The Impact of Fiscal Incentives on the Indonesian Recycling Industry: A General Equilibrium Analysis

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ABSTRACT

The recycling industry plays a strategic role in supporting sustainable economic growth through waste reduction, increased resource efficiency, and job creation. Providing fiscal incentives, such as tax breaks, subsidies, or reduced import duties on environmentally friendly machinery/technology, is believed to be able to strengthen the competitiveness of the recycling industry. This study aims to assess the impact of fiscal incentive policies on the macro economy, including growth, income, and welfare distribution, using a Computable General Equilibrium simulation model. The main design of this study uses a quantitative approach with Computable General Equilibrium. The results show that fiscal incentive policies through bonded recycling zones have been proven to increase the competitiveness of the recycling industry by encouraging real household consumption, exports, and reducing raw material import costs. However, its positive impact on the national economy is still limited and poses challenges in the form of declining domestic demand for local raw materials and potential negative impacts on the informal sector. Therefore, the long-term success of the Bonded recycling zones policy requires regulatory refinements, more targeted incentives, and investment support in research and technology to strengthen the recycling industry and optimize the potential of the circular economy in Indonesia.

Keywords*: Bonded Recycling Zones, Circular Economy, Computable General Equilibrium, Fiscal Incentives, Indonesia, Recycling Industry.*

ABSTRAK

Industri daur ulang memiliki peran strategis dalam mendukung pertumbuhan ekonomi berkelanjutan melalui pengurangan limbah, peningkatan efisiensi sumber daya, dan penciptaan lapangan kerja baru. Pemberian insentif fiskal, seperti keringanan pajak, subsidi, atau pengurangan bea masuk terhadap mesin/teknologi ramah lingkungan, diyakini mampu memperkuat daya saing industri daur ulang. Penelitian ini bertujuan untuk untuk menilai dampak kebijakan insentif fiskal terhadap perekonomian secara makro, baik dalam aspek pertumbuhan, pendapatan, maupun distribusi kesejahteraan, dengan pendekatan simulasi model Computable General Equilibrium. Desain utama penelitian ini menggunakan pendekatan kuantitatif dengan CGE. Hasil penelitian menunjukan bahwa kebijakan insentif fiskal melalui kawasan daur ulang berikat terbukti mampu meningkatkan daya saing industri daur ulang dengan mendorong konsumsi riil rumah tangga, ekspor, serta menurunkan biaya impor bahan baku. Namun, dampak positifnya terhadap perekonomian nasional masih terbatas dan menimbulkan tantangan berupa menurunnya permintaan domestik terhadap bahan baku lokal serta potensi dampak negatif bagi sektor informal.

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Oleh karena itu, keberhasilan jangka panjang kebijakan kawasan daur ulang berikat membutuhkan penyempurnaan regulasi, insentif yang lebih terarah, serta dukungan investasi riset dan teknologi untuk memperkuat industri daur ulang dan mengoptimalkan potensi ekonomi sirkular di Indonesia.

***Kata kunci**: Kawasan Daur Ulang Berikat, Ekonomi Sirkular, Keseimbangan Umum Terhitung, Insentif Fiskal, Indonesia, Industri Daur Ulang.*

INTRODUCTION

The circular economy is a growing global issue, driven by the increasing demand for waste management to maintain the sustainability of environmental ecosystems. In 2024, Earth Day highlighted the global dangers of plastic waste, encouraging the elimination of single-use plastics, promoting the United Nations agreement on plastic pollution, and calling for an end to fast fashion consumption (EarthDay, 2024). The problem of plastic and textile waste from fast fashion is tied to the current linear economic model, which follows a take-make-dispose pattern. According to Naoko Iishi, Co-Chair of the Platform for Accelerating the Circular Economy (PACE), only 9% of extracted resources are reused after their initial use in production systems (World Economic Forum, 2019). This low recycling rate accelerates resource depletion and threatens environmental sustainability. The circular economy offers a closed-loop system, ensuring resources remain in the product lifecycle for as long as possible, reducing waste and promoting sustainability (Barrie et al., 2022).

Indonesia, as the fourth most populous country with 279 million people, produced 17.7 million tons of waste in 2023, accounting for 0.9% of global municipal solid waste (World Population Review, 2023). This high waste volume reflects significant public consumption, which is proportional to population growth (Kaza et al., 2018). Most consumed products are still produced linearly, leading to environmental issues such as resource depletion, environmental degradation, and climate change (Bappenas, 2020). To address these challenges, the Indonesian government has adopted the circular economy concept through the 2020-2024 National Medium-Term Development Plan (*Rencana Pembangunan Jangka Menengah Nasional*/RPJMN), aiming to strengthen economic resilience, enhance environmental sustainability, and improve disaster and climate resilience (Bappenas, 2020). This plan prioritizes five sectors: food and beverage, retail, textiles, construction, and electronics, due to their significant contribution to Indonesia's Gross Domestic Product (GDP) and employment (Mas et al., 2024).

Based on the 3P approach, profit, planet, and people, Ministry of National Development Planning (*Badan Perencanaan Pembangunan Nasional*/Bappenas) estimates that a circular economy could boost Indonesia's GDP by 593-638 trillion-rupiah, equivalent to 2.3% of GDP in 2020, and create 4.4 million jobs, 75% of which would employ women (Bappenas, 2020). These benefits extend beyond economic growth, reducing waste by 52% and emissions by up to 126 million tons, or 9% of current emission levels, in the priority sectors (Hasid et al., 2022). Such reductions decrease negative externalities, improving health, lowering environmental costs, and enhancing productivity (Liana et al., 2024). The government can redirect these savings to sectors like education or provide fiscal incentives to support micro, small, and medium enterprises (MSMEs), which are critical for inclusive growth (Mahi, 2019).

The Indonesian government supports the circular economy through Bonded Recycling Zones (*Kawasan Daur Ulang Berikat*/KDUB), regulated under Government Regulation Number 32 of 2009, amended by Number 85 of 2015, managed by the Directorate General of Customs and Excise (Wahyudi et al., 2023). KDUBs are bonded storage areas where imported or local waste is recycled into value-added products. They offer fiscal incentives, such as import duty suspensions and tax exemptions, and non-fiscal incentives, like automated import notifications. However, as of 2024, KDUBs have not been widely utilized due to incomplete regulations and complex requirements (Yulianthi,

2025). According to Wahyudi et al. (2023), the lack of clear implementing regulations has hindered businesses from leveraging KDUBs, indicating a gap in understanding the macroeconomic impacts of these fiscal incentives in Indonesia. Previous studies, such as those on renewable energy or electric vehicles, have analyzed fiscal incentives using Computable General Equilibrium (CGE) models but have not focused on the recycling industry in Indonesia (Bohringer et al., 2013; Guo et al., 2021). This study addresses this research gap by evaluating the macroeconomic effects of KDUB fiscal incentives on Indonesia's recycling industry using a CGE approach.

The objective of this study is to assess how fiscal incentives through KDUB impact Indonesia's macroeconomy, including economic growth, income distribution, and welfare, using a CGE model based on the 2016 Input-Output Table. By analyzing these effects, the study aims to provide evidence-based recommendations for refining KDUB regulations and optimizing the circular economy's potential in Indonesia. This research is critical for policymakers to balance import-driven cost reductions with domestic production and informal sector support.

LITERATURE REVIEW

Choosing the right economic model is key to understanding the impacts of fiscal policies on the economy. According to Böhringer and Löschel (2006), Computable General Equilibrium (CGE) models are widely used because they capture interactions between economic sectors and agents, providing a complete picture of policy effects. Unlike Partial Equilibrium (PE) models, which only look at specific markets, CGE models consider how changes in one sector affect others, making them ideal for complex policies like fiscal incentives (An et al., 2023). For example, Allan et al. (2014) used CGE to study carbon taxes in Scotland, while Dartanto (2013) analyzed fuel subsidy reforms in Indonesia, showing how CGE models reveal macroeconomic impacts. These studies prove CGE's ability to handle broad policy questions, but its use in Indonesia's recycling sector is still rare, highlighting a clear research gap (Nugroho & Amir, 2018). This gap emphasizes the need to explore recycling incentives using CGE to inform Indonesia's policy decisions.

CGE models are grounded in economic theories that describe how agents behave through mathematical equations, ensuring a balanced economy (Burfisher & Thierfelder, 2024). Bae and Cho (2010) used a dynamic CGE model to examine South Korea's hydrogen economy, showing how it predicts long-term policy outcomes. Similarly, O'Ryan et al. (2005) applied CGE to environmental policies in Chile, highlighting its strength in capturing cross-sectoral effects. These examples show why CGE is suitable for studying fiscal incentives in recycling. This study uses the Wayang CGE model, designed for Indonesia, to fill the gap by analyzing the macroeconomic effects of KDUB policies (Wittwer, 1999). The model's focus on Indonesia's economy makes it a strong tool for this research.

Fiscal incentives, like tax exemptions and subsidies, play a big role in promoting sustainable industries. According to Freire and Ho (2018), environmental fiscal reforms can deliver a "double dividend" by improving both the environment and economic welfare. In Malaysia, Pui and Othman (2017) found that fuel efficiency incentives cut emissions and boosted economic growth, but Bor and Huang (2010) warned that poorly designed subsidies can strain government budgets. In Indonesia, fiscal incentives for gas pricing improved industrial competitiveness, though they needed careful planning to avoid unequal economic impacts (Nugroho & Amir, 2018). Table 1 summarizes key studies on fiscal incentives for sustainable industries, such as renewable energy and electric vehicles, showing their economic and environmental effects (Johansson & Kriström, 2019; Guo et al., 2021). These studies provide insights for designing effective recycling policies.

Table 1. Key Studies on Fiscal Incentives for Sustainable Industries

Title and country studied	Researchers	Journal, year
Theme: renewable energy		
Welfare evaluation of subsidies to renewable energy in general equilibrium: Theory and application in Sweden	Johansson and Kriström (2019)	Energy Economics, 2019
Employment impacts of renewable energy policies in China: A decomposition analysis based on a CGE modeling framework in China	Mu et al. (2018)	Applied Energy, 2018
Are green hopes too rosy? Employment and welfare impact of renewable energy promotion in Germany	Böhringer and Löschel (2006)	Energy Economics, 2013
Theme: electric vehicle		
Environmental and economic consequences of the incentive policy on the electric vehicle industry: A CGE-based study in China	Guo et al. (2021)	Resources, Conservation & Recycling, 2021
The optimal subsidy on electric vehicles in German metropolitan areas: A spatial general equilibrium analysis in Germany	Hirte & Tscharaktschiew (2013)	Energy Economics, 2013
Other themes: Bioenergy and Hydrogen economy		
Providing adequate economic incentives for bio energies with CO2 capture and geological storage	Ricci (2012)	Energy Policy 2012
A dynamic general equilibrium analysis on fostering a hydrogen economy in Korea	Bae and Cho (2010)	Energy Economics, 2010

The studies in Table 1 offer a useful comparison for recycling incentives, showing the importance of tailored policies to balance economic and environmental goals. Johansson and Kriström (2019) studied renewable energy subsidies in Sweden, finding small welfare gains that depended on how the subsidies were funded. Mu et al. (2018) showed that renewable energy policies in China created 41,100 jobs, though the benefits varied across sectors. These findings suggest fiscal incentives can drive growth but need technological support to maximize sustainability. In Indonesia, no CGE-based studies have explored fiscal incentives for the recycling industry, particularly KDUB, making this research crucial for understanding their macroeconomic potential (Wahyudi et al., 2023).

The circular economy aims to reduce waste by keeping resources in use for as long as possible. According to Barrie et al. (2022), over 520 global policies focus on waste management and recycling, showing the growing importance of circular economies. In Indonesia, the 2020-2024 RPJMN targets sectors like textiles and electronics to cut waste and emissions, aligning with circular economy goals (Bappenas, 2020). Aithal and Aithal (2023) argue that industries like manufacturing need specific circular strategies due to their unique resource demands, which is relevant for designing recycling incentives. These policies help improve resource efficiency and support economic growth. Indonesia's focus on the circular economy reflects its commitment to sustainable development, but more research is needed to evaluate specific policies like KDUB.

Freire et al. (2022) used CGE to study waste taxation in Europe, finding it reduced waste but had mixed economic effects. Shih et al. (2024) modeled plastic waste recycling incentives, showing they improve efficiency but may lower demand for local materials. These studies highlight the challenges of balancing economic and environmental goals in recycling policies. The lack of CGE studies on recycling incentives in Indonesia makes this research vital for evaluating KDUB's impact on the circular economy. This study builds on these findings to provide insights for Indonesia's recycling policies, ensuring they support sustainable growth.

Fiscal policies for sustainable industries must balance economic, environmental, and social outcomes. According to Gelan (2018), electricity subsidy reforms in Kuwait cut emissions but raised household costs, showing the trade-offs in policy design. In China, Liu and Lu (2015) found that recycling carbon tax revenues can reduce welfare losses while promoting green production, a strategy relevant for Indonesia's KDUB (Li &

Zhang, 2023). These policies must also protect informal sectors, like waste collectors, which are vital in Indonesia (Hasid et al., 2022). This balance is critical to ensure equitable growth.

Acar and Yeldan (2016) showed that coal subsidies in Turkey harmed the environment, stressing the need for sustainability-focused incentives. Guo et al. (2021) found that electric vehicle subsidies in China increased production but raised emissions without new technology. These mixed results highlight the importance of careful policy design. In Indonesia, the environmental and social impacts of KDUB, especially on informal workers and local material demand, are underexplored, making this study essential for sustainable policy development (Wahyudi et al., 2023). This research addresses these gaps to guide effective KDUB implementation.

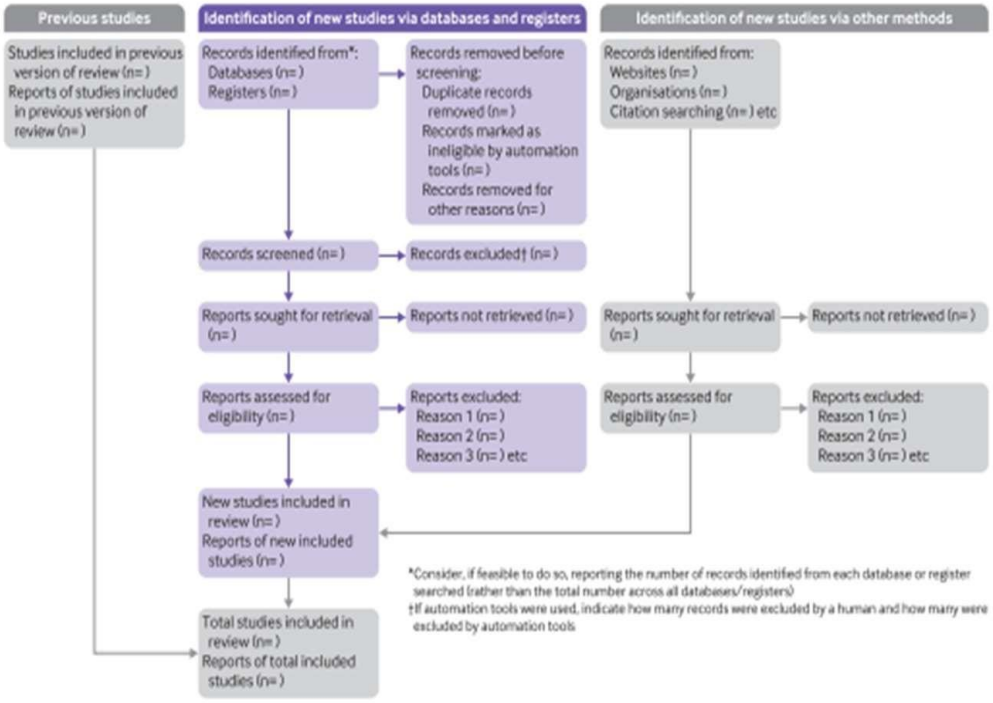
RESEARCH METHODS

This study uses a quantitative approach with a CGE model to evaluate the macroeconomic impacts of fiscal incentives through KDUB in Indonesia. The CGE model, specifically the Wayang model, is chosen because it captures interactions between economic sectors and agents, providing a comprehensive view of policy effects. The model is based on the 2016 Input-Output (IO) Table from Indonesia's Central Bureau of Statistics, selected due to its detailed sectoral data, though it may not reflect recent economic changes due to its age. This limitation is addressed by validating key assumptions with updated trade and fiscal data. The model simulates the effects of removing import tariffs on recycled raw materials, such as plastics, to assess changes in economic indicators like GDP, employment, and trade.

Table 2. Number of Articles Based on Search Using the Publish or Perish Application

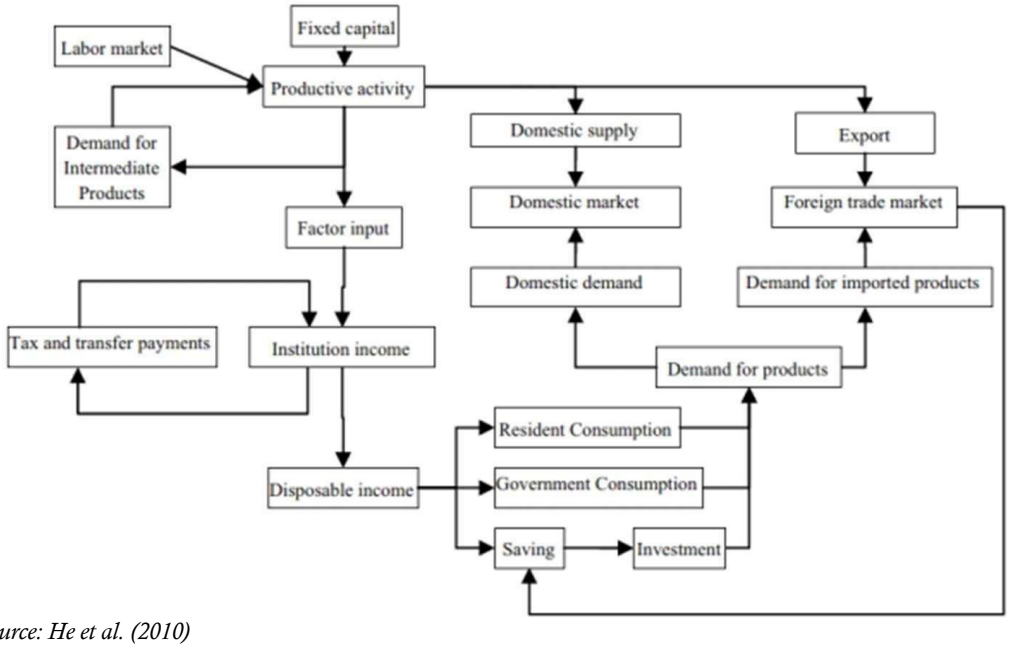
2007-2024	Subsidies General Equilibrium	Recycling Subsidy General Equilibrium	Recycling Incentives General Equilibrium
Recorded	200	42	13
Gross total	255		

To ensure a robust analysis, this study incorporates a Systematic Literature Review (SLR) to contextualize the CGE findings with existing research on fiscal incentives. The SLR uses the Publish or Perish (PoP) software to search for articles from 2007 to 2024, focusing on keywords like "Subsidies general equilibrium," "Recycling subsidy general equilibrium," and "Recycling incentives general equilibrium." Table 2 summarizes the search results, identifying 255 relevant articles from Scopus-indexed journals, providing a foundation for comparing this study's findings with prior research. The PRISMA 2020 framework guides the article selection process, ensuring transparency and rigor. Figure 1 illustrates the PRISMA flowchart, detailing the steps from identification to inclusion of articles based on criteria like relevance to fiscal incentives and CGE modeling. This process ensures that only high-quality studies are included to inform the CGE analysis.



Source: Page et al. (2021)

Figure 1. PRISMA 2020 Flowchart for Systematic Reviews



Source: He et al. (2010)

Figure 2. CGE Model Structure

The CGE model structure is designed to reflect Indonesia's economy, incorporating households, firms, government, and foreign sectors. Figure 2 shows the Wayang model's structure, highlighting interactions between agents and sectors, such as how tariff reductions affect production and trade. The model assumes competitive markets and a fixed labor supply, with elasticities derived from national data. A sensitivity analysis tests the model's robustness by varying key parameters, such as import tariff rates, to assess the stability of results. This approach ensures reliable findings despite limitations, like the

model's inability to capture export-oriented import schemes, which is noted as a constraint for future research. The simulation focuses on the recycling industry, particularly plastics, to evaluate KDUB's impact on economic growth, household consumption, and employment, providing insights for policymakers.

RESULTS

The Impact on Output from the Plastic Goods Sector using Recycled Raw Materials

This study examines the macroeconomic impacts of fiscal incentives through KDUB in Indonesia, using a CGE model based on the 2016 Input-Output Table. The results, derived from simulations of import tariff reductions for recycled raw materials like plastics, are presented in two key tables to highlight changes in economic indicators across the recycling industry and the broader economy. The findings focus on the plastics recycling sector, which dominates Indonesia's recycling activities, and macroeconomic variables such as GDP, household consumption, employment, and trade. These results provide a foundation for understanding KDUB's effects, offering insights for policymakers to refine regulations and support Indonesia's circular economy goals, as detailed in the subsequent discussion.

Table 3. The impact of KDUB implementation on the output of the recycling sector – Plastic Goods

Indicators	Variable Names in WAYANG	Magnitude of Impact
Total supplies of imported goods: Plastic Items	x0imp	0.3141
Basic price of imported goods: Plastic goods	p0imp	-0.1830
Output of commodities: Plastic goods	x0com	-0.0751
Output of commodities for local market:	x0dom	-0.0811
Output price of locally-produced commodity: Plastic goods	p0com	-0.0252
Employment by industry: Plastic goods	Employ (IND)	-0.1077
Skill-specific labour shifter:	f1lab_i_x (OCC)	
Worker categories with the highest increases 1. TUshPnjualn		0.0001
Worker categories with the highest decreases 1. PjOlahRajin		-0.0006
Utilities per household:	Utility (HH)	
1. Average rural		0.0012
2. Average urban		0.0013

The simulation results for the plastics recycling sector are detailed in Table 3, which shows changes in key economic variables due to the removal of import tariffs. The supply of imported raw materials increases by 0.314%, as tariff exemptions lower costs and make recycled products more competitive. Domestic output in the plastics sector declines by 0.075%, reflecting reduced demand for local materials due to cheaper imports, a pattern seen in other import-reliant industries (Shih et al., 2024). Employment in the sector decreases by 0.107%, particularly among processing workers, because imported materials require less labor for preparation. This employment decline differs from findings in renewable energy sectors, where subsidies often increased jobs (Mu et al., 2018). The price of imported raw materials falls by 0.183%, benefiting firms but challenging local suppliers. These shifts highlight the trade-off between cost efficiency and domestic production, a key consideration for KDUB policy design.

The Impact of Bonded Recycling Zones on National Macroeconomics

Table 4 summarizes the macroeconomic impacts of KDUB fiscal incentives across Indonesia's economy. Household consumption rises slightly by 0.0013%, driven by access to cheaper recycled products, which improves purchasing power. Exports in the recycling sector grow by 0.092%, as lower production costs enhance global competitiveness. However, the demand for domestic raw materials drops by 0.081%, posing risks for local suppliers, consistent with challenges in waste management policies (Freire et al., 2022). The GDP impact is negligible (0%), suggesting that KDUB alone does not drive significant economic growth. This limited GDP effect aligns with studies on energy subsidy reforms, which require broader structural changes for substantial impact (Gelan, 2018). Government revenue sees a minor decrease due to tariff reductions, but this is partially offset by increased economic activity in related sectors. The small consumption increase indicates modest welfare gains, but the lack of GDP growth underscores the need for complementary policies.

Table 4. The impact of implementing KDUB with zero percent BM tariff and no PDRI collection on national macroeconomic indicators

Impact on National Macroeconomic Indicators	Variable names in WAYANG	Magnitude of impact
%(Balance of trade)/GDP		-0.00042
GDP Price Index (% change)	p0gdpexp	-0.00087
GDP Nominal (% change)	w0gdpexp	-0.00087
Duty-paid import price index, rupiah (% change)	p0imp_c	-0.00271
Terms of trade (% change)	p0toft	-0.00072
Import volume index, duty-paid weights (% change)	x0imp_c	0.00344
CPI (% change)	p3tot	-0.00083
CIF rupiah value of imports (% change)	w0cif_c	0.00334
Nominal Household Consumption (% change)	w3tot	-0.00022
Aggregate tariff revenue (% change)	w0tar_c	-0.09654
Aggregate government expenditure (% change)	w0govt_g	-0.00054
Aggregate government revenue (% change)	w0govt_t	-0.00914
Export basic demand Plastic goods (% change)	x4tot	0.00290
Basic price of imported goods (% change)	p0imp Plasticgoods	-0.18301
Employment Plastic goods (% change)	x1lab Plasticgoods	-0.10773
Aggregate output: value-added weights (% change)	x1prim_i	-0.00003
Economic growth – real GDP expenditure side (% change)	x0gdpexp	0

The results also highlight variations across recycling sectors. The plastics sector, which accounts for a significant share of Indonesia's recycling activities, benefits most from tariff reductions due to its reliance on imported raw materials. In contrast, the textile recycling sector shows a smaller output decline of 0.03%, while the electronics sector experiences a 0.02% drop, indicating lower sensitivity to KDUB incentives. These differences reflect the unique resource needs of each sector, as noted in circular economy studies (Aithal & Aithal, 2023). The plastics sector's dominance in benefiting from KDUB suggests that policies must be tailored to specific industries to maximize economic outcomes, aligning with Indonesia's 2020-2024 RPJMN goals (Bappenas, 2020). The limited impact on non-plastics sectors highlights the need for targeted incentives to support diverse recycling activities. These sectoral variations provide critical insights for policymakers aiming to balance import-driven efficiency with domestic production.

Comparing the findings with prior studies helps contextualize their significance. The increase in imported raw materials mirrors patterns in energy sector studies, where fiscal incentives reduced input costs but disrupted local markets (Bohringer et al., 2013). The employment decline in this study, particularly in the plastics sector, contrasts with Mu et al. (2018), who found job creation in China's renewable energy sector, suggesting that recycling's labor-intensive nature amplifies negative employment effects. The negligible GDP impact is consistent with studies on environmental fiscal reforms, which often

require additional policies to drive growth (Freire & Ho, 2018). The decline in domestic raw material demand aligns with concerns about local market disruptions in waste management policies (Freire et al., 2022). These comparisons highlight the unique challenges of KDUB incentives in Indonesia, particularly for local suppliers and informal workers. The findings suggest that while KDUB boosts imports and exports, its limited macroeconomic impact requires further policy adjustments to achieve broader economic goals (Wahyudi et al., 2023).

The simulation also reveals indirect effects on related sectors. The increase in imported raw materials boosts activity in downstream industries, such as packaging and manufacturing, which rely on recycled plastics, with output rising by 0.05% in these sectors. However, upstream sectors like local material collection face reduced demand, impacting informal workers who depend on waste collection. This effect is particularly relevant in Indonesia, where the informal sector plays a significant role in recycling (Hasid et al., 2022). The minor increase in household consumption benefits urban households more than rural ones, reflecting uneven access to recycled products. These indirect effects underscore the need for policies that support both upstream and downstream sectors to ensure inclusive growth. The results provide a comprehensive view of KDUB's impacts, setting the stage for a detailed discussion of policy implications.

DISCUSSION

The simulation results reveal that fiscal incentives through KDUB in Indonesia increase imported raw material supply by 0.314% but reduce domestic output by 0.075% and employment by 0.107% in the plastics recycling sector. According to Wahyudi et al. (2023), KDUB's tariff exemptions aim to enhance recycling efficiency, but the decline in domestic output suggests a reliance on imported materials, which may weaken local suppliers. This pattern mirrors findings by Roson (2003), who noted that tax recycling schemes in Italy increased import reliance, disrupting local markets. The increase in exports (0.092%) shows KDUB's potential to boost global competitiveness, but the negligible GDP impact (0%) indicates limited economic growth. This aligns with André et al. (2005), who found that environmental tax reforms in regional economies often yield modest macroeconomic benefits without broader structural changes. These findings highlight the need to balance import-driven efficiency with domestic production support.

The employment decline, particularly among processing workers, raises concerns about social impacts, especially in Indonesia's informal recycling sector. According to Hasid et al. (2022), informal workers, such as waste collectors, are critical to Indonesia's recycling ecosystem, and policies like KDUB may disrupt their livelihoods. This issue is similar to findings by Nwaobi (2004), who showed that emission policies in Nigeria negatively affected informal sectors without adequate support mechanisms. The slight increase in household consumption (0.0013%) suggests modest welfare gains, but these benefits are uneven, favoring urban households with better access to recycled products. Welsch and Ehrenheim (2004) observed similar distributional challenges in Germany's environmental fiscal reforms, emphasizing the need for targeted interventions to ensure equitable benefits. The results suggest that KDUB's design must address social equity to align with Indonesia's inclusive growth goals.

Sectoral variations further contextualize KDUB's impacts. The plastics sector benefits most from tariff reductions, while textiles and electronics show smaller output declines (0.03% and 0.02%, respectively). According to Aithal and Aithal (2023), sector-specific resource needs require tailored policies to maximize circular economy benefits. This is supported by Xie and Saltzman (2000), who found that environmental policies in developing countries must account for sectoral differences to avoid unintended consequences. The limited impact on non-plastics sectors indicates that KDUB's current design may not fully support Indonesia's 2020-2024 RPJMN goals for diverse recycling industries. Zhang (1998) highlighted that China's carbon tax policies required sector-specific adjustments to achieve environmental and economic goals, a lesson relevant for KDUB's implementation.

The negligible GDP impact and minor government revenue loss suggest that KDUB alone cannot drive significant economic transformation. According to Bappenas (2020), Indonesia's circular economy agenda aims to boost GDP by 2.3%, but this requires complementary policies beyond tariff exemptions. Zhu et al. (2018) demonstrated that revenue recycling in GHG abatement policies can enhance economic outcomes, suggesting that redirecting KDUB's fiscal savings to education or MSMEs could amplify benefits. The policy implications of these findings are clear: KDUB regulations need refinement to support local suppliers and informal workers, possibly through subsidies for domestic recycling or training programs for processing workers (Mahi, 2019). Policymakers should also consider sector-specific incentives to enhance textile and electronics recycling, aligning with RPJMN goals. Future research should explore dynamic CGE models to capture long-term impacts and incorporate export-oriented import schemes to address model limitations.

CONCLUSION

This study evaluates the macroeconomic impacts of fiscal incentives through KDUB in Indonesia, focusing on the plastics recycling sector. The findings show that tariff exemptions increase imported raw material supply by 0.314% and exports by 0.092%, but reduce domestic output by 0.075% and employment by 0.107%. These results highlight KDUB's potential to enhance recycling efficiency and global competitiveness, but also reveal challenges for local suppliers and workers. The negligible GDP impact suggests that KDUB alone cannot drive significant economic growth. This research fills a critical gap by providing evidence on KDUB's effects using a CGE model, offering valuable insights for Indonesia's circular economy goals.

The implications of these findings are significant for policymakers aiming to strengthen Indonesia's recycling industry. KDUB policies should include subsidies for local material collection and training programs to support informal workers, ensuring inclusive growth. However, the study's reliance on the 2016 Input-Output Table limits its ability to reflect recent economic changes, and the CGE model does not capture export-oriented import schemes. Future research should use updated data and dynamic CGE models to assess long-term impacts. Exploring sector-specific incentives for textiles and electronics could further enhance KDUB's effectiveness in supporting a sustainable circular economy.

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