

THE ECONOMICS OF PLASTIC WASTE MANAGEMENT: ASSESSING THE IMPACT OF GLOBAL POLICY SHIFTS ON RECYCLING MARKETS

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Abstract: Plastics constitute more than 80 percent of marine litter, significantly impacting the aquatic environment, climate, public health, and socio-economic conditions. In response to this environmental challenge, the European Union (EU) has introduced new regulations designed to reduce plastic use. Countries such as Germany and Denmark have increased excise duties on disposable tableware and carrier bags. This study aims to assess the impact of international regulations on global recycling markets. Data on recycling rates of plastic packaging materials were collected from Eurostat to closely examine the effects of these changes. The results indicate that regulatory shifts, including new laws and bans on plastic use, have resulted in a downward trend in recycling rates in Europe since 2017 and more broadly a negative impact on the recycling market. Future research should explore how these regulations, including the plastic packaging tax and China's plastic ban, impact specific industries such as retail, food and beverage, and cosmetics.

Keywords: Plastics; Recycling; Taxes; Regulations; Bans

1 INTRODUCTION

A significant number of countries have passed regulations to address the use of plastics. In Europe, many policies have focused on reducing plastic waste. The EU has introduced a levy to regulate plastic use and has banned various plastic products, such as stirrers, plates, cutlery, and cotton buds. Existing measures to reduce plastic use include taxes, regulatory bans, licensing requirements, and littering levies. European countries such as Germany have raised excise duties on disposable tableware and carrier bags. Additionally, they have imposed levies on plastic products such as food and beverage containers and beverage cups. The purpose of this study is to analyze the impact of these international regulations on the global recycling markets.

1.1 Research Questions

How have international regulations on plastic use affected global recycling markets?
What are the economic implications of reducing plastic use?

1.2 Significance of the Study

This study will help policymakers understand the effects of various measures, such as plastic taxes and levies, on plastic use. It will also help them gauge the effectiveness of plastic bans. Additionally, the study will offer insights into the economics of plastic bans, specifically how they have affected various businesses including waste management companies and recycling facilities. The research will also highlight the alternative materials companies have adopted to replace plastics in response to these bans, providing valuable guidance for future policy decisions.

2 LITERATURE REVIEW

Kumamaru and Takeuchi [1] examined the effects of China's import ban on plastics. The authors argued that the prices of plastics decreased significantly after the imposition of these bans. Trade surpluses in both China and Japan also fell as a result. The purpose of these import bans was to reduce plastic debris in the oceans and mitigate environmental pollution. As a consequence of the import bans, the number of plastics supplied to China decreased significantly, leading to economic losses for companies that previously relied on plastic waste orders.

Wen et al. [2] also analyzed China's plastic ban, noting that it drastically reduced global plastic trade flows. Global plastic waste has generally flowed from developed to developing countries. Prior to the ban, China was the largest importer of plastic waste, receiving 8.88 million tons annually. The country was also the largest producer of plastic materials, exporting plastic products to various countries. When China banned plastic imports, the global plastic waste trade flow was significantly reduced.

The global recycling trade had long benefited China's economy. The country earned substantial revenue from importing plastic waste and manufacturing plastic products. However, importing plastic waste was damaging to the environment, which led China to introduce the ban. The ban had adverse economic effects on developed countries, which had previously relied on developing nations to handle plastic waste. While developed countries like the UK and the USA had effective waste disposal systems, they preferred exporting plastic waste due to stringent environmental regulations

and high disposal costs [3], relying on developing countries to accept this waste. As a result of China's refusal to continue receiving the waste, it was redirected to other Asian countries.

China's plastic ban reshaped the recycling supply chain in the United States. Exports of recycled paper products to China decreased, as China reduced its imports of U.S. paper waste and plastics. Domestic prices for recovered paper in the U.S. have been decreasing since 2017 [4], leading to lower revenues for the paper recycling industry. The volume of recovered products exported to China fell by 25%, and the number of recycling facilities in the U.S. also decreased. Despite the decline in the number of recycling facilities, those that remain have increased investments to upgrade their recycling processes.

Ren et al. [5] highlighted that many European countries have implemented measures to reduce plastic waste, including introducing fees, charges, duties, and new taxes on plastic products. The growing number of new taxes, duties and levies has had a significant impact on organizations, requiring them to adjust internal procedures and processes. Businesses have had to familiarize themselves with current levies and taxes, which have implications for pricing and invoicing. These organizations have faced higher costs due to the plastic levies and have had to hire and train employees to ensure compliance.

Syberg et al. [6] reviewed legislation aimed at controlling plastic use, including the EU's Packaging Waste Directive, Waste Framework Directive, and the Plastic Bags Directive. They argued that increased legislation on plastic use has restricted businesses' ability to trade in plastic products. Companies engaged in activities involving plastic products must notify taxation bodies and pay charges if they exceed usage limits. Additionally, companies using plastic waste are required to register with waste management authorities.

Ren et al. [5] further observed that organizations have been forced to adopt alternative materials to comply with plastic use regulations. Raw polymer and plastic-sourced materials have attracted taxes in various countries, so many companies have started using biodegradable packaging materials, such as cardboard and paper, as well as glass, metal, and bioplastics. Glass is now commonly used for packaging cosmetics, beverages, and food. Steel and aluminum are used for food and beverage containers, with the latter used to produce beverage cans in particular. Companies have also adopted bioplastics made from sugarcane and corn starch for bags and food packaging.

Some companies importing plastics have been required to pay pollution taxes. Governments have set taxes based on the quantity of plastic used. To avoid these taxes, many companies have switched to plant-based materials, textiles, wood, and bamboo. Firms have also used agricultural waste and mushroom mycelium to produce containers. Other alternative materials include natural fibers such as jute and cotton for packaging and bags [7]. Wood is used for pallets and crates, while bamboo is used to produce containers and cutlery. While these materials help reduce plastic use, investing in alternative packaging has increased operational costs for firms.

Wen et al. [5] also noted that many stores in areas with plastic bans experienced a decline in sales, while stores in areas without plastic bans experienced growth. Consumers chose stores that were not impacted by plastic bans, and retailers and wholesalers dealing in plastic products had to pass on additional fees and taxes to consumers. Stores in regions with plastic bans also saw a reduction in jobs, leading to higher unemployment rates. The plastic recycling sector, which employs many people in Europe and Asia, has been particularly impacted by these changes.

Organizations that import or manufacture plastic packaging materials have been required to register for taxes in European countries. After registration, they must file tax returns with various bodies and store evidence and documentation on plastic packaging. Penalties have been introduced for organizations that fail to register for taxes or submit returns [4]. As a result, organizations have had to seek guidance on how to comply with new plastic use regulations and laws.

Environmental protection laws have had a significant impact on the recycling market. Many enterprises have faced sanctions for violating these laws, including censure, criminal detention, and suspension of operations. As a result, some plastic recycling companies have relocated to regions with less stringent regulations, such as Southeast Asia [7]. These companies have been attracted by tariff exemptions, lower shipping costs, and the ease of obtaining recycling licenses.

Plastic recycling companies have supplemented the shortage of plastic materials by relying on half-finished products, domestic materials, and virgin plastics. Countries like Germany and China have regulated the use of plastic materials by enacting legislation, but companies can still access domestic waste plastics [4]. However, domestic recycling of waste plastics has been insufficient to meet demand. As a result, medium-sized enterprises in the recycling sector have gone out of business due to reduced recycling volumes.

Plastic packaging pollution has raised concerns about human health, animal welfare, and environmental damage, in both urban and rural areas. Plastic waste management has become a major concern in developed and developing countries alike. Several directives have been introduced to reduce lightweight or single-use plastic bags [7], with many countries implementing bans on single-use plastics due to their harmful effects on oceanic ecosystems and on marine life in particular.

3 METHODOLOGY

Quantitative research was conducted to analyze the effects of plastic use regulations and laws on the recycling market. Data on the recycling rates of plastic packaging materials were collected from Eurostat to assess the impact of existing regulations. The study focused on the annual recycling rates of the European Union from 2017 to 2022, as significant regulatory changes occurred during this period. Notably, China banned plastic imports in 2017, and the European Union

introduced new waste legislation in 2018. Line graphs were used to visualize trends and patterns in the recycling rates over the specified period.

4 RESULTS

The results indicate that regulatory changes, such as new laws and regulations on plastic use, have had a significant impact on the recycling market. Recycling rates began to decline in most European countries starting in 2017. The average recycling rate in 2017 was 67.5%, while by 2022, it had decreased to 65.4%. Some countries in Europe exhibited lower recycling rates than others, indicating that the recycling markets in certain countries, such as Hungary, is considerably smaller than those in countries like Germany.

Recycling Rates:

Table 1 Recycling rates from 2017-2022 across the EU

Year /region	2017	2018	2019	2020	2021	2022
European Union	67.5	65.6	64.8	64	64	65.4
Hungary	49.7	46.1	47	52.4	47	44.6
Denmark	71.5	70.1	69.3	64	64.7	64.9
Germany	69.9	68.5	64	68.1	67.9	68.5

Note. Numbers are provided for the EU as a whole and for selected countries for comparison.

As shown in Table 1, line graphs of the recycling rates over the five-year period showed a general decrease in recycling rates. The graphs visually represented changes in the recycling market, indicating that some countries experienced a more rapid decline in recycling rates than others. For example, Denmark's recycling rate fell from 71.5% in 2017 to 64.9% in 2022, while Germany's rate only slightly decreased from 69.9% to 68.5% over the same period. Data on recycling rates across various markets indicated an overall downward trend.

Changes in the Recycling Market:

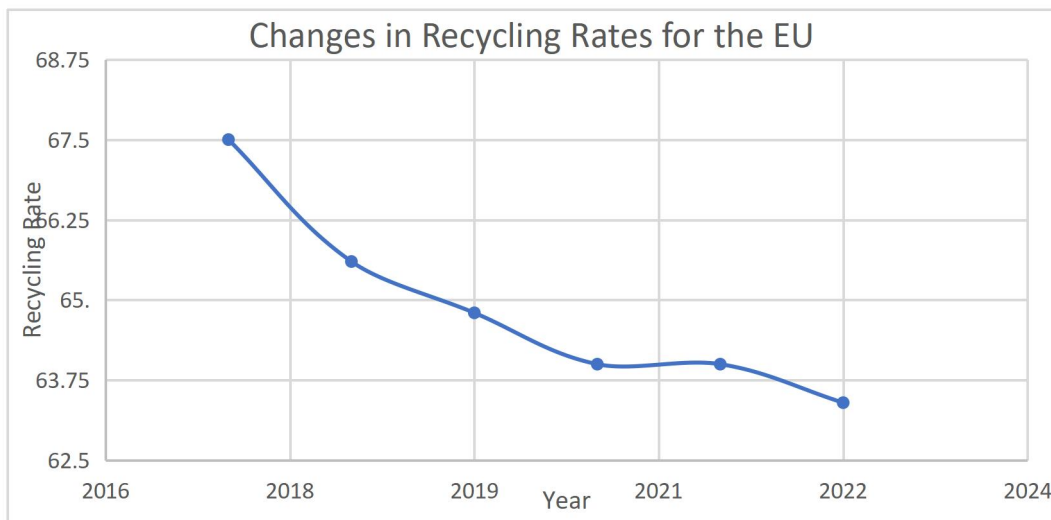


Figure 1 Overall trend in recycling rates for the EU from 2017 to 2022

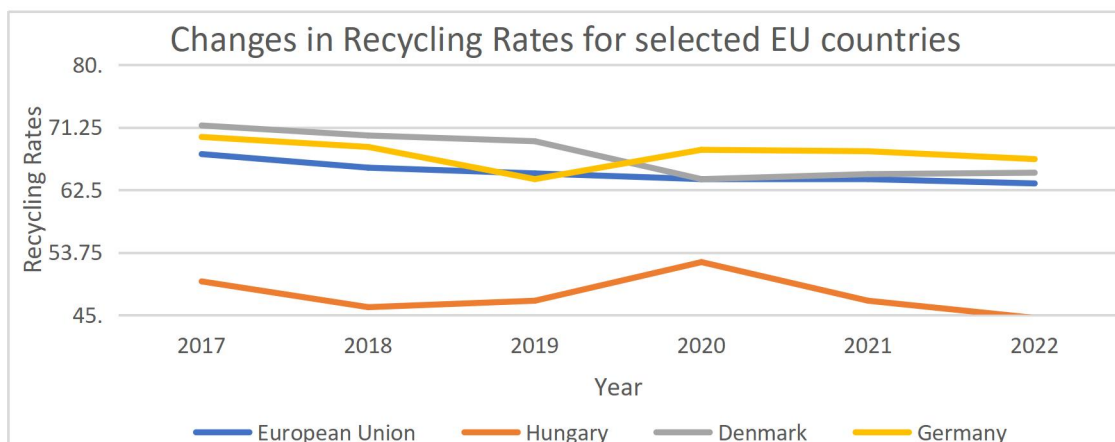


Figure 2 Trends in recycling rates for the EU compared to selected countries from 2017 to 2022

In Figure 1 and Figure 2, as mentioned in the Literature Review, the decline in recycling rates can be attributed to several factors, including regulatory changes that disrupted the recycling supply chain. These changes have led to challenges in sourcing plastic waste and increased costs for companies in the recycling sector. The impact of these shifts is reflected in the observed decrease in recycling market volumes, particularly in countries where recycling infrastructure is less robust.

5 DISCUSSION

The downward trend in recycling rates across various markets suggests that international regulations, such as China's plastic import ban and new laws developed by the European Union, have had a negative effect on the global recycling market. These findings are consistent with the research done by Kumamaru and Takeuchi [1], who found that plastic bans resulted in significant decreases in the prices of recycled materials or other products in the recycling market. Similarly, Syberg et al. [6] noted that regulations on plastic use increased operational costs for companies and disrupted established supply chains.

The global recycling market has been significantly disrupted by plastic use bans. Many countries previously relied on China to supply plastic packaging materials, and China's ban has had a direct economic impact on these countries. Recycling markets have shrunk because companies are now struggling to source the required plastic materials. Moreover, companies have faced increased costs to comply with new regulations and to use alternative materials in place of plastics. They have incurred taxes, fines, and levies [7], all of which have contributed to the rising cost of production.

To avoid these additional costs, many companies have turned to alternatives such as glass, biodegradable materials, and plant-based packaging. However, sourcing these materials has proven challenging and has led to disruptions and complexity in the supply chain. Additionally, the imposition of new levies, along with regular audits, has created higher compliance and reporting costs for businesses, increasing their administrative burden and overall operating expenses. As a result, the global recycling market has undergone a contraction, with many recycling companies closing down or scaling back operations.

The decline of the recycling market has had adverse effects on businesses and individuals. Recycling firms, faced with lower revenues, have downsized and laid off workers to reduce operational costs. Consequently, the declining recycling market has contributed to job losses, particularly in industries related to waste management and recycling. Consumers have also been impacted by these changes, as the cost of plastic packaging materials has risen. Companies have passed these additional costs onto consumers, leading to higher prices for goods that rely on plastic packaging [4].

In the short term, from a strictly economic point of view, the results suggest that neither businesses nor consumers have benefited from the new legislation or import bans. Although the demand for recycled plastics has increased, the supply of these materials has decreased due to the disruptions in the recycling market. However, the bans on plastic use have led to a reduction in environmental pollution, with fewer plastic materials being disposed of in oceans and landfills. Thus, it could be claimed that the regulatory changes have been at least partially successful in achieving their intended goal, and the long-term benefits to society may eventually outweigh the economic downsides or instability.

6 CONCLUSION

This study investigated the effects of international regulations for plastic use on global recycling markets and examined the economic implications of reducing plastic use. The findings indicate that the global recycling market began to decline after various legislative measures were implemented to regulate plastic use. Recycling rates in several European countries, including Germany, Hungary, and Denmark, have decreased over the past several years. The average recycling rate for the European Union has also shown a decline during this period. Overall, international recycling markets have been completely transformed due to the imposition of new bans and legislation.

To ease the transition to reduced plastic usage, organizations must ensure compliance with plastic packaging taxes and regulations. This includes ensuring that employees are aware of relevant taxes and laws and conducting regular audits to assess waste management and plastic usage. Furthermore, organizations should explore sustainable alternatives, such as glass, bioplastics, and biodegradable materials, to reduce their reliance on plastic packaging. Optimizing operations can help reduce operating costs in the long term. Firms should also adjust their pricing strategies to reflect the new taxes on plastic packaging and educate consumers on the importance of these changes [4]. Adequate training on sustainability, compliance, and plastic reduction will be crucial for the future of businesses in this sector. Companies should also develop systems to track their recycling and plastic usage rates, further reinforcing their compliance procedures.

Future research should focus on the impact of international regulations, such as the plastic packaging tax and China's plastic ban, on specific industries such as retail, cosmetics, beverages, and food production. Additionally, further research is needed to explore the viability of alternative materials, particularly plant-based options. Researchers should also examine how plastic use taxes and bans are affecting industries in countries beyond Europe and the U.S.A.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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