for legal interpretation.

Section 35 of the Constitution Act states:

> "(1) The existing aboriginal and treaty rights of the aboriginal peoples of Canada are hereby recognized and affirmed.
>
> (2) In this Act, "Aboriginal peoples of Canada" includes the Indian, Inuit and Métis peoples of Canada.
>
> (3) For greater certainty, in subsection (1) "treaty rights" includes rights that now exist by way of land claims agreements or may be so acquired.
>
> (4) Notwithstanding any other provision of this Act, the aboriginal and treaty rights referred to in subsection (1) are guaranteed equally to male and female persons."

Canadian Constitution 1982, Part-1 describes the Canadian Charter of Rights and Freedoms. Section 25 of the Charter of Rights and Freedoms also guarantees the Aboriginal rights stated in the 1763 Royal Proclamation. Section 25 states,

"25. The guarantee in this Charter of certain rights and freedoms shall not be construed to abrogate or derogate from any Aboriginal, treaty or other rights or freedoms that pertain to the Aboriginal peoples of Canada including

> (a) any rights or freedoms that have been recognized by the Royal Proclamation of October 7, 1763; and
>
> (b) any rights or freedoms that now exist by way of land claims agreements or may be so acquired." (Freedoms, Fundamental, and Democratic Rights, 1982).

Regardless of the fact that indigenous rights are not defined or created in the Constitution Act of 1982, the Royal Proclamation of 1763 recognized indigenous rights over unceded lands. The Indian Act of 1876 uses the word "*Indian*" for the indigenous people residing in Canada. It does, however, define 'bands' to differentiate between various categories of '*Indians*' (see https://laws-lois.justice.gc.ca/eng/acts/i-5/). The Indian Act of 1876 is

still the governing legislation that rules the '*Indian*' or the indigenous affairs in Canada.

The Indian Act of 1876 states:

"Definitions 2 (1) In this Act, band means a body of Indians

(a) for whose use and benefit in common, lands, the legal title to which is vested in Her Majesty, have been set apart before, on or after September 4, 1951,

(b) for whose use and benefit in common, moneys are held by Her Majesty, or

(c) declared by the Governor in Council to be a band for the purposes of this Act" (see https://laws-lois.justice.gc.ca/eng/acts/i-5/page-1.html#h-331721)

The above definition gives rise to certain conclusions under the Indian Act of 1876. The Crown holds the legal title to all lands either as part of *'Indian Reserves'* or otherwise that are used or for the benefit of the '*Indians*'. Any funds allocated or belonging to the '*Indians*' are controlled by the Crown. The Crown has the discretion to define if indeed a group of Indians is a 'band' or not.

The word '*Indian*' comes from the Latin word '*idios*', meaning a person from the land of river Indus, in the Indian Subcontinent. One cannot but be skeptical of the continued ignorance towards the use of the word '*Indian*' within the contemporary legal lexicon of Canada for the indigenous people of North America. It seems the colonial mindset continues to prevail even at the rudimentary level of written legal connotations.

3. Dispossession of Indigenous Lands

The Indian Act of 1876's creation of 'Bands', their recognition and categorization at the discretion of the Crown seems to be a step towards attempting to redefine thousands of years of indigenous identity. The sad history of creating '*Indian reserves'* goes back to the French colonization (Neu, 2000). The French colonization of the indigenous people was replaced with British colonization in 1763. The French missionaries had the discretion to allocate lands for the Indians to *'assimilate'* them with the ways of the civilized world and to convert them to Christianity. The British colonizers continued with the trend under the Indian Act of 1876 by furthering the control over the identity of the indigenous people through the power to recognize the bands.

The *reserves* also helped to box the indigenous people into parcels of land that the Crown deemed fit for the purpose. It also helped to exploit and allocate the remaining lands to the European settlers for the benefit of the Crown.

The Indian Act of 1876, Section 20 states:

"**Possession of lands in a reserve**

20 (1) No Indian is lawfully in possession of land in a reserve unless, with the approval of the Minister, possession of the land has been allotted to him by the council of the band.

Certificate of Possession

(2) The Minister may issue to an Indian who is lawfully in possession of land in a reserve a certificate, to be called a Certificate of Possession, as evidence of his right to possession of the land described therein." (see https://laws-lois.justice.gc.ca/eng/acts/i-5/page-5.html#h-332093)

Ordinary reading of the above section clarifies the Crown's position related to indigenous land rights, even on the lands allocated as '*Indian reserves'*. The word 'traditional territories' is not part of the Crown's legal lexicon concerning indigenous people or their land rights. The relations defined by the Crown with regard to the rights of the indigenous people are defined by the Indian Act of 1876 and the recent First Nation Land Management Act of 1999 (see https://laws.justice.gc.ca/eng/acts/F-11.8/page-1.html). Both pieces of legislation reflect the Crown's desire to act as the '*guardian*' of its *'Indian wards'*. The paternalistic undertones of the legislative framework guiding the indigenous rights especially their land rights injure the equality doctrine under international law (Coté, 2001).

Articles 2 to 10 of the United Nations Declaration on the Rights of Indigenous Peoples (61/295) in 2007 provide clarification regarding indigenous rights to their lands. Article 10 states:

"Indigenous peoples shall not be forcibly removed from their lands or territories. No relocation shall take place without the free, prior and informed consent of the indigenous peoples concerned and after agreement on just and fair compensation and, where possible, with the option of return." (UN General Assembly, 2007).

In the seminal case of *Calder v. Attorney-General of British Columbia* (Calder v British Columbia, 1973), the Supreme Court of Canada upheld the recognition of the *Nisga* nation's title to their traditional, ancestral and unceded lands. The recognition of the indigenous title existence before the *Royal Proclamation of 1763*, effectively confirmed that the indigenous title to the lands pre-existed the colonial law, thus the aboriginal land title is not a derivative of the colonial law. This fine distinction is a landmark victory since the *Nisga* nation's aboriginal land title claim was rejected by the BC Supreme Court and also the Court of Appeal.

The seven-member bench of the Canada Supreme Court hearing the appeal was split in deciding: (1) if the aboriginal land title pre-dated Royal Proclamation 1763 and (2) if the land claim was still valid. Three members ruled that while the title pre-dated Royal Proclamation 1763, the land claim was extinguished in favor of the Confederation and upon colonial rule. Three members ruled that not only did the title preexist in the 1763 Proclamation, but the land

claim also was never extinguished either through treaty or statute. The seventh member ruled to dismiss the appeal on a technicality.

In *Guerin v. The Queen* (Guerin v The Queen, 1984), the Supreme Court of Canada held that the Crown owed a fiduciary duty to the indigenous people to establish Aboriginal title under the sui generis doctrine. This is a landmark case that allows the recognition of a separate identity for the Aboriginal law within the existing common law framework. The *Sui Generis* cloak for the aboriginal law, defined by the Court in Guerin created unique challenges for the Crown's assertion of sovereignty and the perceived benevolence towards aboriginal law (Borrows & Leonard, 1997).

In *The Tsilhqot'in Nation v. British Columbia* (Tsilhqot'in Nation v. British Columbia, 2014), the Supreme Court of Canada relied on Section 35 of the Canadian Constitution Act 1982. The Court in *ratio decidendi* held,

> "Pursuant to Sparrow (R v Sparrow, 1990), provincial regulation is unconstitutional if it results in a meaningful diminution of an Aboriginal right that cannot be justified pursuant to s. 35 of the Constitution Act, 1982. Pursuant to inter-jurisdictional immunity, provincial regulation would be unconstitutional if it impaired an Aboriginal right, whether or not such limitation was reasonable or justifiable." (Tsilhqot'in Nation v. British Columbia, 2014)

The Court's *obiter dicta* reliance on *Sparrow* clarifies the Section 35 usage in *ratio*. It held that:

> "Section 35(1) states that existing Aboriginal rights are hereby "recognized and affirmed". In Sparrow, this Court held that these words must be construed in a liberal and purposive manner. Recognition and affirmation of Aboriginal rights constitutionally entrenches the Crown's fiduciary obligations towards Aboriginal peoples. While rights that are recognized and affirmed are not absolute, s. 35 requires the Crown to reconcile its power with its duty. "The best way to achieve that reconciliation is to demand the justification of any government regulation that infringes upon or denies aboriginal rights" (Sparrow, p. 1109). Dickson C.J. and La Forest J. elaborated on this purpose as follows, on p. 1110:
>
> The constitutional recognition afforded by the provision therefore gives a measure of control over government conduct and a strong check on legislative power. While it does not promise immunity from government regulation in a society that, in the twentieth century, is increasingly more complex, interdependent and sophisticated, and where exhaustible resources need protection and management, it does hold the Crown to a substantive promise. The government is required to bear the burden of justifying any legislation that has some negative effect on any Aboriginal right protected under s. 35(1)." (Tsilhqot'in Nation v. British Columbia, 2014)

In *Tsilhqot'in* in *Conclusion* at para 153, the Supreme Court included the necessity of *prior consultation* with the indigenous people for any activities on their lands, as part of the Crown's fiduciary duty owed to the indigenous people recognized in *Guerin*.

The struggle of the indigenous people of North America, especially in Canada to protect their land rights and subsequently the rights to their natural environment, laws and culture are far from over. The case of the Wet'suwet'en nation against the passing of the TC Energy Canada pipeline through their lands in making its way through the Canadian judicial system. A quick and amicable solution is unlikely due to the Crown's assertion of its sovereignty, the allocation and use of the country's natural resources and the complexity of legal interpretations emerging from the statutory laws and legal precedents by the Courts.

4. Indigenous People of Brazil and Colonization

Brazil was colonized by the Portuguese subsequent to 1493 AD Pope Alexander VI's papal bull, "*Inter Caetera*". The Pope authorized Spain and Portugal to colonize the Americas and all of its indigenous people (Symcox & Sullivan, 2005). The colonization memory of the indigenous people in Brazil along with other contemporary nations in Central and South America is relatively fresh in terms of its brutality and violence. The complex land rights situation facing Central and South American indigenous nations post-colonization is beyond normative.

The abundance of earth's soil and subsoil resources in the region have made it a target for the natural resource-starved Europe since the 15th Century. The fifteenth-century colonization of the central and South American regions for their abundant natural resources has been replaced with corporate interests and geopolitical influences from their rich neighbors in North America and Europe.

Van Uhm et.al (2021) have argued that European colonization stressed the geographical sovereignty to exploit the natural resources of the indigenous people. The theory can be tested by looking at the historical examples of the East India Company (1600), the Dutch West Indies Company (1621), and the Hudson Bay Company (1670) etc. Most of these 'companies' were the vessels of the European Courts that would enter a lucrative region with a thriving economy as traders and subsequently pave the way for European armies to invade and colonize.

Brazil's indigenous people are distinct from the indigenous people in North America due to their continued presence in the vastitude of the Amazon. Their tribal way of life in the Amazon still reflects their strong linkages with their rich knowledge of the land. Similar to Canada's *Indian Act 1876*, the Brazilian *Indian Statute Law 6.001*, promulgated in 1973 defines an indigenous person. Article 3 of the 1973 Law states:

> "Any person with pre-Columbian origin who identifies himself as belonging to an ethnic group whose cultural characteristics distinguish it from the national society." (Góis, 2013)

Large populations of the Brazilian indigenous people were confined to Christian missionary 'villages' between the years 1686 to 1759. These confinements led to the spread of epidemics, killing thousands of indigenous people. The survivors (mostly men) were inducted into paramilitary forces to fight for the colonizers (Cunha, 2012). These and other brutal indigenous population control measures led to the annihilation of many indigenous tribes that have no surviving members today. There are only 900,000 indigenous people in Brazil today, out of the total population of 212 million (de Oliveira Martins Pereira, 2017).

Article 231 of theBrazilian Constitution 1988 provides for the protection and recognition of indigenous lands and culture as follows:

> "Indians shall have their social organization, customs, languages, creeds and traditions recognized, as well as their original rights to the lands they traditionally occupy, it being incumbent upon the Union to demarcate them, protect and ensure respect for all of their property." (see https://www.oas.org/es/sla/ddi/docs/acceso_informacion_base_dc_leyes_pais_b_1_en.pdf , page 152)

Article 231 of the 1988 Constitution further elaborates on the definition of indigenous lands. Article 231, Paragraph 1 through 6 provide clarity on the land title, possession and any usufruct from the lands that are possessed by the indigenous people. Paragraph 1 states,

> "Lands traditionally occupied by Indians are those on which they live on a permanent basis, those used for their productive activities, those indispensable to the preservation of the environmental resources necessary for their well-being and for their physical and cultural reproduction, according to their uses, customs and traditions." (see https://www.oas.org/es/sla/ddi/docs/acceso_informacion_base_dc_leyes_pais_b_1_en.pdf , page 153)

Brazil severed all ties with its European colonizers and became a Federal Union. This is distinct from Canada, which has ties with the colonizers, accepting the reign of the British Crown as its sovereign. The Brazilian Constitution 1988, Article 231, Paragraphs 2 and 4, specifically provides for the 'inalienable' and 'permanent possession' of indigenous lands by the indigenous people. It states:

> "Paragraph 2. The lands traditionally occupied by Indians are intended for their permanent possession and they shall have the exclusive usufruct of the riches of the soil, the rivers and the lakes existing therein.
>
> Paragraph 4. The lands referred to in this article are inalienable and indisposable and the rights thereto are not subject to limitation." (see https://www.oas.org/es/sla/ddi/docs/acceso_informacion_base_dc_leyes_pais_b_1_en.pdf page 153)

The provisions of Article 231 of the Brazilian Constitution 1988 are distinct from the indigenous land provisions provided in Section 20 of the Canadian Indian Act of 1876.. While the Brazilian Constitution 1988 protects and provides for inalienable, permanent possession of indigenous lands by the indigenous people, the indigenous people of Canada can only inhabit their indigenous lands at the pleasure of the Crown.

Article 67 of the Brazilian Temporary Constitutional Provisions Act of 1988 states "*The Union shall conclude the demarcation of the Indian lands within five years of the promulgation of the Constitution* (see https://pdba.georgetown.edu/Constitutions/Brazil/tcpa.html#:~:text=Brazil%27s%201988%20Constitution%20with%20the%201996%20reforms%2C%20Temporary,the%20National%20Congress%20shall%20take%20an%20oath%20to) . The 'Marco temporal' or the 'time limitation stated in Article 67 above has caused constitutional challenges for the indigenous land rights in Brazil. The 'Marco Temporal' is not defined in the Brazilian Constitution of 1988 and does not dilute the protections afforded to indigenous land rights under Articles 231 and 232.

The 'Marco Temporal' provision expired on October 5th, 1993. The process of demarcation has continued due to the non-binding nature of the 'Marco temporal' clause. The process of demarcating indigenous lands, however, has faced much opposition from the farming lobby. Data is difficult to obtain as to the true extent of indigenous land demarcation in Brazil due to a myriad of laws and the slow pace of the demarcation process.

As of 2009, only 431 of the 634 indigenous land parcels identified were demarcated as indigenous lands (Santilli, 2016). Conselho Indigenista Missionári or CIMI was formed to document and defend the rights of Brazilian indigenous people in 1972. In its 2019 report, it states:

> "It should be noted that of 1,298 indigenous lands in Brazil, 829 (63%) are pending something from the government to finalize its demarcation process and registration as a traditional indigenous territory with Brazil's Department of National Heritage (Secretaria do Patrimônio da União, SPU). Of these 829, a total of 536 lands (64%) have had zero action from the government." (see https://cimi.org.br/wp-content/uploads/2020/10/Executive-Summary-2019-cimi_ingles.pdf)

Violent land disputes between indigenous communities and illegal land occupiers due to deforestation are an undisputed fact. Many Guajajara people have been hunted by loggers, defending the ancient rainforest (Neto, 2020). The Guajajara people are located in the Arariboia indigenous territory. It houses the Guajajara and Tentehar people in the central-west

of Maranhão state. Guajajara people are considered the defenders of the eastern edge of the Amazon Forest.

The indigenous land protection afforded in the Brazilian Constitution of 1988 is far greater than in Canada. However, the farming lobby in Brazil has played a crucial role in watering down the Constitutional protections afforded to the indigenous land rights under Articles 231 and 232 (see https://www.oas.org/es/sla/ddi/docs/acceso_informacion_base_dc_leyes_pais_b_1_en.pdf page 153). The recent present government of Brazil has come under intense local and international criticism for its stance on upholding the rights of indigenous people. The present President of Brazil made a campaign promise to not allow any demarcation of indigenous lands under his government to promote the interest of the logging and farming industries. CIMI in its 2019 report states:

> "President Bolsonaro and his administration, through its Ministry of Justice, returned 27 demarcation processes to the National Indian Foundation (FUNAI)…. in 2019, 256 cases of possessory invasions, illegal exploitation of resources, and property damages were recorded in at least 151 indigenous lands, of 143 indigenous peoples, in 23 states…. these data reveal an extremely worrying reality: last year alone, there was an increase of 134.9% of cases related to invasions compared to those recorded in 2018. This represents more than double the 109 cases recorded in 2018." (see https://cimi.org.br/wp-content/uploads/2020/10/Executive-Summary-2019-cimi_ingles.pdf)

The Brazilian Supreme Court ("Supremo Tribunal Federal-**STF**") is currently hearing a case concerning the 'Marco temporal' clause and Indigenous land rights (STF Recurso Extraordinário 1.017.365, 2005). The Extraordinary Appeal 1.017.365 before the STF rests on two opposing arguments. The STF has to rule; (1) if there is a time frame (Marco temporal) under the Constitution for the indigenous people to claim their traditional land titles (2) that the indigenous people must prove their land possession at the time of 1988 Constitutional promulgation (Attorney General's view) or the STF must uphold the "*indigenato*" thesis that states the indigenous peoples' ancestral rights to their lands preceding the federal union (indigenous peoples' appeal). It remains to be seen, what would be the outcome of the case.

5. Conclusion

Canada and Brazil provide an interesting study for indigenous rights under IL. While the corpus of IL concerning indigenous rights is heavily influenced by English as well as French law, it has added dimensions that are dynamic and speak to the evolving needs of the time. The 2007 UN Declaration on the Rights of Indigenous Peoples, the American Convention on Human Rights, and the International Labour Organisation Convention No.169 speak to the indigenous rights and their inalienable rights to their traditional lands. It is an entirely different matter how these bodies of IL concerning indigenous rights are being incorporated into the municipal laws.

Canada is working on its relationship with the indigenous people. It's a work in progress. The recent findings of unmarked children's graves in the residential schools are another sensitive matter that exposes the fissures beneath the veneer of normalcy that defines secular Canadian race relations. Such socio-economic complexities juxtapositioned with the scars of colonization make it difficult the balance various rights and obligations, wherever they may rest. The indigenous people of Canada have been active in raising their claims for the protection of their traditional lands. The trend is unlikely to change.

Brazil's share of the Amazon Forest encompasses biodiversity that is critical to the earth's natural environment. The indigenous people of Brazil are less than 900,000 compared to its total population of 212 million. The indigenous people of Brazil have been subjected to 500 years of brutal colonization that continues to this day in one form or another. Their struggle to maintain their traditional way of life while safely protecting their natural environment comes at a great price.

Both Canada and Brazil have non-native populations controlling the land resources. Both countries are success stories of capitalism. The laws in both countries provide for the protection of indigenous populations albeit with a different mindset. The pristine natural environments in both countries are the shared heritage of the global community. It is the responsibility of the international community to support the indigenous people's right to their traditional lands if we are to see our future generations experience the biodiversity of these two distinct natural environments.

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